

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 in the vicinity of this or any other appliance.
- WHAT TO DO IF YOU SMELL GAS:
 - Do not try to light any appliance.
 - Do not touch any electrical switch; do not use any phone in your building.
 - 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.

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.

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



GLOBAL
power technologies

P-5050
THERMOELECTRIC GENERATOR
Operating Manual



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1 ABOUT THIS MANUAL

This manual provides instructions for the operation and maintenance of the model P-5050 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-5050, 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-5050 TEG produces 50 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, 0.2 W per °C (0.1 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 0.2 W per °C (0.1 W per °F) of temperature change.

Set-up Voltage: V_{set} : Voltage from the power unit for a specific ambient temperature when the power unit is connected to a precision load, 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 through the power unit, 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_{set} : V_{set} measured across the precision load on the output of the electronics without a customer load connected using a voltmeter.

Required V_{set} : V_{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 the purpose of 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 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:

- a) 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-5050 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 Washer, #8 External Lock

CAUTION: *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.*

- b) 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.
- c) Connect the fuel supply to the manual shut off 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®.
- d) Connect the customer load:
 - I) connect the load to terminals 7 (+) and 8 (-);
 - II) 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:

- a) Ensure the battery is connected
- b) Open the manual SO valve.

Note: Once the TEG is started re-closing the manual SO valve will stop it.

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.

- c) 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 - see the Spark Ignition Control System section 4.1.2.



WARNING: *When the TEG is operating, surface temperatures in the vicinity of the thermopile, burner, exhaust stack and around the cooling fin duct may be in excess of 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:

- a) Disconnect the customer load from the TEG, terminals 7 (+) and 8 (-) of TB-1 and allow to stabilize for 15 minutes.
- b) Measure the V_{set} voltage between terminals 5 (+) and 6 (-).
- c) 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 C/L and CP interface systems, if applicable, are located in section 8, Adjustment.

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.

Note: Servicing requirements are given in the Maintenance section.

3 TECHNICAL SPECIFICATIONS

This section gives the technical specifications for the Global Power Technologies (GPT) Model P-5050 Thermoelectric generator.

3.1 Overview

The Model P-5050 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-5050 Thermoelectric Generator provides 67 Watts of electrical power from the power unit at the beginning of life and at an ambient temperature of 20°C. 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 54 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. Figure 6 identifies the electrical parameters of the P-5050's power unit as a function of the load resistance.

3.2 Options

Mounting Stand: The P-5050 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. Global Power Technologies's 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, 20° C, 750 m above sea level, available at the terminal strip including reverse current diode.	50 Watts @ 6.7 Volts 50 Watts @ 14.1 Volts 50 Watts @ 28 Volts
Electrical	
Adjustment	6.7 V 4 - 11 Volts 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	4.9 m ³ /day (173 ft ³ /day) of Std. 1000 BTU/ SCF (37.7 MJ/Sm ³) gas
Propane	6.4 l/day (3.2 US 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. 55° C (130° F) Min. -40° C (-40° F)
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.

Depth	686 mm (26.99 in.)
Width	306 mm (12.06 in.)
Height	991 mm (39.01 in.)
Net Weight	41 kg (90 lb)
Shipping Weight	75 kg (165 lb)
Mounting Holes	267 mm wide × 457 mm deep (10.50 in. × 18.00 in.)

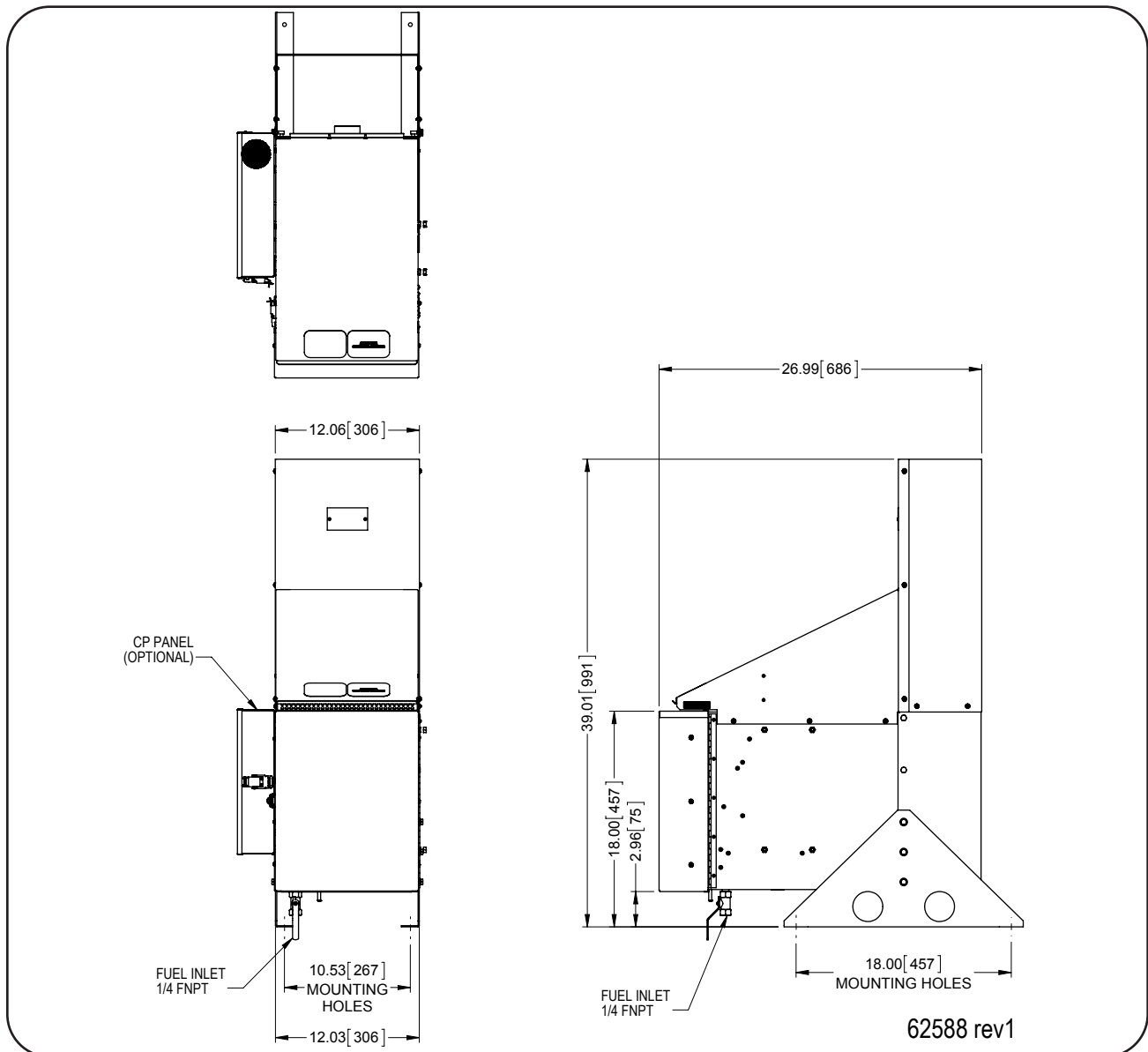


Figure 1 Overall Dimensions of the P-5050 TEG

3.4 SI System

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

Electrical SI Power Supply	Input Voltage	Minimum 5.5 V DC
		Maximum 35.0 V DC
	Power Input	8 Watts
	Output Voltage	14.0 VDC
SI	Spark Rate	10/second
	Trial For Ignition	7 seconds
	Number of tries for Ignition	3 trials until lockout
	Inter-Purge Time	10 seconds
Spark Gap	Nominal	4.8 mm (0.19 in.)
	Minimum	3.3 mm (0.13 in.)
	Maximum	6.3 mm (0.25 in.)
Continuous Operating Time Without Charge		120 minutes with full charged 6V, 5 A.h battery @ 25°C (75°F)

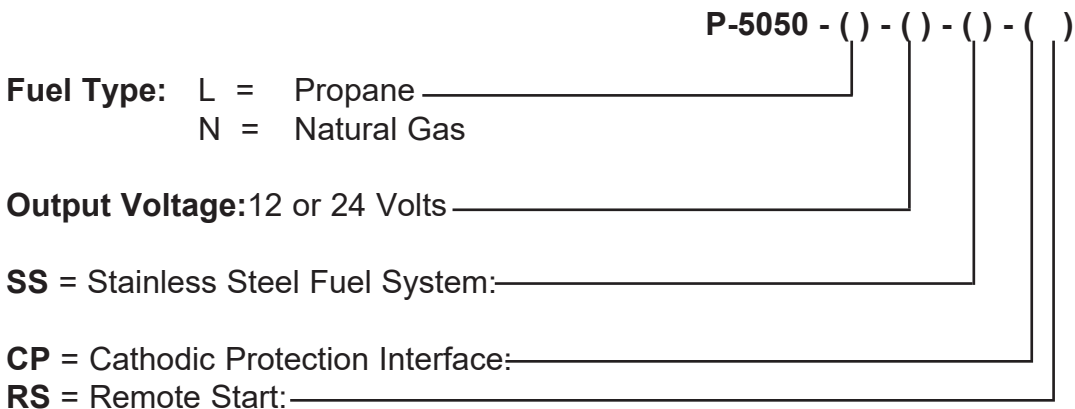
3.5 Data Plate

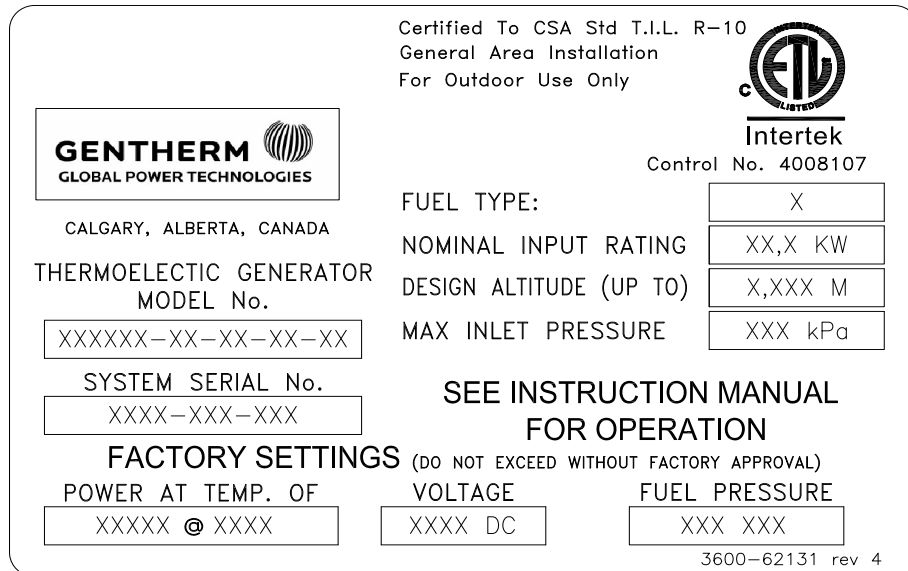
The data plate is on the inside of the cabinet door and includes vital information about the generator, see Figure 2.

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

Fuel Type: an "X" will be marked in the appropriate box to show whether the generator is set to burn natural gas (CH₄) or propane (C₃H₈). 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 Global Power Technologies Factory before shipping. Note that the fuel pressure is recorded in kPa and the pressure gauge must be adjusted for the altitude as described in Section 8.1.1.





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Figure 2 Data Plate

3.6 Fuel Consumption

The P-5050 is certified to operate on commercial propane and natural gas.

The fuel consumption of the P-5050 at rated power is listed in the table below for various fuels.

Fuel Consumption at Rated Power	Propane	Natural Gas
lb/hr*	0.3	-
gal/hr*	0.08	-
kg/hr*	0.15	-
L/hr*	0.29	-
ft ³ /hr**	2.88	7.2
m ³ /hr**	0.081	0.205

* 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

3.7 Global Power Technologies (GPT) Standard Specification for Gaseous Fuel

Note: Fuel considered is for standard configurations.

Gaseous fuel supplied to GPT's Thermoelectric Generators:

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 have a hydrocarbon dew point of less than 0°C (32°F) at 170 kPa_g (25psi_g).
3. Shall have less than 115 mg/m³ * (approx. 150 ppm) of H₂S.
4. Shall have less than 60 mg/m³ * (approx. 88 ppm) of Mercaptan Sulphur.
5. Shall have less than 200 mg/m³ * (approx. 294 ppm) of total Sulphur.
6. Shall have less than 10% [CO₂] and/or [N₂] by volume, nor vary more than +/- 1% [CO₂] and/or [N₂] during operation.
7. Shall have less than 120 mg/m³ (5 g/100 cu.ft.) of water vapour.
8. Shall have less than 1% by volume of free oxygen.
9. Shall have a nominal gross heating value of:

Natural Gas: 37 MJ/m³ (1000 BTU/cu.ft.)

Propane: 93 MJ/m³ (2500 BTU/cu.ft.)

Butane: 122 MJ/m³ (3300 BTU/cu.ft.)
10. Fuel temperature of less than 60°C (140° F).

*at 1 atm and 15°C.

4 PROCESS DESCRIPTION

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

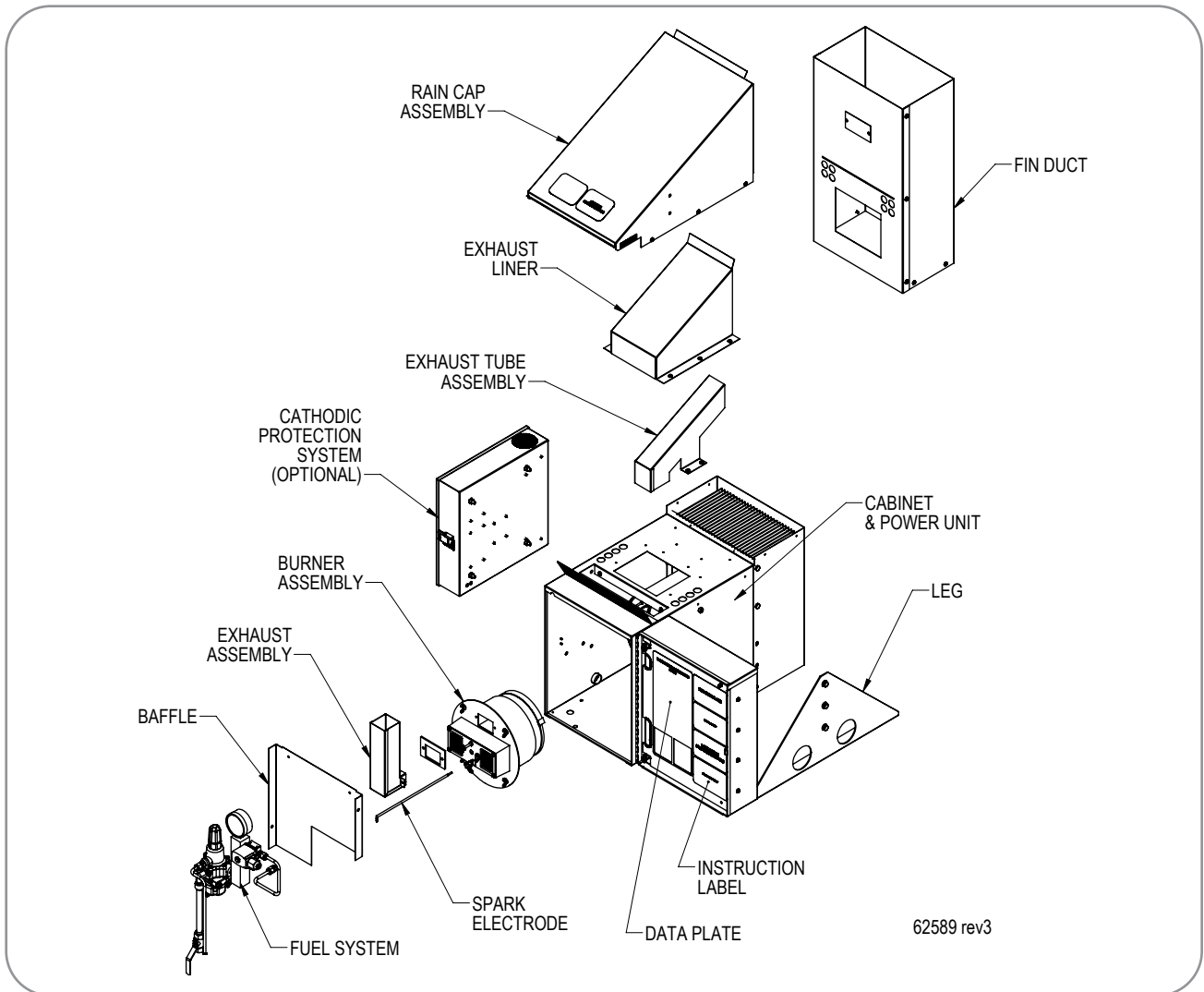


Figure 3 P-5050 TEG General Assembly

4.1 Model P-5050 Thermoelectric Generator

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

- Provide fuel, mix it with air and ignite making heat available.
- Warm the hot-end of a thermoelectric power unit using the available heat of combustion.
- Cool the cold-end of the thermoelectric power unit using cooling fins.

- d) Generate electrical power from the temperature difference created across thermoelectric materials housed within the power unit
- e) Make the electrical power available to the load

The main parts of the model P-5050 TEG, with CP attached, are shown in Figure 3.

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.

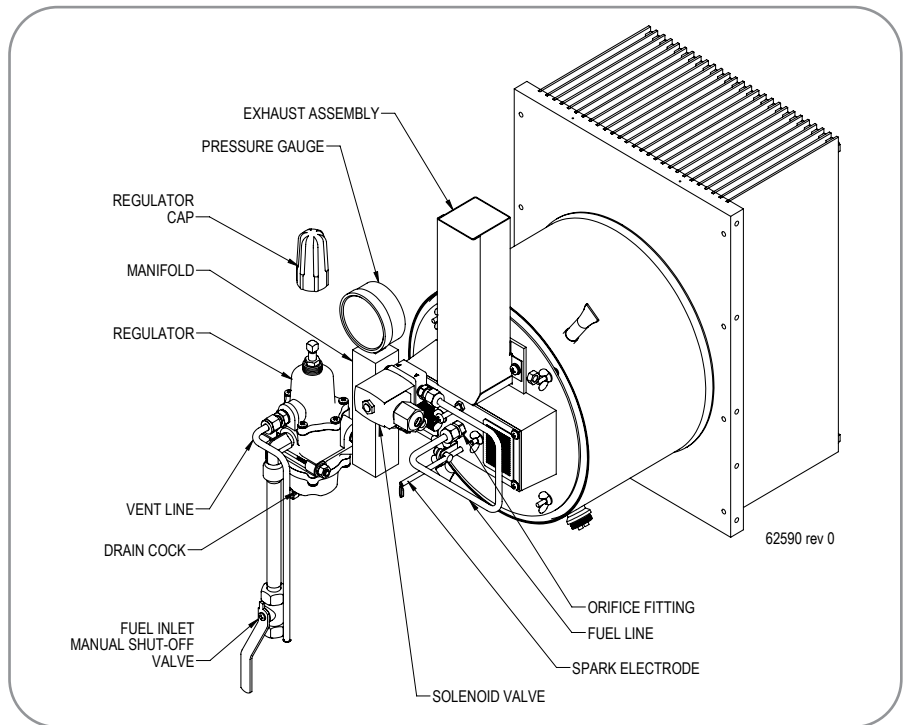


Figure 4 P-5050 Fuel System General Assembly

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. The main parts of the fuel system are shown in Figure 4.

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 Controller Board
- 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, see Section 4.1.2.1, 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

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.

If the optional TEG Controller board is installed:

Press the Reset (S3) or send a SCADA Reset signal to the TEG Controller board

See Figure 7.

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.

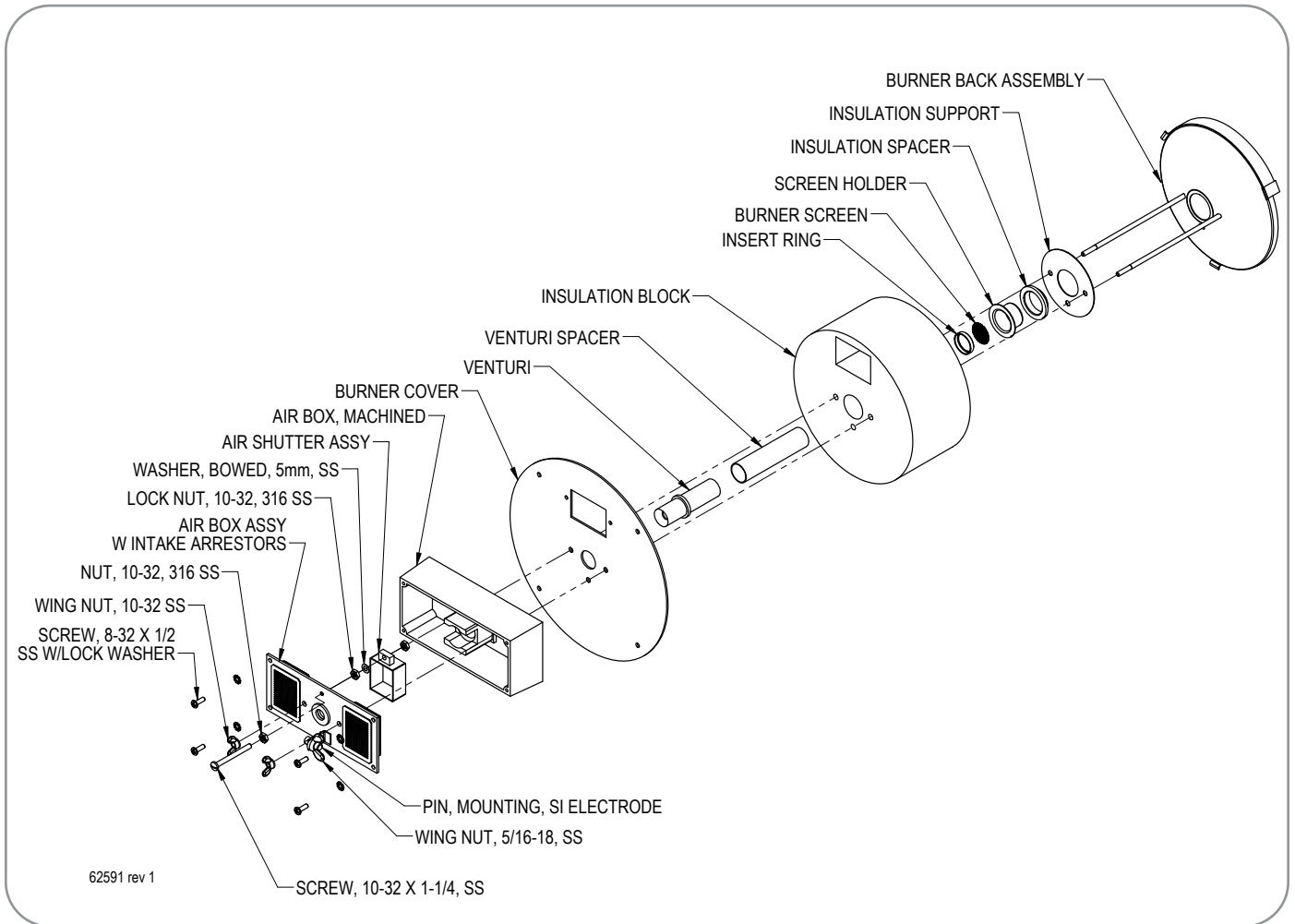


Figure 5 Burner General Assembly

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.

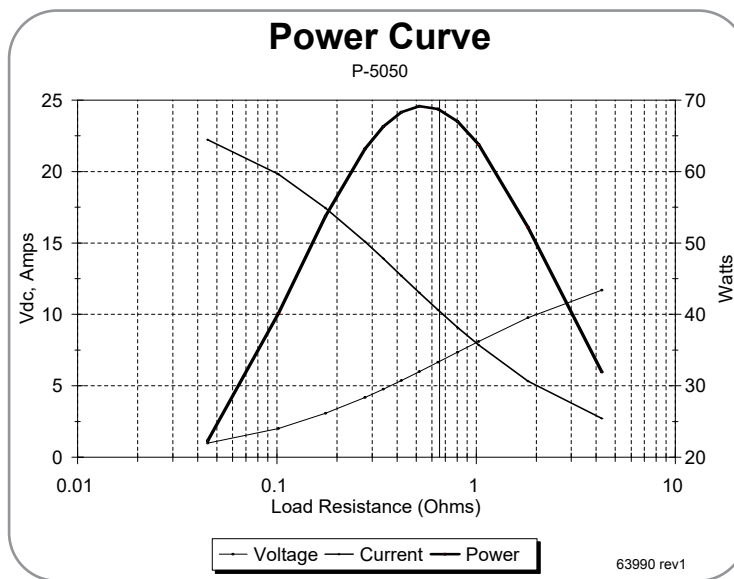


Figure 6 Model P-5050 Power Unit Electrical Output Characteristics

Electrical output characteristics are shown in Figure 6. Power peaks in broad load resistance range of 0.5-0.75 Ω . Rated power of 67 W gross is obtained when the power unit load resistance is within this range, at the beginning of the service life of the TEG.

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 >100°C.*

4.1.6.1 Optional TEG Mounting Stands (Pole or Bench Type)

The Pole Stand consists of a 76 in. long piece of 3 in. diameter pipe with an "H" shaped bracket welded to one end which the TEG can be firmly attached to using a 1/4 in. fastener (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.

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 5 A slow blow for the model P-5050-12 or a 2.5 A slow blow for the model P-5050-24 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 as shown in Figure 7.

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:

- a) Ensure that a lead acid battery is part of the customer load connection circuit.
- b) Set the SW1 dip switches on the regulating limiter board to the following positions:

	SW1 – switch 1	SW1 - switch 2
Temp Comp ON	OFF	ON
Temp Comp OFF	ON	OFF

Note: 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.

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 together 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.

Note: The Blocking Diode is included with the TEG for 12 and 24V models but not in the 6.7V model. If the Diode is not present and the TEG is not running, power from the system battery will be consumed by the electronics. If a 6.7V TEG is hooked up with another power generating source, it must have an external diode installed.

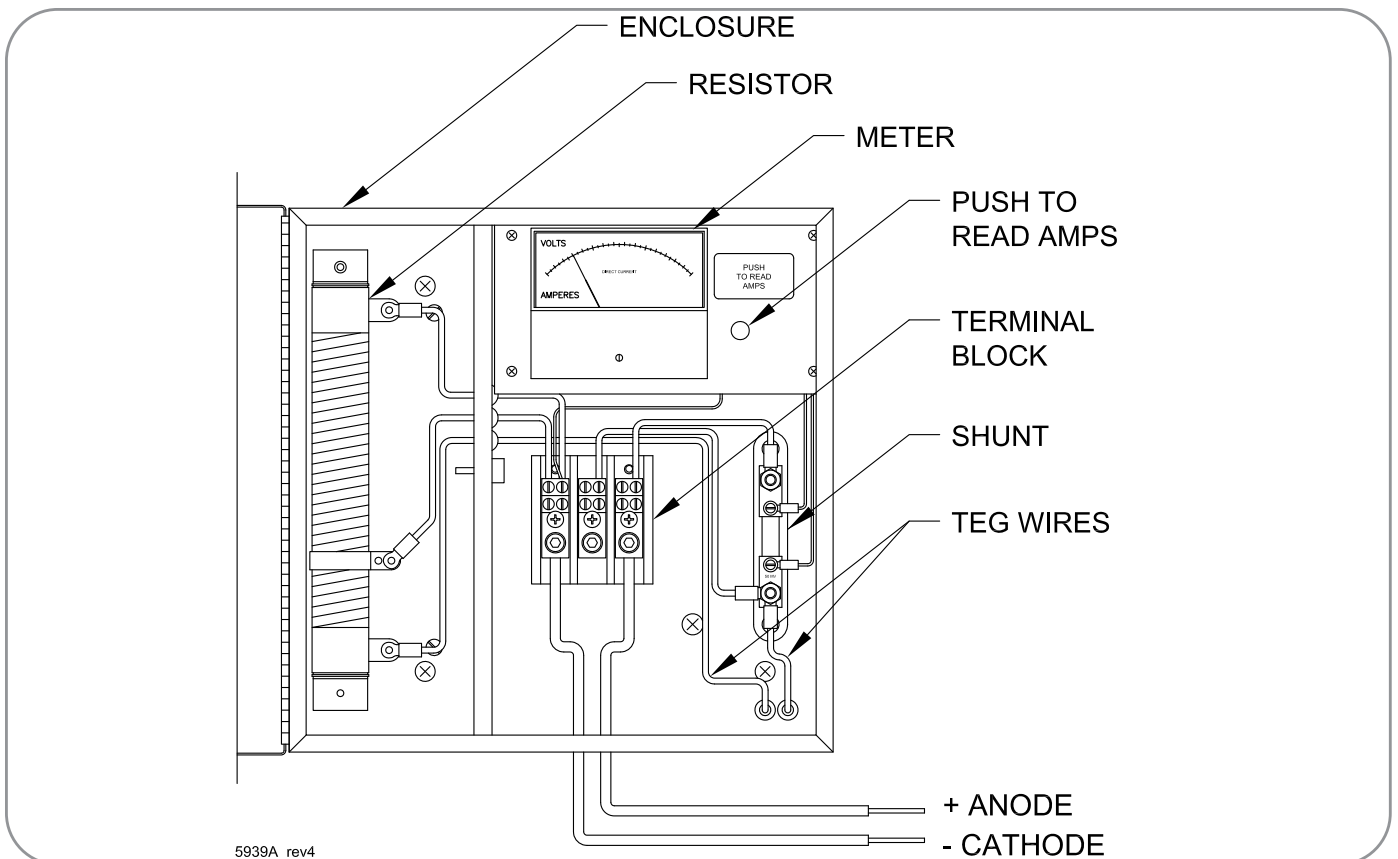


Figure 8 CP Interface System General Assembly

4.5 Optional Cathodic Protection Interface System

An optional cathodic protection interface system is available for use with the model P-5050 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.

The main parts of the CP interface system are shown in Figure 8.

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 $\pm 3\%$ 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 to start be attempted.

The TEG Controller provides an ignition request signal to the spark ignition control system when it is 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 blink 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.

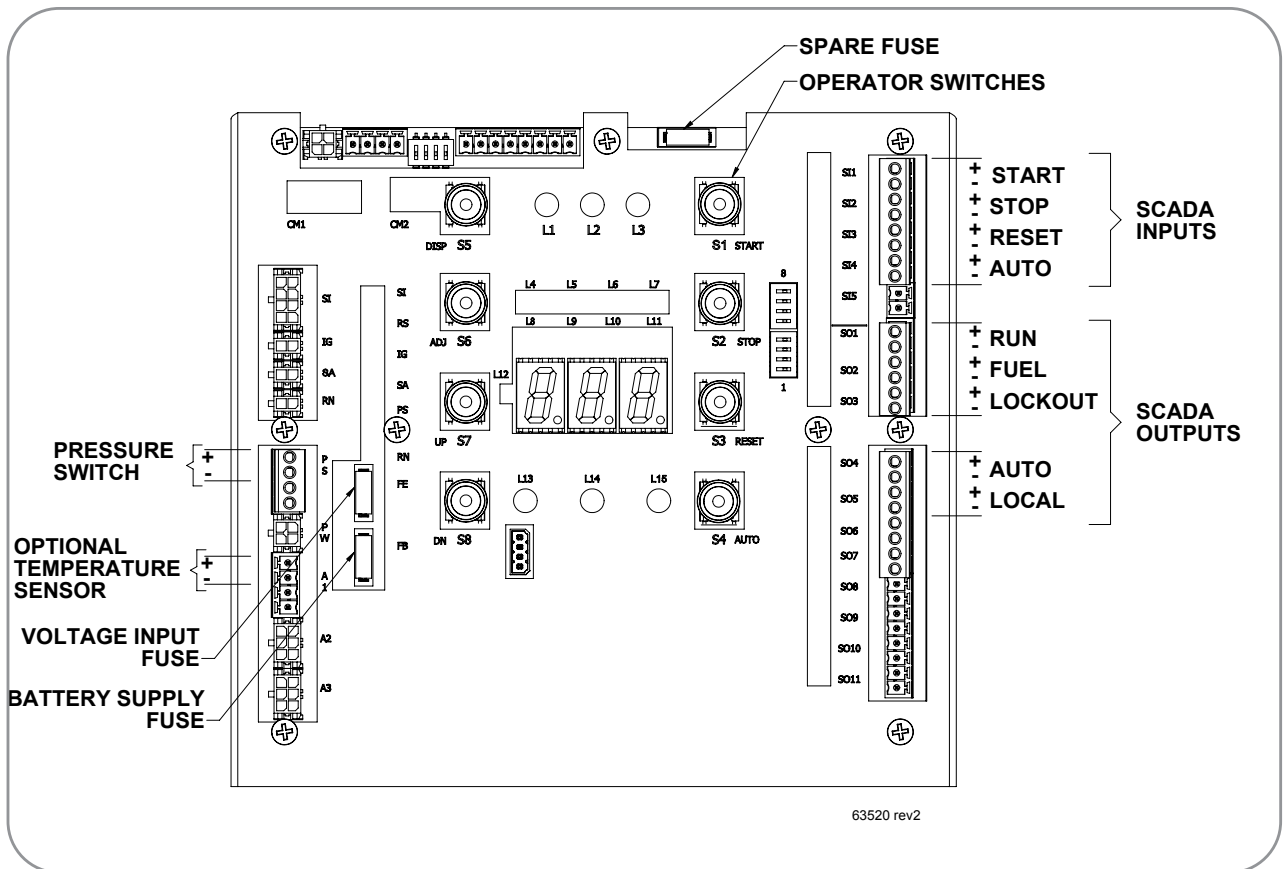


Figure 9 TEG Controller Assembly

Interface	Operation	Specs
SI1 - SCADA Start input	Signal received from the SCADA system to request a TEG start	5-36 Vin, 1-7mA
SI2 - SCADA Stop input	Signal received from the SCADA system to request a TEG stop	5-36 Vin, 1-7mA
SI3 - SCADA Reset input	Signal received from the SCADA system to request a reset of the Lockout state	5-36 Vin, 1-7mA
SI4 - SCADA Auto input	Signal received from the SCADA system to change the Auto functionality On or Off	5-36 Vin, 1-7mA
SO1 - SCADA Run output	Signal to the SCADA system that the TEG is running. Blinks during startup	Up to 36V, 200mA contact closure
SO2 - SCADA Fuel output	Signal to the SCADA system that the fuel pressure switch is closed, indicating fuel available	Up to 36V, 200mA contact closure
SO3 - SCADA Lockout output	Signal to the SCADA system that the SI System failed to start	Up to 36V, 200mA contact closure
SO4 - SCADA Auto output	Signal to the SCADA system that the Auto functionality is on	Up to 36V, 200mA contact closure
SO5 - SCADA Local output	Signal to the SCADA system that the TEG is operating in the Local mode. SCADA start signals are ignored till the mode time-out switches back to Remote.	Up to 36V, 200mA contact closure
S1 button - Start	Operator button to start the TEG.	
S2 button – Stop	Operator button to stop the TEG	
S3 button – Reset	Operator button to reset the Lockout state	
S4 button – Auto	Operator button to switch Auto functionality on or off	
S5 button – Display	Operator button to turn on the display and toggle through measured values	
S6 button – Adjust	Operator button to toggle through the adjustable values. Up and Down buttons can be used to make changes to adjustable values.	
S7 button – Up	Operator button for incrementing an adjustment	
S8 button – Down	Operator button for decrementing an adjustment	

Interface	Operation	Specs
SO4 - SCADA Auto output	Signal to the SCADA system that the Auto functionality is on	Up to 36V, 200mA contact closure
SO5 - SCADA Local output	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.	Up to 36V, 200mA contact closure
S1 button - Start	Operator button to start the TEG.	
S2 button – Stop	Operator button to stop the TEG	
S3 button – Reset	Operator button to reset the Lockout state	
S4 button – Auto	Operator button to switch Auto functionality on or off	
S5 button – Display	Operator button to turn on the display and toggle through measured values	
S6 button – Adjust	Operator button to toggle through the adjustable values. Up and Down buttons can be used to make changes to adjustable values.	
S7 button – Up	Operator button for incrementing an adjustment	
S8 button – Down	Operator button for decrementing an adjustment	
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

TEG Controller DIP Switches

Voltage	Switch 1	Switch 2	Switch 3	SW4-8
12V	OFF	OFF	OFF	OFF (Reserved)
24V	ON	OFF	OFF	OFF (Reserved)

Start the TEG using the TEG Controller board

a) Press S1 (Start) or apply a remote SCADA Start signal across SI1 of the TEG Controller for a minimum of 10 seconds

Stop the TEG using the TEG Controller board

a) Press S2 (Stop) or apply a remote SCADA Stop signal across SI2 of the TEG Controller for a minimum of 10 seconds

Reset a Locked Out SI Controller

a) Press S3 (Reset) or apply a remote SCADA Reset signal across SI3 of the TEG Controller for a minimum of 10 seconds

b) To start the TEG following a Reset, wait a minimum of 10 seconds then follow the steps specified above

Measurement Display on TEG Controller

a) 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.

b) 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.

Adjustments on the TEG Controller

a) 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.

b) Press S7 (Up) or S8 (Down) to make changes to the variable.

c) 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 Display mode is not available until the Adjustment 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 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. Global Power Technologies (GPT) considers compliance with API 12N as evidence that the Flame Arrestors are adequate for use in unclassified areas.⁷

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 arrestor still provides enhanced safety, and as such, includes a factory installed flame arrestor 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 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.

The flame arrestors do not require maintenance other than cleaning the intake screen as seen in Section 9.3.1.

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-5050 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: *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-5050 TEG:

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

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:

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

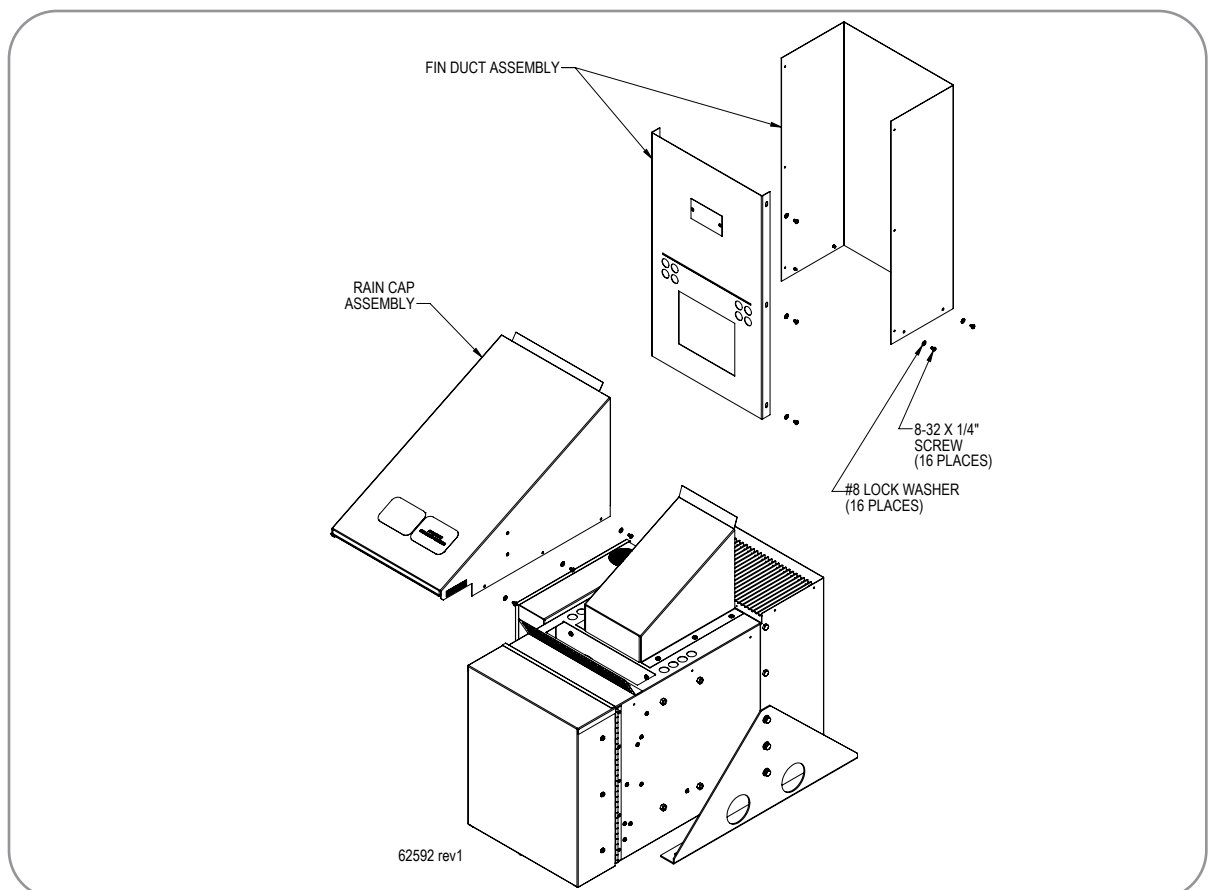
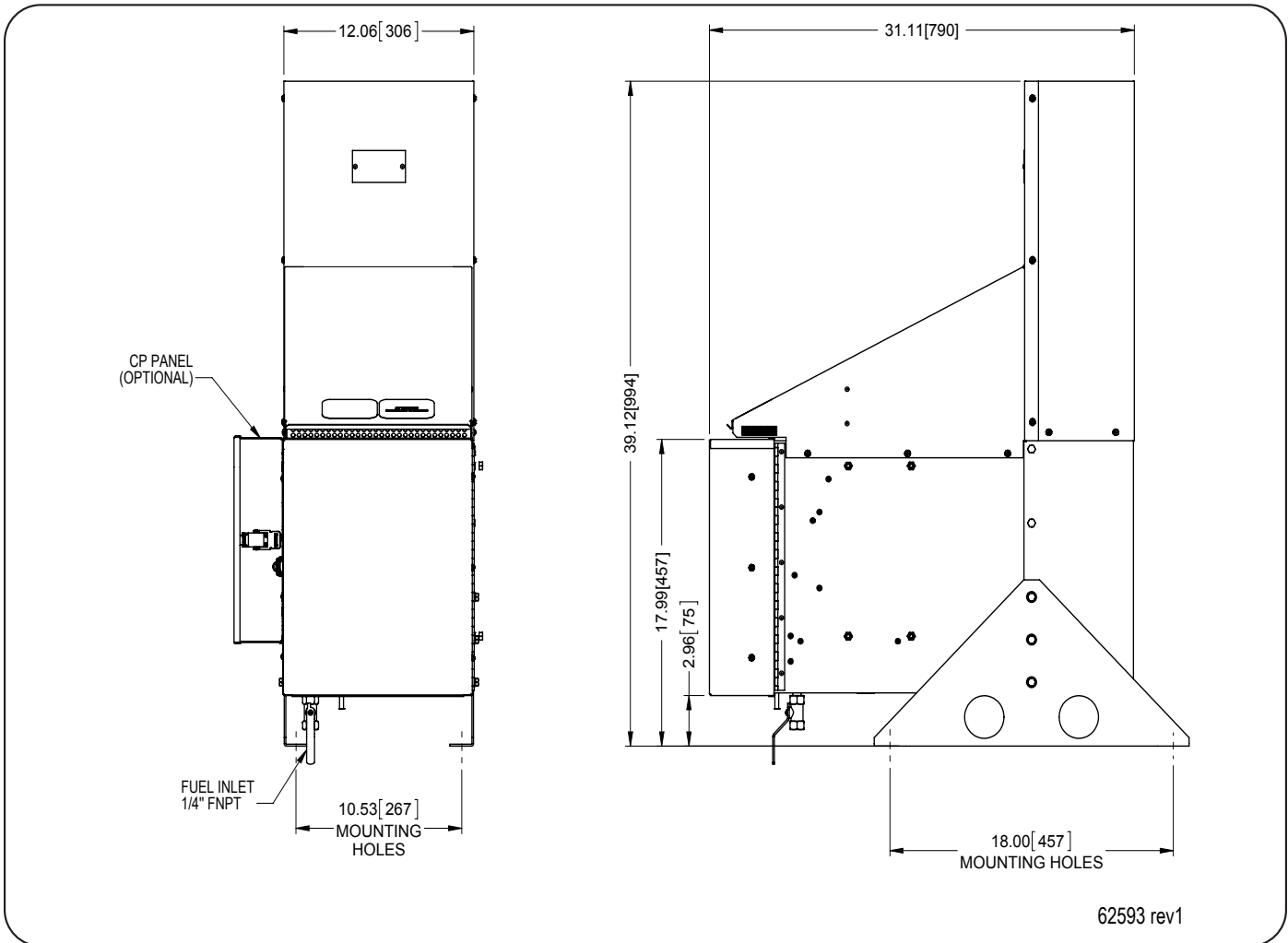


Figure 10 Assembling the P-5050 TEG

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 41 kg (90 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 600 mm (36 in.) above the top of the fin duct. Locate the TEG to avoid flooding interfering with the flow of cooling air.*



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-5050 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:

- a) Remove the protective cap or plugs.
- b) Apply thread sealant to the fuel line threads as per Figure 12.

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

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

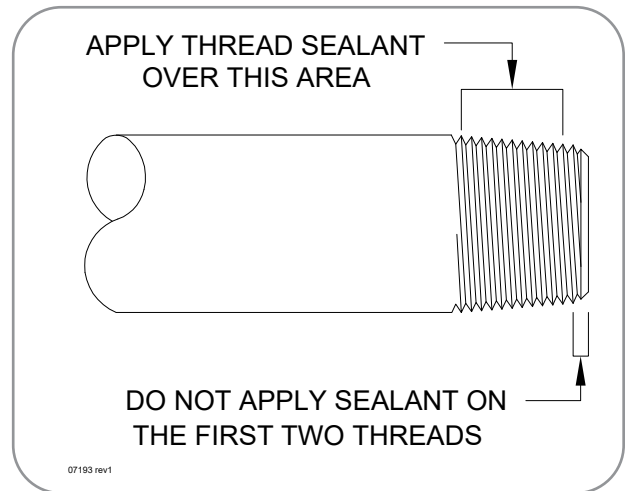


Figure 12 Applying Thread Sealant

Caution: *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 in excess of 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 pressures less than 3.5 kPa (0.5 psig).

- d) Inspect the fuel lines and fittings to be sure they are free of foreign material.
- e) Purge fuel lines of all air.

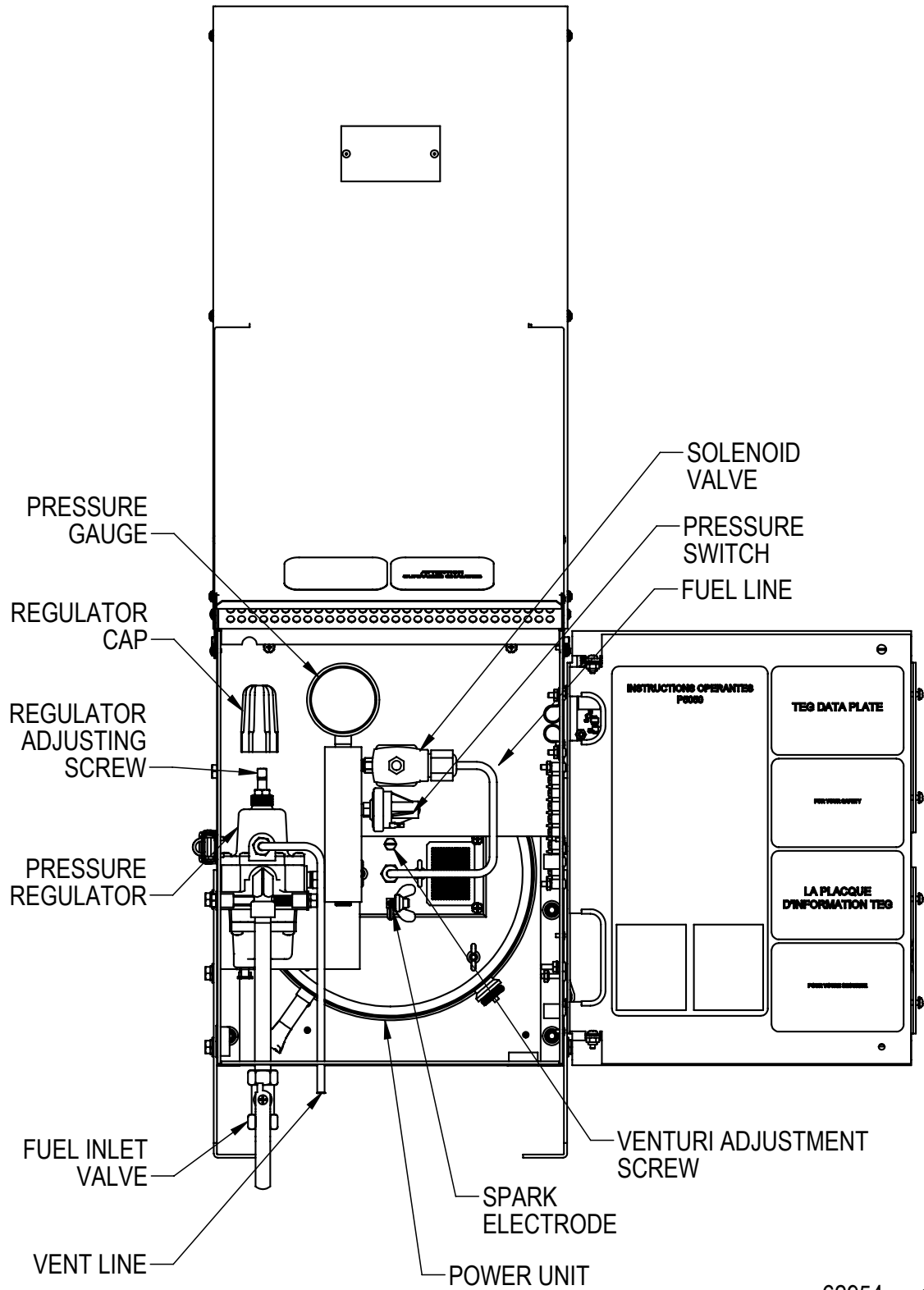


WARNING: *All fuel piping must be in accordance with local regulations.*

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.



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Figure 13 Setting-up the P-5050 TEG

Clean Fuel: The fuel used to operate the P-5050 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_3H_8) at temperatures below $-30^{\circ}C$ ($-22^{\circ}F$) special consideration must be given to the low vapour pressure of the fuel.

5.6.3 Propane/LPG 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, water proof 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.

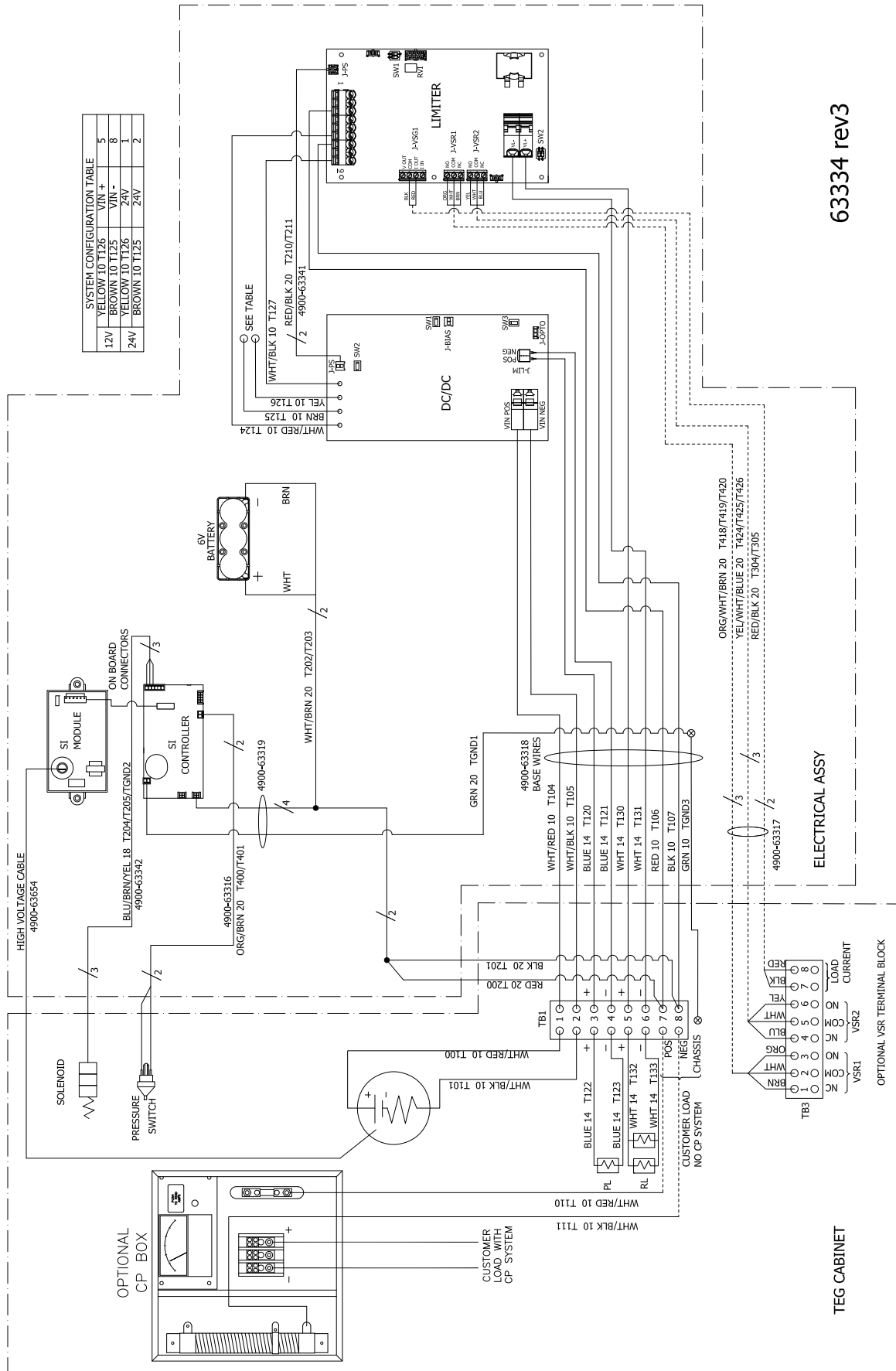
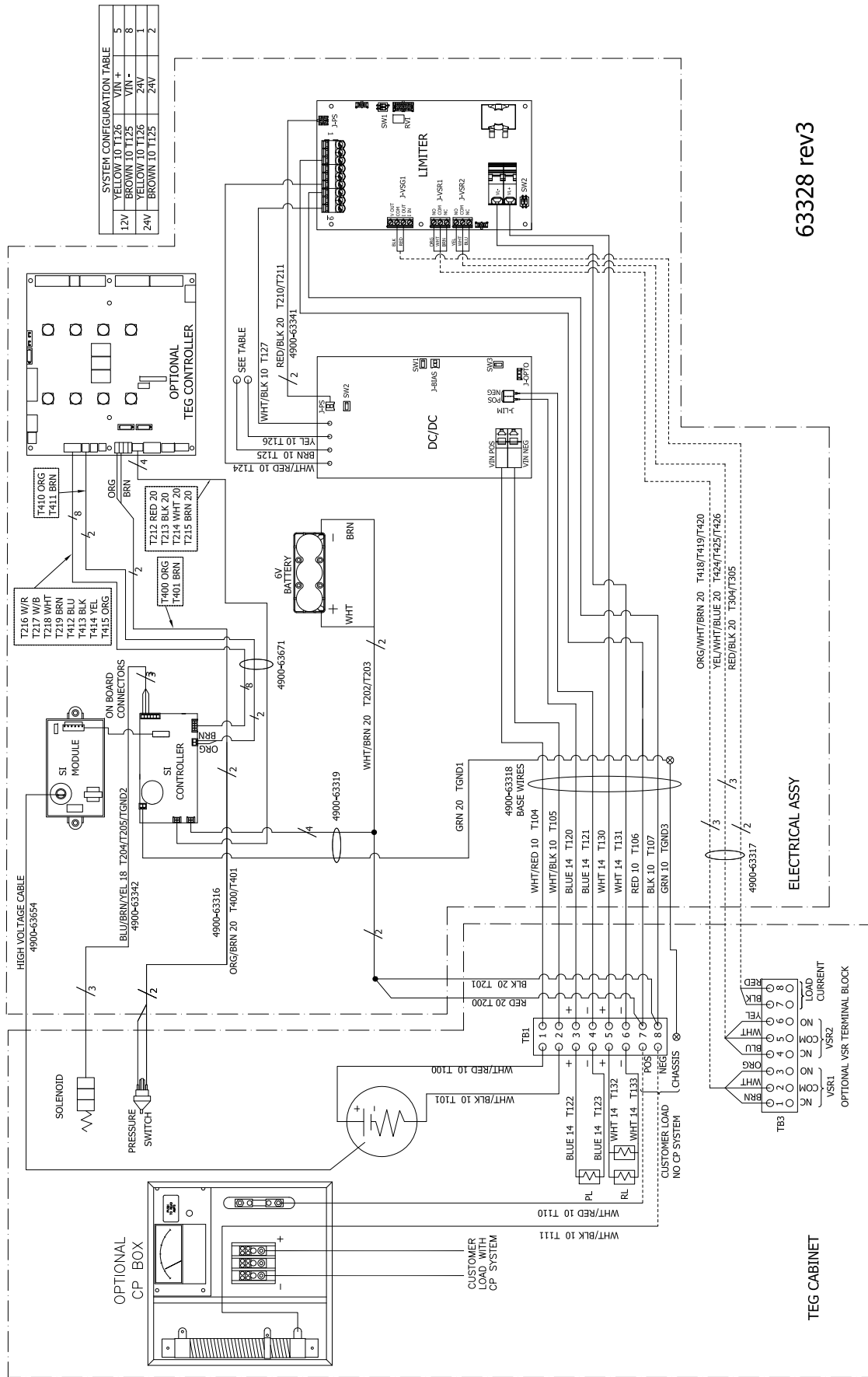


Figure 14 Wiring Diagram P-5050 TEG for 12 or 24 V



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Figure 15 Wiring Diagram P-5050 TEG for 12 or 24V with optional TEG Controller

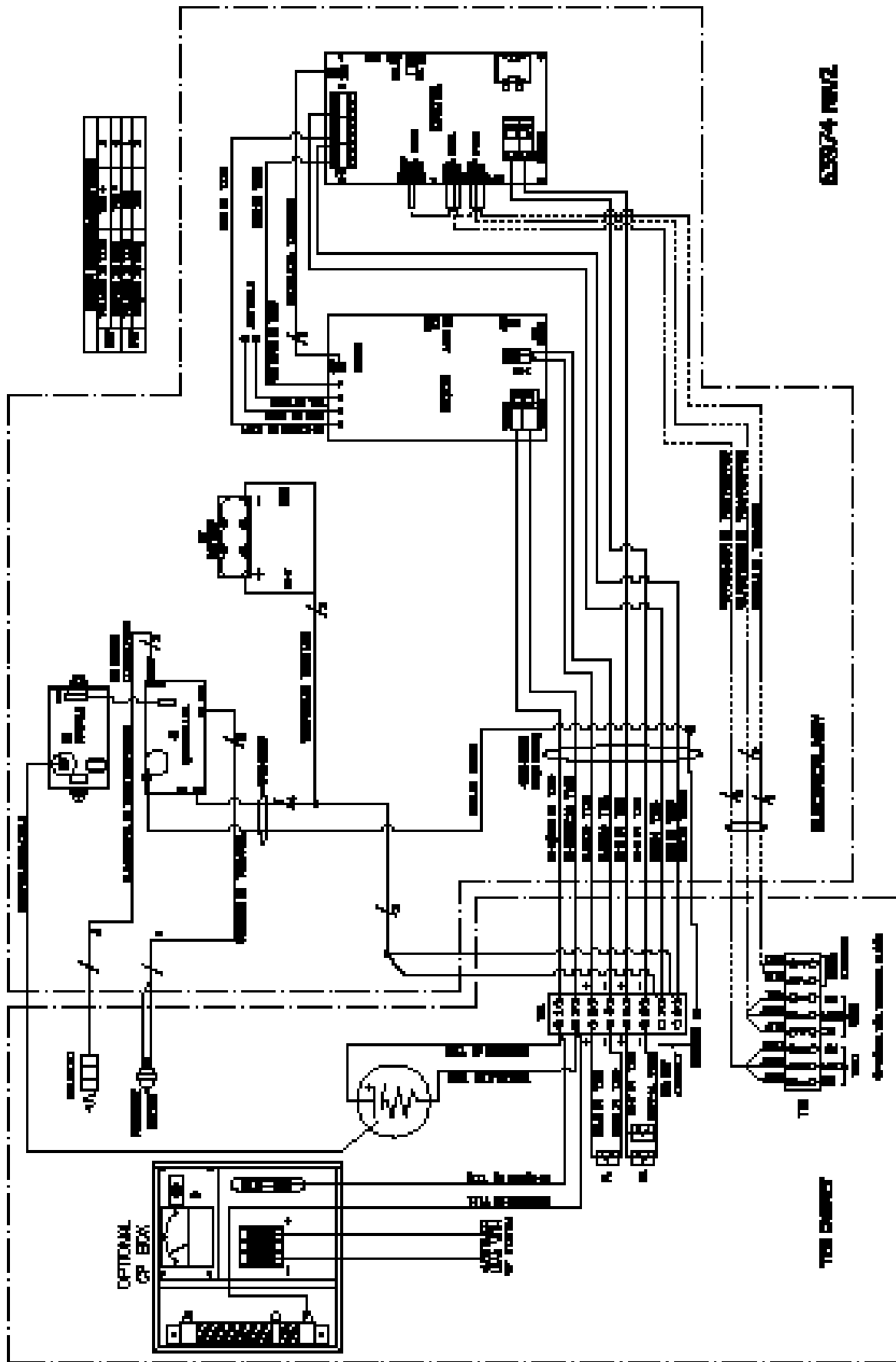


Figure 16 Wiring Diagram P-5050 TEG for 6.7V

5.7 Connecting Customer Load

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:

- a) 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. Refer to Figure 17.



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 °C (194 °F).

- b) Connect the customer load wires to TB-1 terminals 7(+) and 8(-):
6.7 V: see Figure 14. The load is connected directly to the power unit.
12 or 24 V: see Figure 15 or Figure 16 if TEG Controller present.

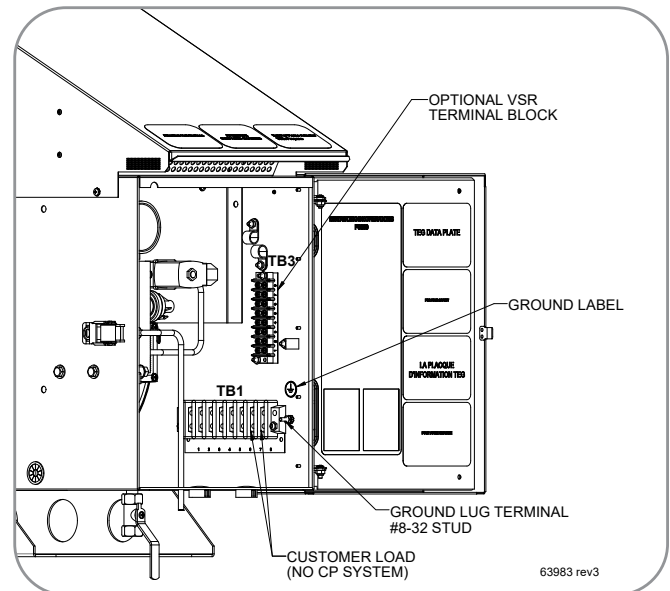


Figure 17 Customer Load Connections

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 18. Remove the fuel system and remove the baffle plate to gain access to the holes in the TEG cabinet for mounting the CP Interfac*Note: Always mount the CP interface system in an upright position and allow the free flow of air through the unit.*

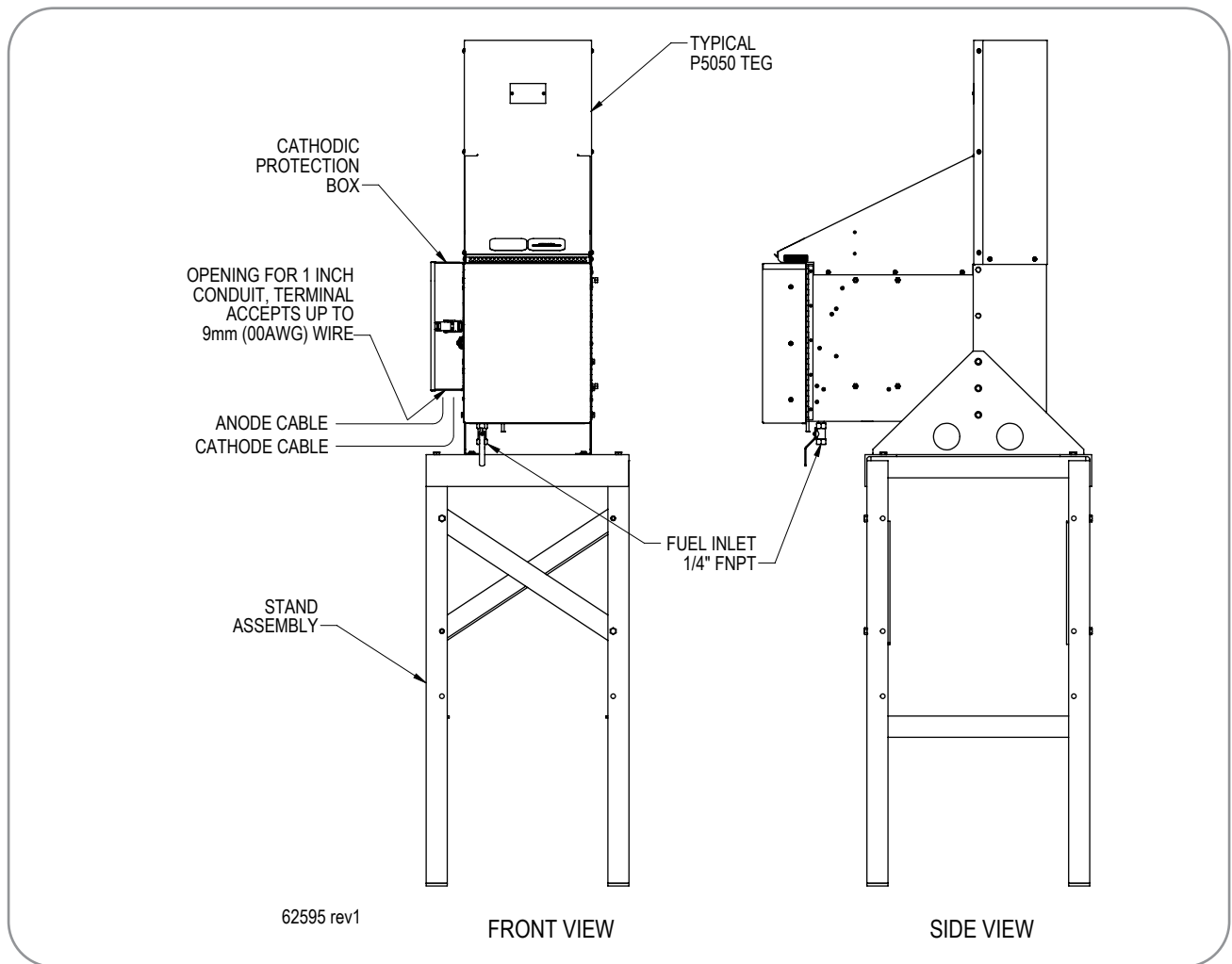


Figure 18 CP Installation

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:

- a) Check the wiring diagram, Figure 14, 15 or 16 as applicable, and choose the wiring diagram for your application.
- b) Run the CP interface system wires to the TEG as per Figure 14, 15 or 16, 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-5050 TEG.

6.1 Before Starting

Before starting the TEG perform these steps:

- a) Make sure that all of the connections in the fuel system are tight and have been checked for leaks.
- b) Ensure the battery is connected
- c) 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_{set} .
- d) 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:

- a) 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.

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 in the vicinity of the thermopile, burner, exhaust stack and around the cooling fin duct may be in excess of 100°C. 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 41 to 48 kPa (6.0 to 7.0 psi) for natural gas and 48 to 55 kPa (7.0 to 8.0 psi) for propane.

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-5050 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 temperature drop of 1°C from the ambient temperature as indicated on the data plate effects a power increase of 0.2 W and similarly, a temperature climb of 1°C from the ambient temperature as indicated on the data plate effects a power decrease of 0.2W. 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 19 for V_{set} adjustment with ambient temperature. They require correction for ambient temperatures different to that indicated. The following formulas apply:

$$V_{set} = V_{setref} + [(T_{ref} - T) \times 0.006] \quad \text{Equation 1}$$

Where:

- T = Ambient temperature, at site (°C)
- T_{ref} = Reference ambient temperature, marked on TEG (°C)
- V_{setref} = Reference set-up voltage, marked on TEG (V)
- V_{set} = Set-up voltage, at site (V)

$$P_{set} = P_{setref} + [(T_{ref} - T) \times 0.184] \quad \text{Equation 2}$$

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 setup 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 Global Power Technologies' Customer Service Department for guidance.

Example: Ambient temperature at site is 35°C. Set-up power of 67 W and V_{set} of 5.88 V, for a temperature of 22°C, is marked on the TEG.

$$\begin{aligned} V_{set} &= V_{setref} + [(T_{ref} - T) \times 0.006] \\ &= 5.88 + [(22 - \{35\}) \times 0.006] \\ &= 5.88 + [-13 \times 0.006] \\ &= 5.88 + [-0.078] \\ &= 5.88 - 0.078 \\ &= \underline{5.61 \text{ V}} \end{aligned}$$

Similarly, power from the power unit at beginning of life is,

$$\begin{aligned} P_{set} &= P_{setref} + [(T_{ref} - T) \times 0.184] \\ &= 67 + [(22 - \{35\}) \times 0.184] \\ &= 67 + [(22 - 35) \times 0.184] \\ &= 67 + [-13 \times 0.184] \\ &= 67 + [-2.39] \\ &= 67 - 2.39 \\ &= \underline{64.61 \text{ W}} \end{aligned}$$

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 20. 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_{set} or Setup Power

V_{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.

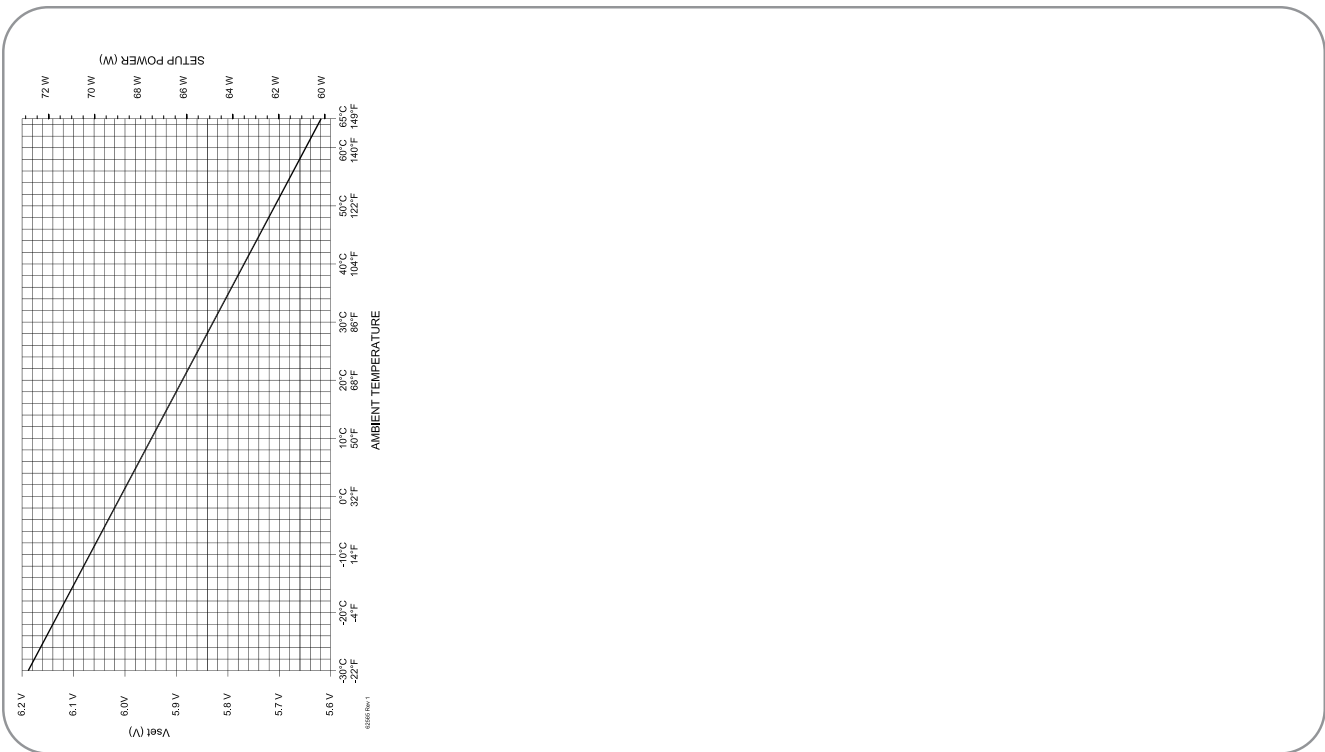


Figure 19 V_{set} and Setup Power Versus Ambient Temperature

7.2.1 Examining V_{set} Immediately after Ignition

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

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

- Disconnect the customer load from the TEG, terminals 7 (+) and 8 (-) of TB-1 and allow to stabilize for 15 minutes.
- Consult the data plate inside TEG door for the reference V_{set} voltage and determine the required V_{set} for the present ambient temperature. See Working-out Required V_{set} or Setup Power topic above, or Alternative Method of Working-out Required V_{set} or Setup Power.
- Connect a voltmeter between terminals 5 (+) and 6 (-). This is the measured V_{set} , and should tend towards the required V_{set} . It will climb as shown in Figure 20.

Caution: *Do not allow measured V_{set} to exceed that required V_{set} for present ambient temperature, otherwise overheating may cause irreparable damage to the power unit.*

- d) V_{set} will rise quickly at first then begin to level out. It will take at least one hour for the V_{set} to level out. When no longer V_{set} changes (± 0.2 V in ten minutes) compare this value with required V_{set} . Measured V_{set} should be within 0.2 V of that required.

Note: Typically, if the measured V_{set} is greater than required V_{set} then the fuel pressure needs to be reduced.

7.2.2 Examining V_{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_{set} after running for some time:

- Disconnect the customer load from the TEG, terminals 7 (+) and 8 (-) of TB-1 and allow to stabilize for 15 minutes.
- Consult the data plate inside TEG door for the reference V_{set} voltage and determine the required V_{set} for the present ambient temperature. See Working-out Required V_{set} or Setup Power topic above, or Alternative Method of Working-out Required V_{set} or Setup Power.
- Connect a voltmeter between terminals 5 (+) and 6 (-). This is the measured V_{set} , and should match the required V_{set} for the present temperature.

Caution: *Do not allow measured V_{set} to exceed that required V_{set} for present ambient temperature, otherwise overheating may cause irreparable damage to the power unit.*

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

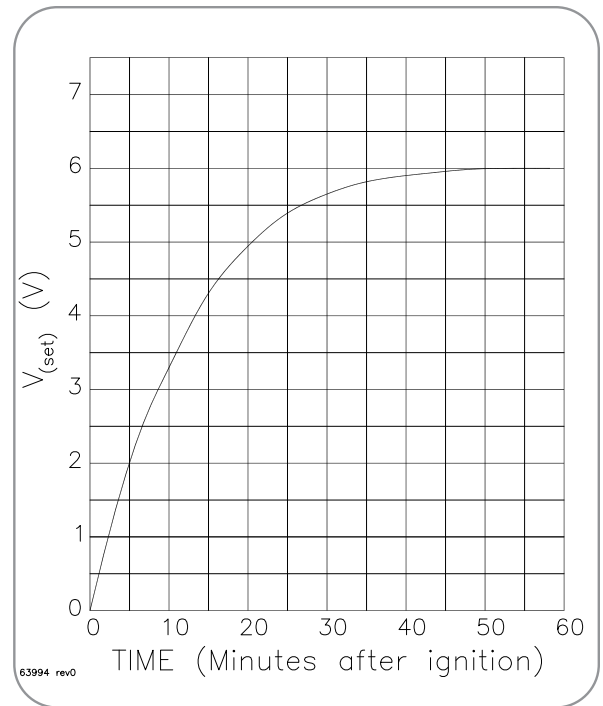


Figure 20 V_{set} Versus Time After Ignition, Typical Response

8 ADJUSTMENT

This section describes how to adjust the Model P-5050 Thermoelectric generator.

Note: Typical settings are 41 to 48 kPa (6.0 to 7.0 psi) for natural gas and 48 to 55 kPa (7.0 to 8.0 psi) for propane.

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.

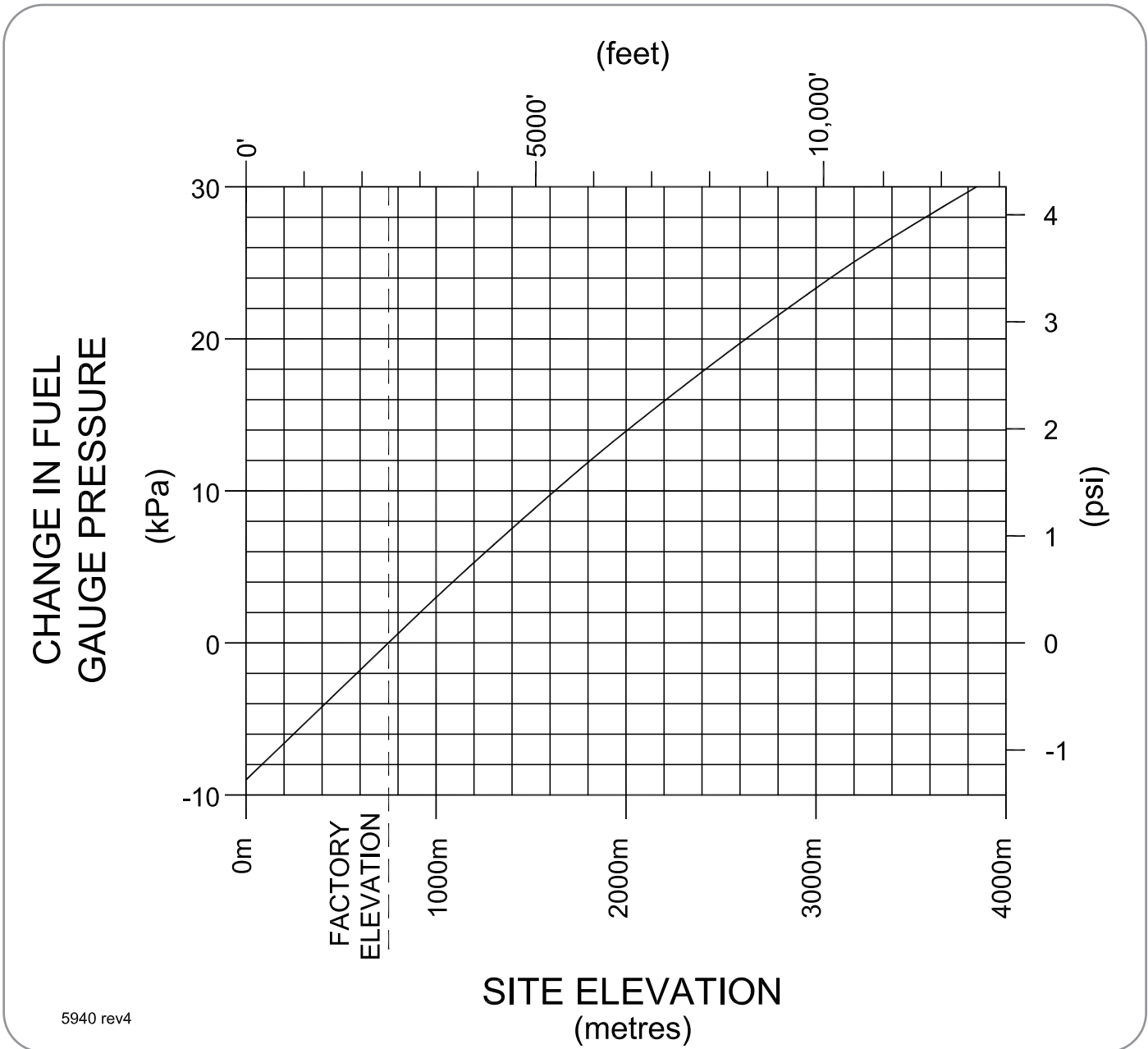


Figure 21 Change in Fuel Gauge Pressure Versus Elevation Above Mean Sea Level, Typical

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 at or below the pressure indicated on the data plate. If the TEG is located at a different altitude than the factory, 792 m (2600 ft.), the pressure will also be different. Use Figure 21 to determine how much to adjust the fuel pressure.

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

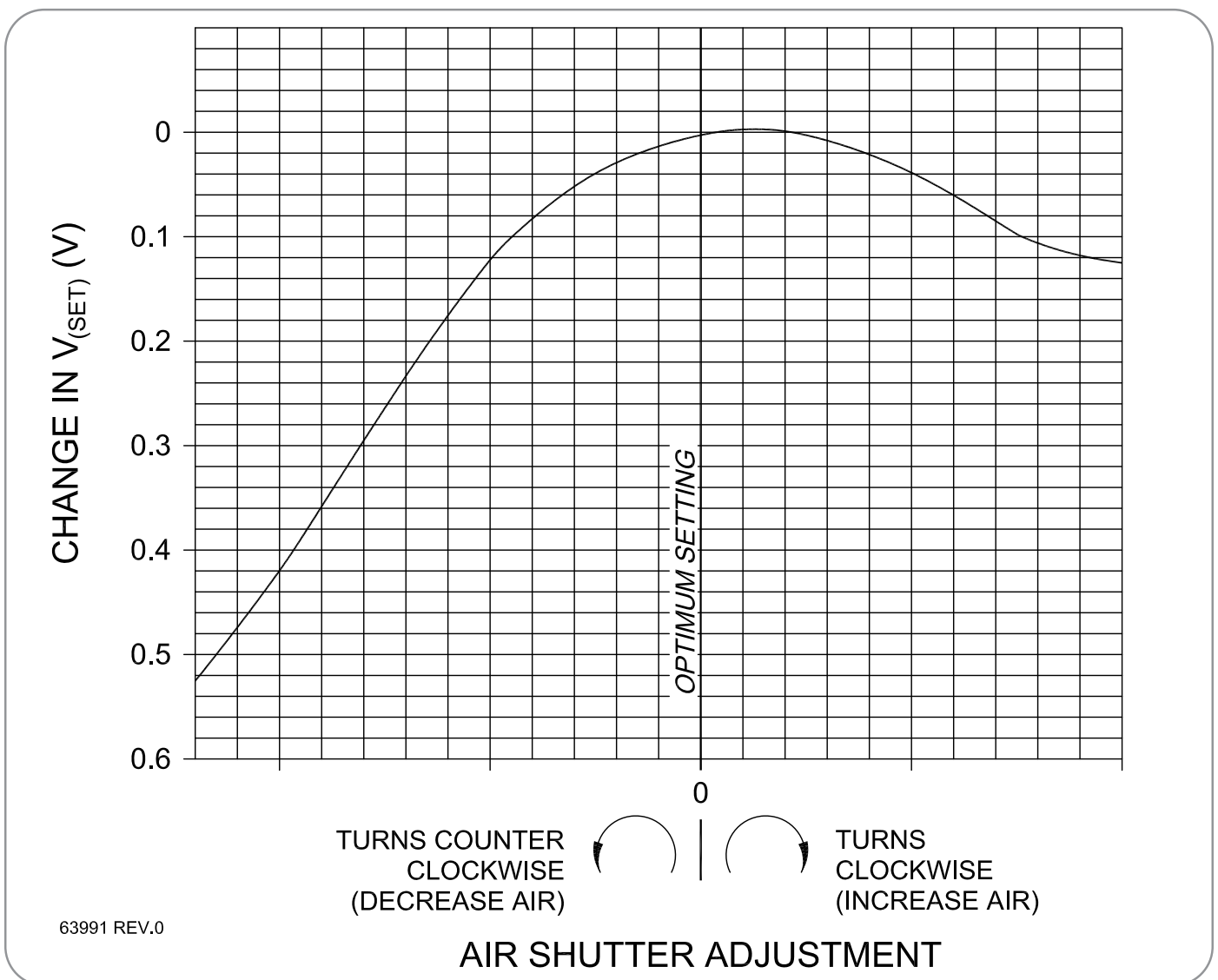


Figure 22 Change in V_{set} Versus Air-Shutter Adjustment, Typical

Follow these steps to adjust fuel pressure:

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

Note: Consult Data Plate Label Located on Inner Door for Reference Factory Fuel Pressure.

- c) 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:

- a) Check V_{set} , see Power Output Evaluation Section 7, and record.
- b) Open the doors and loosen the lock-nut on the air-shutter adjusting screw.
- c) 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:

- i) Turn air adjusting screw counter clockwise until it is free from the Air Lid. This will completely close off air intake.
- ii) Turn air adjustment screw clockwise:
 1. 2 to 2.5 turns for natural gas
 2. 4.5 to 5 turns for propane.

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.

- d) Close the doors, wait ten minutes then measure and record V_{set} .

If V_{set} is greater than the original value or did not change, the burner adjustment is air-rich, see Figure 22, 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 (see section 8.1.2.1) and proceed to e).

If V_{set} is less than original value, the burner adjustment is fuel-rich, see Figure 22. 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 (see section 8.1.2.1) and proceed to e).

- e) Tighten the lock-nut.

8.1.2.1 Measuring CO Emissions Levels

The model P-5050 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-5050 will produce less than 120 ppm CO air free. In order to be able to determine the levels of air-free CO_{ppm}, a combustion analyzer capable of measuring CO_{ppm} and either CO₂ percentage, or O₂ percentage, is needed.

The equations used to calculate the air-free stage of CO are:

- For Propane when using as measured CO₂ percentage, and CO_{ppm}:

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

- For Natural Gas when using as measured CO₂ percentage, and CO_{ppm}:

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

- When using as measured O₂ percentage, and CO_{ppm}:

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

Where: CO_{AFppm} = Carbon monoxide, air-free ppm.
CO_{ppm} = As-measured combustion gas carbon monoxide ppm.
O₂ = Percentage of oxygen in combustion gas, as a percentage.
CO₂ = Percentage of carbon dioxide in combustion gas, as a percentage.

The model P-5050 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 22 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

[1], [2], [3] as per CSA

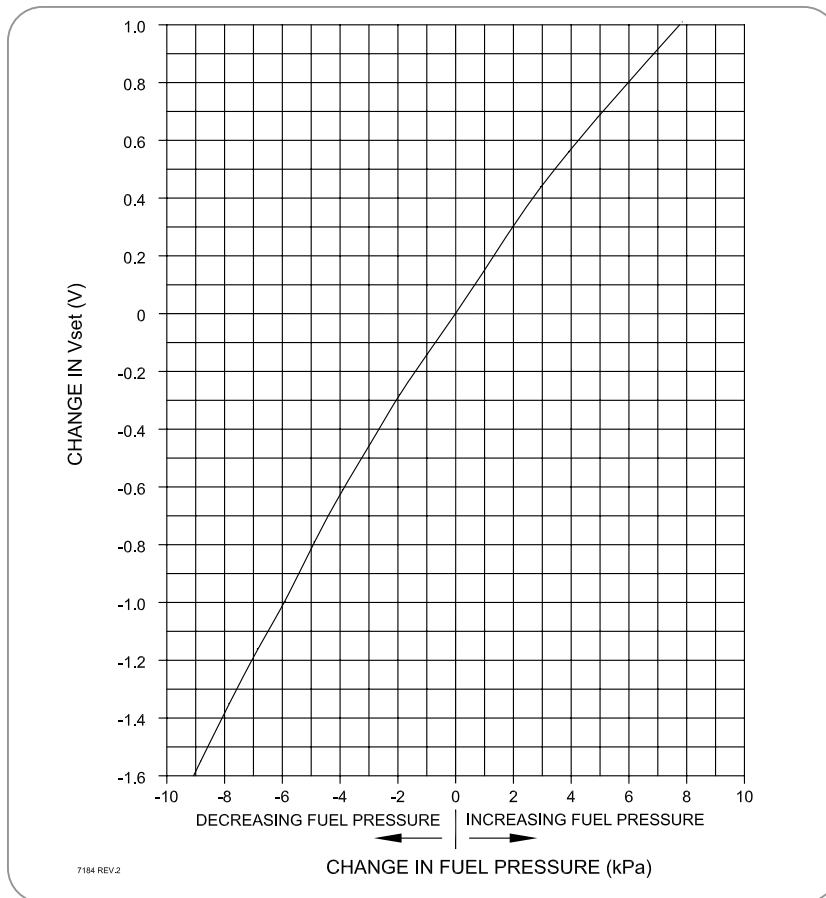


Figure 23 Change in V_{set} Versus Fuel Pressure Adjustment, Typical

Based on Figure 23 the fuel pressure must then be increased 2.4 kPa (0.35 psig).

Follow these steps to adjust fuel pressure:

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

Note: Consult Data Plate Label Located on inner door for Reference Factory Fuel Pressure.

- c) Wait ten minutes then measure V_{set} and record. If the TEG can not be adjusted to match required V_{set} value then a problem exists with one of the TEG's systems. If necessary see Troubleshooting section for guidance.
- d) Tighten the lock nut and replace the cover on the fuel regulator.

8.2 Adjustment of C/L

A C/L is available for use with the model P-5050 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-5050-12) or 28.0 V (Model P-5050-24). If this requires adjusting use the following procedure.

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

- a) Disconnect the customer load from the TEG, terminals 5 (-) and 6 (+) of TB-1.
- b) Connect a voltmeter between terminals 7 and 8 of TB-1 and measure the output voltage.
- c) 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-5050-24) or 11.5V and 14.3V (Model P-5050-12). 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:

- a) Remove both the positive and negative wires from the customer load terminals.
- b) Connect a DC voltmeter to the customer load terminals.
- c) Set the output voltage to the desired alarm point value.
- d) Place an ohmmeter between the common and normally open contact of the VSR.
- e) Turn the VSR adjustment pot until the contacts open (the normally open contacts are closed when output voltage is above VSR trip-point).

- f) Using the output voltage adjustment, raise output voltage to a value where the VSR will reset.
- g) To re-check the trip-point, lower output voltage and monitor opening of the VSR contacts. Fine tune as required to achieve desired trip value.
- h) 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:

- a) Remove the customer load
- b) 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
- c) Connect a DC Voltmeter to the customer Load Terminals
- d) 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.
- e) 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-5050 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 24 for series connection and Figure 25 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.

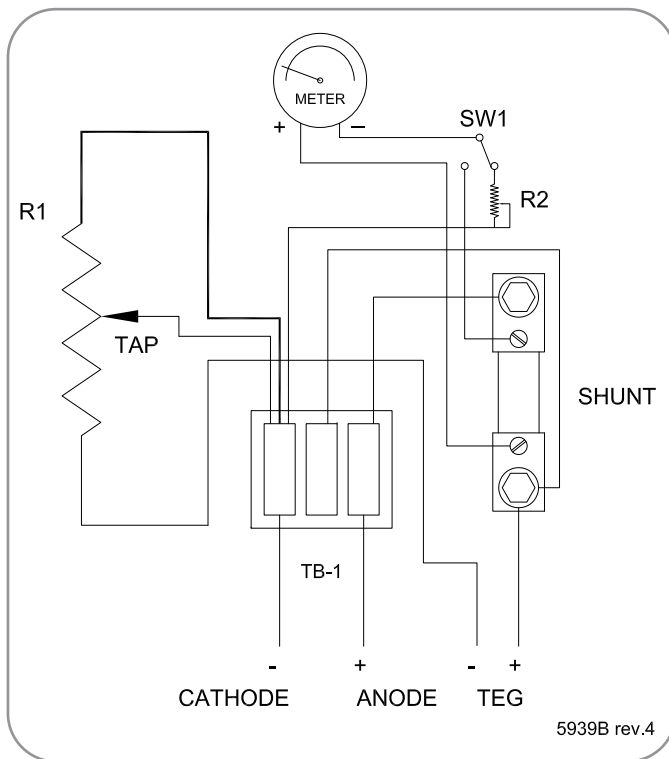


Figure 24 CP Interface System,
Series Wiring Diagram

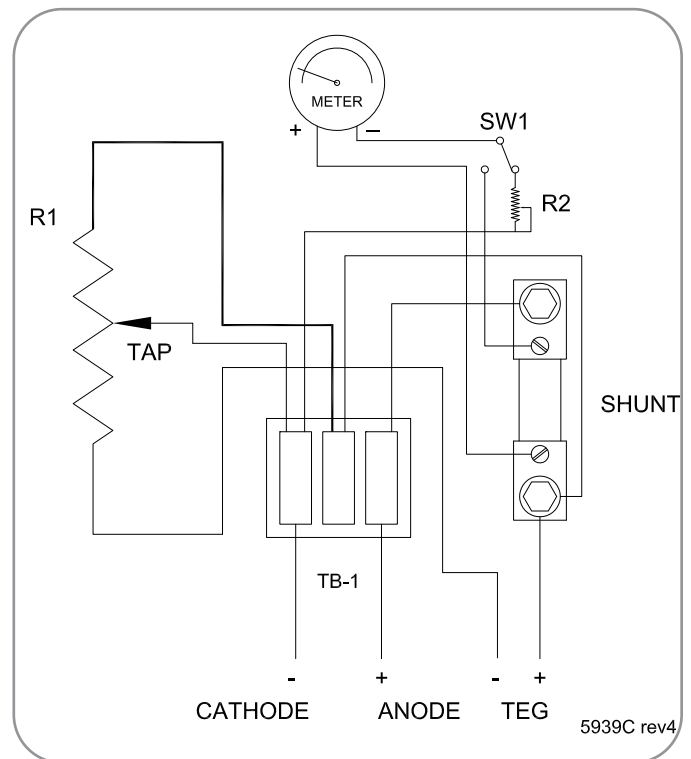


Figure 25 CP Interface System,
Parallel Wiring Diagram

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 centre 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 make adjustments to some variables

8.5.1 Measurement Display on TEG Controller

- a) 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.
- b) 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

- a) 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.
- b) Press the S7 (Up) or (S8) Down to make changes to the variable.
- c) 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 Display mode is not available until the Adjustment mode is exited.

9 MAINTENANCE

This section describes how to maintain the model P-5050 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 in order 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 3400-22363
- 1 Fuel orifice: for natural gas service use orifice #6, part number 4200-00688, for propane service use orifice #4, part number 4200-00686.
- 1 Battery 6V, 5.0 Ahr, Monoblock, part number 2400-24559*

*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} :

- a) Check V_{set} , see Power Output Evaluation Section 7, and record.
- b) Compare measured voltage with required V_{set} for present ambient temperature and act as follows:

- I) If measured voltage is more than 0.1 V above required V_{set} :

The fuel pressure must be reduced. Proceed with Routine Service, per topic below. Remember to adjust the fuel pressure during restart or before leaving the site. See Adjustment section.

Caution: *Do not continue operating the TEG with measured V_{set} exceeding that required V_{set} for present ambient temperature, otherwise overheating may cause irreparable damage to the power unit.*

- II) 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, per topic below.

- III) 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. In 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 possible causes:

- i) **Change in Fuel Pressure**

Refer back 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, Section 9.1.3.

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.

- ii) **Change in Air Flow**
Check for obstructions at the cooling fins and the air lid screens. 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, Section 9.1.3.
- iii) **Change in Fuel Quality**
In order to maintain a constant output power it is essential that the TEG be supplied with a constant heating value fuel. Proceed with Routine Service, Section 9.1.3.

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:

- a) Stop the TEG and pause to let cool. See Startup and Shutdown Section 6.
- b) Drain the pressure regulator sediment bowl. See Draining the Sediment Bowl Section 9.2.1.
- c) Replace the fuel filter in the pressure regulator. See Fuel Filter Replacement Section 9.2.2.
- d) Check the fuel orifice for clogging and replace if necessary. See Fuel Orifice Replacement Section 9.2.3.
- e) 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.
- f) Check all bolts and wire connections for tightness.
- g) Start the TEG. See Startup and Shutdown Section 6.
- h) Check V_{set} , record and adjust if necessary. See Power Output Evaluation Section 7 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:

- a) Shut off the fuel supply to the TEG and allow to cool.
- b) 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.)
- c) Close drain cock.
- d) 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:

- a) Shut off the fuel supply to the TEG and allow to cool.
- b) Drain the sediment bowl by opening the drain cock. (Place empty container beneath drain cock to prevent spillage inside the cabinet.)
- c) Remove the four screws from the bottom of the regulator.
- d) Remove the filter, and gasket. See Figure 26.

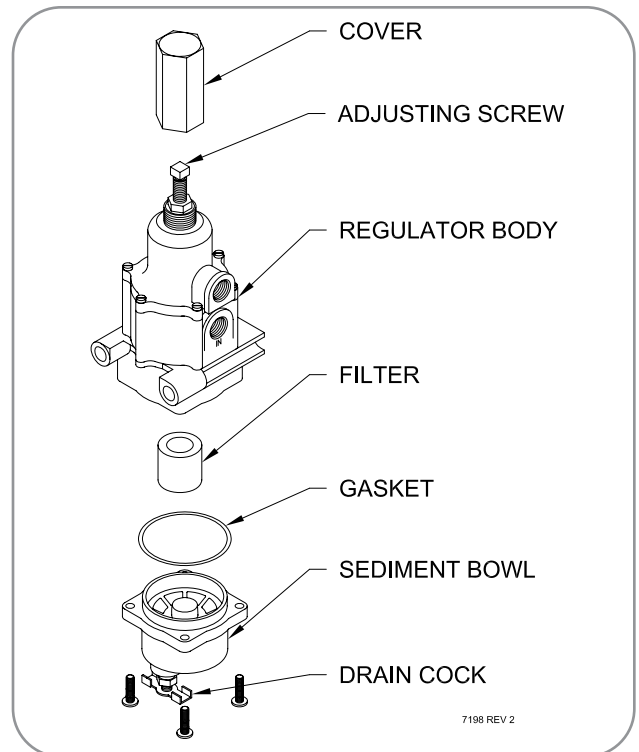


Figure 26 Pressure Regulator

Follow these steps to install the fuel filter:

- a) Install the filter, and gasket onto the sediment bowl. See Figure 26.
- b) Carefully replace the bottom of the regulator making sure the filter and gasket are in their proper position.
- c) Align the sediment bowl with the regulator body, replace the four screws and tighten.

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.

- d) With the fuel pressure on, leak checks all regulator joints and fuel connections using a commercial leak detector.



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

9.2.3 Fuel Orifice Inspection

Follow these steps to inspect the fuel orifice:

- a) Shut off the fuel supply to the TEG and allow to cool.
- b) Disconnect the fuel line from the solenoid valve.
- c) Disconnect the other end of the fuel line from the orifice from the lid of the air box.
- d) Remove the orifice fitting from the lid of the air box.
- e) 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.
- f) Connect the orifice fitting to the lid of the air box. This only needs to be finger tight.

Caution: Always use the same size orifice as was removed.

Propane orifice (#4) - Part# 4200-00686

Natural gas orifice (#6) - Part# 4200-00688

- g) Connect the fuel line to SV valve and orifice, then tighten the fuel line fittings.
- h) 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:

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



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

- b) Disconnect the supply fuel line and fuel inlet valve.
- c) Disconnect the solenoid wire terminal connection and the orange wire connections of the pressure switch electrical connections.
- d) Remove fuel line between the solenoid valve and orifice fitting.
- e) Remove the fuel system same as section 9.3.2 e).
- f) 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.

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

Note: If the air shutter setting was disturbed turn the venturi adjusting screw counterclockwise until it is removed and then turn clockwise 3 full turns. This will set the adjustment in the correct range to begin balancing the air-fuel mixture when re-starting.

- j) 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.

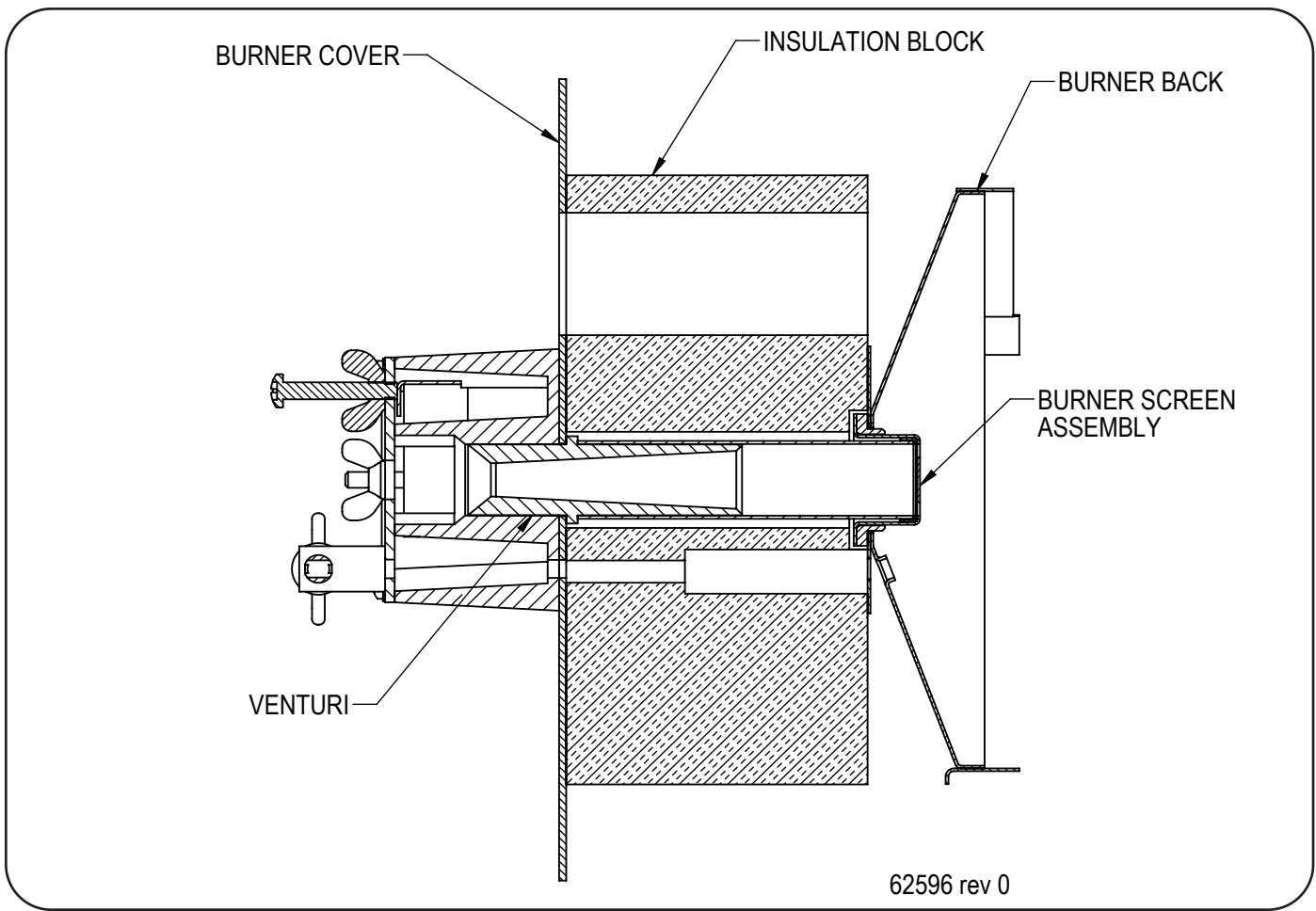


Figure 27 Burner Assembly Cross Section

Follow these steps to remove the burner:

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



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

- b) Disconnect the supply fuel line and fuel inlet valve.
- c) Disconnect the solenoid wire terminal connection and the orange wire connections of the pressure switch electrical connections.
- d) Remove fuel line between the solenoid valve and orifice fitting.
- e) Remove the 2 bolts mounting the fuel regulator to the cabinet wall and remove the fuel system.
- f) 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.

- g) Disconnect the ignition wire from the spark electrode.
- h) Loosen the wing-nut and slide the spark electrode out. See Figure 13.
- i) Remove screws from sides of rain cap and remove rain cap.
- j) Remove screws from top exhaust shield and remove exhaust shield.
- k) Remove screws from exhaust arrestor and remove exhaust arrestor.
- l) Remove the 2 screws mounting the exhaust stack to the burner back cover.
- m) Remove the four wing-nuts holding the burner in place and remove the cabinet exhaust shield.
- n) Slide the burner assembly out of the burner chamber.

Follow these steps to inspect the burner:

- a) 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.
- b) Check the air screens for any dust and debris. If any are found it should be cleaned.
- c) Check the burner screen.
- d) Check the ceramic spacer.

Follow these steps to install the burner:

- a) 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.

- b) 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 Figures 14, 15 and 16 for reference.



WARNING: Remove the orange wire from the pressure switch and make sure it can not 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:

- Remove the spark electrode by loosening the wing-nut and sliding the electrode out, (see Figure 13).
- Inspect the electrode for any cracks in the ceramic rod. If any cracks are found the electrode must be replaced.
- 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.
- Tighten the wing-nut only until it is snug.

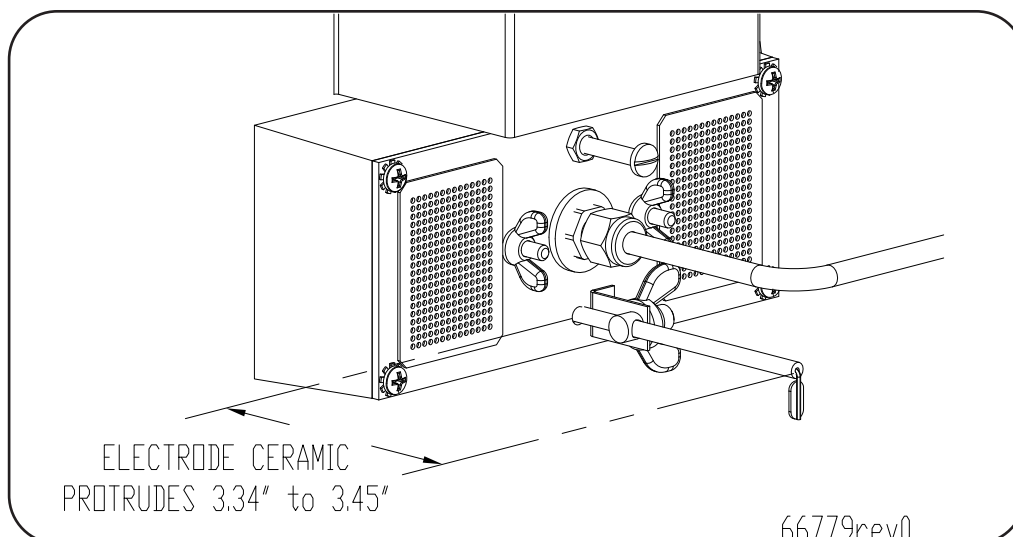


Figure 28 Electrode Protrusion From Air Box Lid

Caution: *Do not over tighten the wing-nut or the ceramic rod will crack.*

- e) 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:

- a) 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.
- b) 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.
- c) Provide fuel pressure to the switch by opening the manual gas valve and holding open the safety SO valve.
- d) 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).

- e) 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.

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.

- f) 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).

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:

- a) Open the front of the TEG, then open the cover door to the electronics, located inside the door assembly.
- b) Locate the battery, see Figure 7.

- c) 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.
- d) 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 5.5V

9.4.4 Check the Operation of the Ignition Control Module and Spark Generation

- a) Verify electrode gap (1/8" - 1/4"), Section 9.4.1.
- b) Start the TEG.
- c) If arcing occurs, the ignition control module is functioning.
- d) 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 together with good contact, otherwise replace the SI module.

9.4.5 Check the spark return path for the SI module

- a) 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.
- b) Verify that the TEG bonding wire is connected between the electronics assembly and the TEG cabinet.

Both connections are required for the SI module to properly detect flame recognition. Refer to Figure 14, 15 or 16.

9.4.6 Check Solenoid Valve

- a) 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.
- b) 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 C/L 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 C/L Switch Settings

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

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

9.5.3 Check Output Voltage from the C/L

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

- a) Disconnect the customer load from the TEG, terminals 7 (+) and 8 (-) of TB-1.
- b) Connect a voltmeter between terminals 7 and 8 of TB-1 and measure the output voltage.
- c) 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:

- a) Start the TEG.
- b) 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.
- c) 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.

- d) 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.

- e) 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.

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:

- a) Start the TEG.
- b) Disconnect the customer load from terminals 7(+) and 8(-) of TB-1.
- c) Connect a voltmeter between terminals 5 (+) and 6 (-).
- d) 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.
- e) Record V_{set} .
- f) 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 multi-meter 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 (V_{oc}). If this was not recorded quickly enough replace the connection and repeat steps d) to f) above.
- g) Measure the Voltage across Terminals 1 and 2 and record.

Note: Do not remove the bottom connection from Terminal 1 (connected to the power unit). Remove the top connection that is connected to the electronics. Removing the power unit connection will result in a reading of zero volts.

- h) Calculate the internal resistance using the equations 3 and 4 below.

$$I_L = 1.38 \left(\frac{V_{set}}{R_L} \right) \quad \text{Equation 3}$$

$$R_i = (V_{oc} - V_L) / I_L \quad \text{Equation 4}$$

Where:

- R_i = internal resistance (ohms)
- V_{oc} = momentary open circuit voltage (V)
- V_L = load voltage (V)
- I_L = load current (A)
- R_L = precision load resistance (ohms)
- V_{set} = voltage measured across terminals 5 and 6 (V)

- i) Check the internal resistance, R_i , is less than 0.58 W. If not the power unit may be damaged.

Example: If the load voltage and momentary open circuit voltages were measured as 5.88 V and 10.8 V respectively and the precision load resistance was 0.75 ohms then:

$$\begin{aligned} I_L &= 1.38 (V_L / R_L) \\ &= 1.38 (5.88/0.75) \\ &= \underline{10.59 \text{ A}} \end{aligned}$$

$$\begin{aligned} R_{INT} &= (V_{oc} - V_L) / I_L \\ &= (10.8 - 5.88) / 10.59 \\ &= 4.92 / 10.59 \\ &= 0.46 \text{ ohms} \end{aligned}$$

Internal resistance is acceptable, < 0.58 ohms.

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

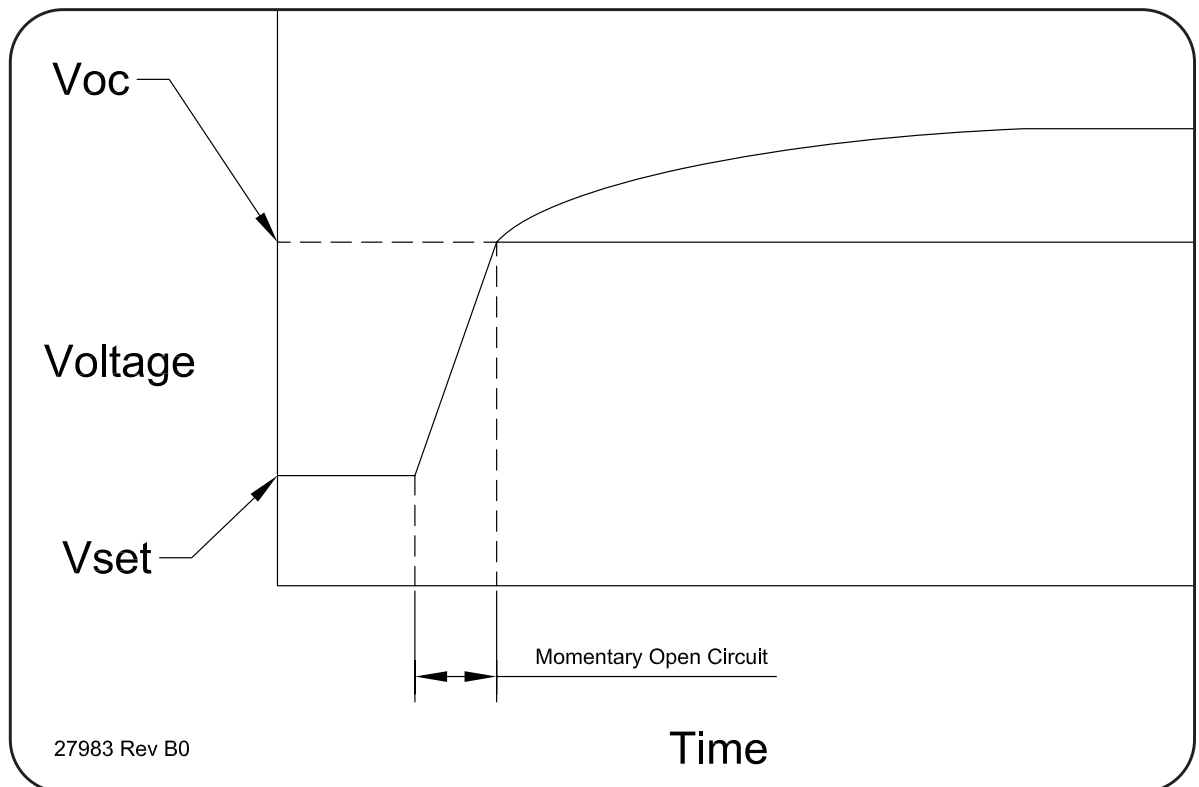


Figure 29 Momentary Open Circuit Diagram

10 TROUBLESHOOTING

Problem	Probable Cause	Possible Solution	Lookup Section
Burner does not ignite	Air in fuel line	Purge fuel lines of air	<i>Installation</i>
	Supply gas pressure too low	Increase the gas supply pressure to the TEG	<i>Installation</i>
	Fuel filter dirty	Drain the regulator sediment	<i>Maintenance</i>
		Replace the fuel filter	<i>Maintenance</i>
	Fuel pressure adjustment incorrect	Adjust the TEG fuel manifold pressure	<i>Adjustment</i>
	Fuel orifice plugged	Replace the fuel orifice	<i>Maintenance</i>
	Fuel orifice size incorrect	Replace the fuel orifice	<i>Maintenance</i>
	Air filter dirty	Clean the air filter	<i>Maintenance</i>
	Air-shutter adjustment incorrect	Adjust the air-shutter	<i>Adjustment</i>
	SI system faulty	Maintain the SI system	<i>Maintenance</i>
Burner will ignite but will not continue to burn	Supply gas pressure too low	Increase the gas supply pressure to the TEG	<i>Installation</i>
	Fuel filter dirty	Drain the regulator sediment bowl.	<i>Maintenance</i>
		Replace the fuel filter	<i>Maintenance</i>
	Fuel pressure adjustment incorrect	Adjust the TEG fuel manifold pressure	<i>Adjustment</i>
	Fuel orifice plugged	Replace the fuel orifice	<i>Maintenance</i>
	Fuel orifice size incorrect	Replace the orifice with one of the correct size	<i>Maintenance</i>
	Ignition control system faulty	Maintain the SI system	<i>Maintenance</i>
	Air filter dirty	Clean the air filter	<i>Maintenance</i>
	Air shutter adjustment incorrect	Adjust the air-shutter	<i>Adjustment</i>

continued on next page

TROUBLESHOOTING, *continued*

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

*applicable for L/C option only

11 PART LIST

This section lists the parts that form the equipment.

For parts and service please contact Global Power Technologies's Customer Service Department at:



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

Global Power Technologies
Customer Service Department
Direct: 001-403-720-1190
Fax: 001-403-236-5575
Switchboard: 001-403-236-5556
E-mail: customer.service@globalte.com
Web: www.globalte.com

11.1 Model P-5050 TEG

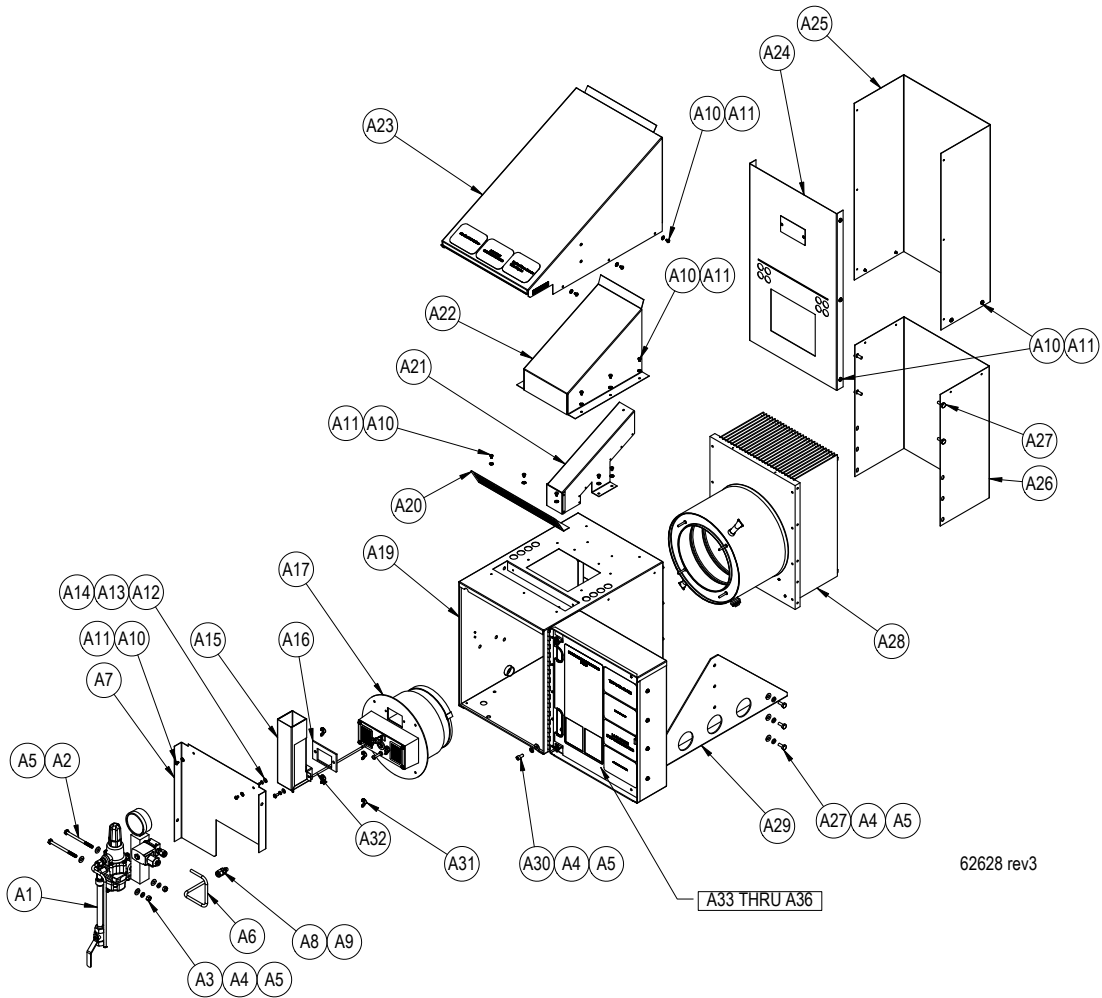


Figure 30 Model P-5050 TEG

Item	Part No.	Description
A1	6400-61864	FUEL SYSTEM, P-5050/P-5100
or	6400-62557	FUEL SYSTEM, SS, P-5050/P-5100
A2	2514-02105	SCREW, CAP, HEX-HD, 1/4-20 X 3-1/2, SS, 1-1/2" THREAD
A3	2714-00611	NUT, HEX, 1/4-20, SS
A4	2814-00541	WASHER, LOCK, SPRING, 1/4, SS
A5	2814-00557	WASHER, FLAT, 1/4" SS
A6	4900-62120	FUEL LINE, P-5050/P-5100
or	4900-65821	FUEL LINE, SS FUEL SYSTEM, P-5050/P-5100
A7	4900-62064	BAFFLE, INNER CABINET, P-5050/P-5100
A8	4200-00688	ORIFICE, 6, 0.0185, 5060-N
A9	4200-00686	ORIFICE 4, 0.0145, 5060-L
A10	2508-07410	SCREW, MACH, P-H-P, 8-32 X 1/4, SS
A11	2808-00472	WASHER, LOCK, EXT. #8, SS
A12	2810-00569	WASHER, FLAT, #10, SS
A13	2810-29696	WASHER, LOCK, SPRING, #10, 316 SS
A14	2510-00255	SCREW, MACH, P-H-P, 10-32 X 3/8 SS
A15	4900-61984	EXHAUST ASSY, P-5050/P-5100
A16	4500-61569	GASKET, EXHAUST, P-5050/P-5100

11.1 Model P-5050 TEG (cont'd)

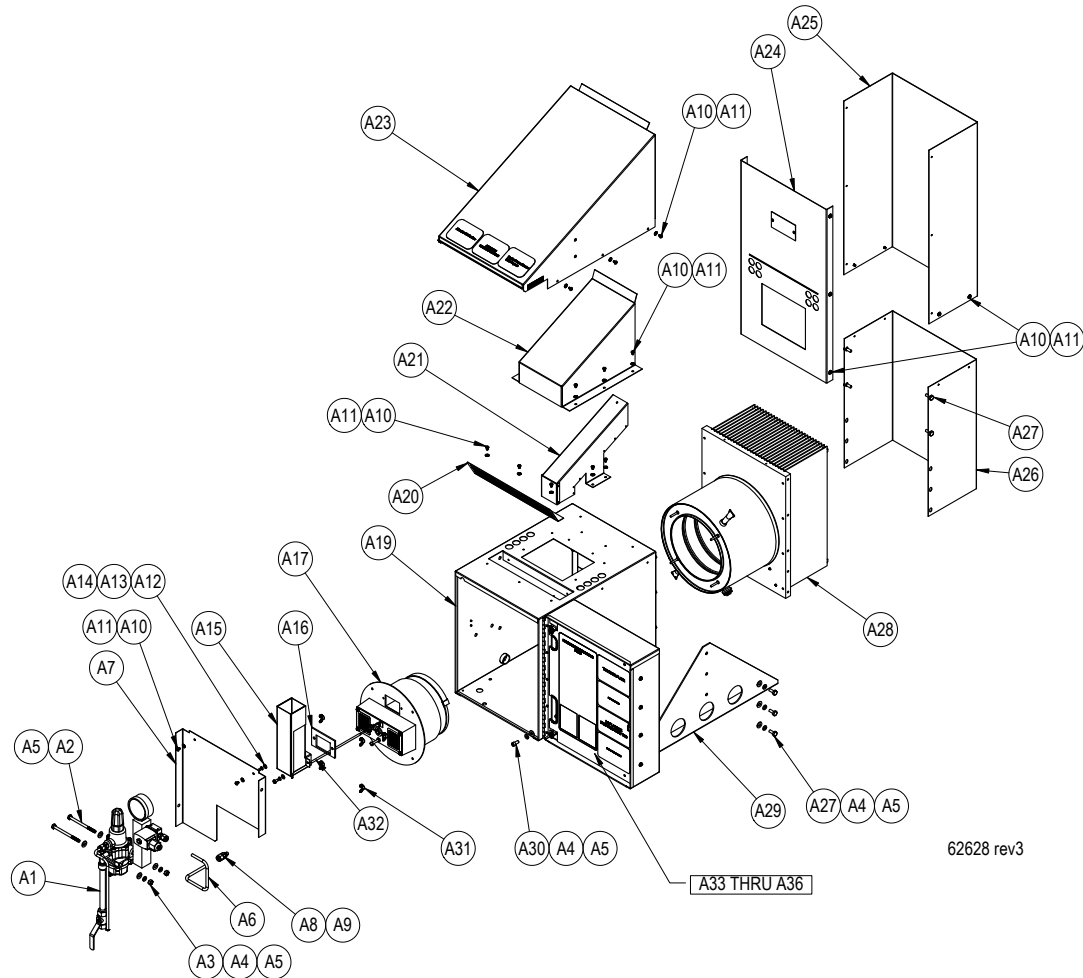
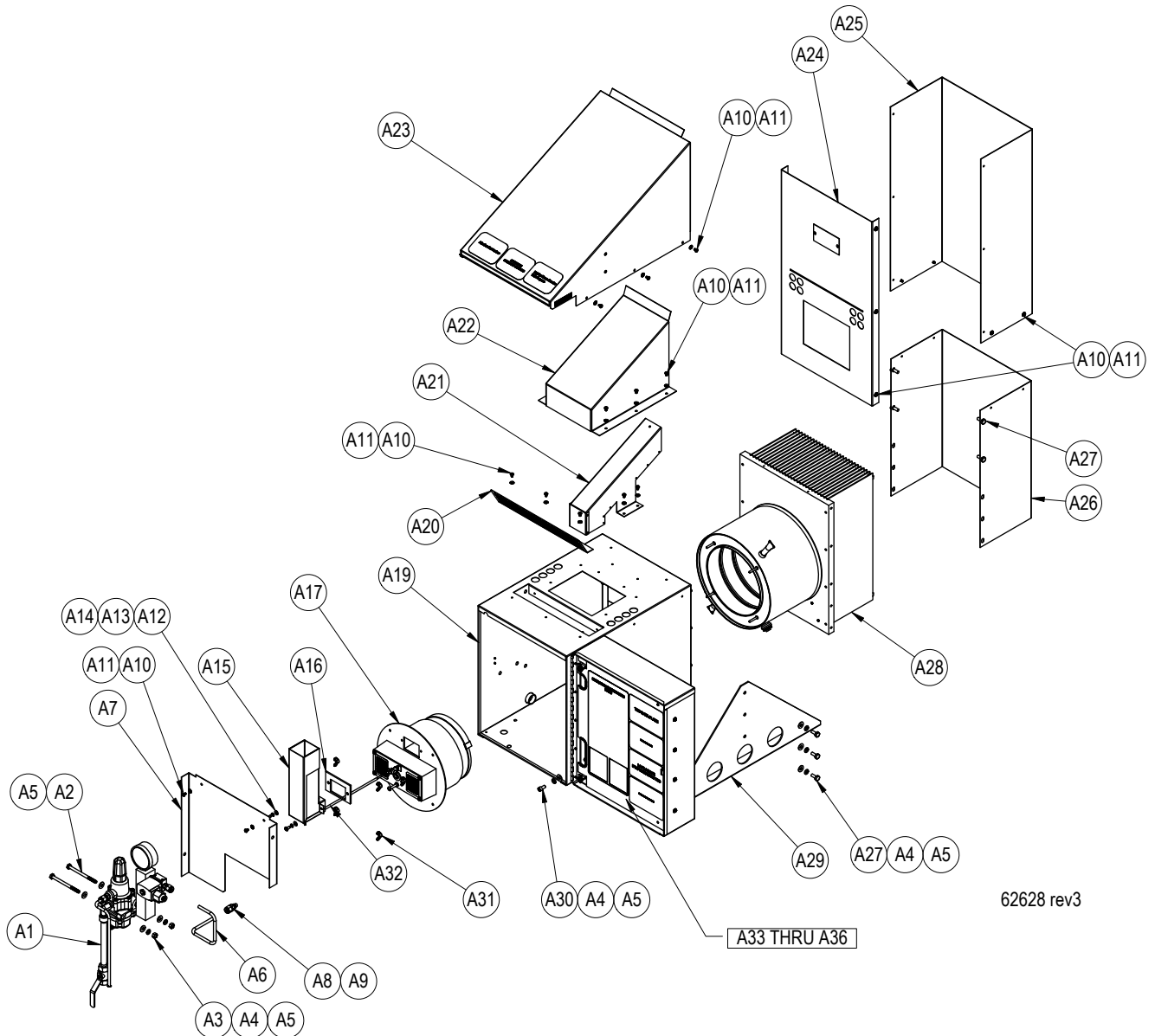


Figure 30 Model P-5050 TEG

Item	Part No.	Description
A16	4500-61569	GASKET, EXHAUST, P-5050/P-5100
A17	6100-61567	BURNER ASSEMBLY, P-5050
A19	6200-61993	CABINET ASSEMBLY, P-5050/P-5100
A20	4900-62122	RAIN GUARD, P-5050/P-5100
A21	4900-62126	EXHAUST TUBE ASSY, P-5050/P-5100
A22	4900-62065	LINER, EXHAUST, P-5050/P-5100
A23	4900-62067	RAIN CAP ASSEMBLY, P-5050/5100
A24	4900-62113	COVER ASSY, UPPER, FIN DUCT, P-5050/P-5100
A25	4100-61552	FIN DUCT, UPPER, P-5050
A26	4100-61551	FIN DUCT, LOWER, P-5050
A27	2514-20535	SCREW, HEX HD, 1/4-20 X 5/8, SS
A28	7000-61555	POWER UNIT, SEAT IN, P-5050
A29	4900-62114	LEG, P-5050/P-5100
A30	2514-00266	SCREW, CAP, SOC, 1/4-20 X 1/2 SS
A31	2708-00600	NUT, WING, 8-32, SST
A32	4900-58496	ELECTRODE ASSY, FLAME SENSING SI

11.1 Model P-5050 TEG (cont'd)



62628 rev3

Figure 30 Model P-5050 TEG

Item	Part No.	Description
A33	6300-65176	LIMITER/CONVERTER ASSY, 12V, P-5050/P-5100 (OPTIONAL)
A34	6300-65175	LIMITER/CONVERTER ASSY, 24V, P-5050/P-5100 (OPTIONAL)
A35	6300-63515	LIMITER/CONVERTER ASSY, 12V, RS, P-5050/P-5100 (OPTIONAL)
A36	6300-63516	LIMITER/CONVERTER ASSY, 24V, RS, P-5050/P-5100 (OPTIONAL)
A37	6300-65206	CP INTERFACE ASSEMBLY, P-5050-6.7V (NOT SHOWN) (OPTIONAL)
A38	6300-65207	CP INTERFACE ASSEMBLY, P-5050-12V (NOT SHOWN) (OPTIONAL)
A39	6300-65245	CP INTERFACE ASSEMBLY, P-5050-24V (NOT SHOWN) (OPTIONAL)
	2400-56980	SENSOR, TEMPERATURE, TRISTAR TS-RTS (NOT SHOWN) (OPTIONAL)

11.2 Model P-5050 Burner

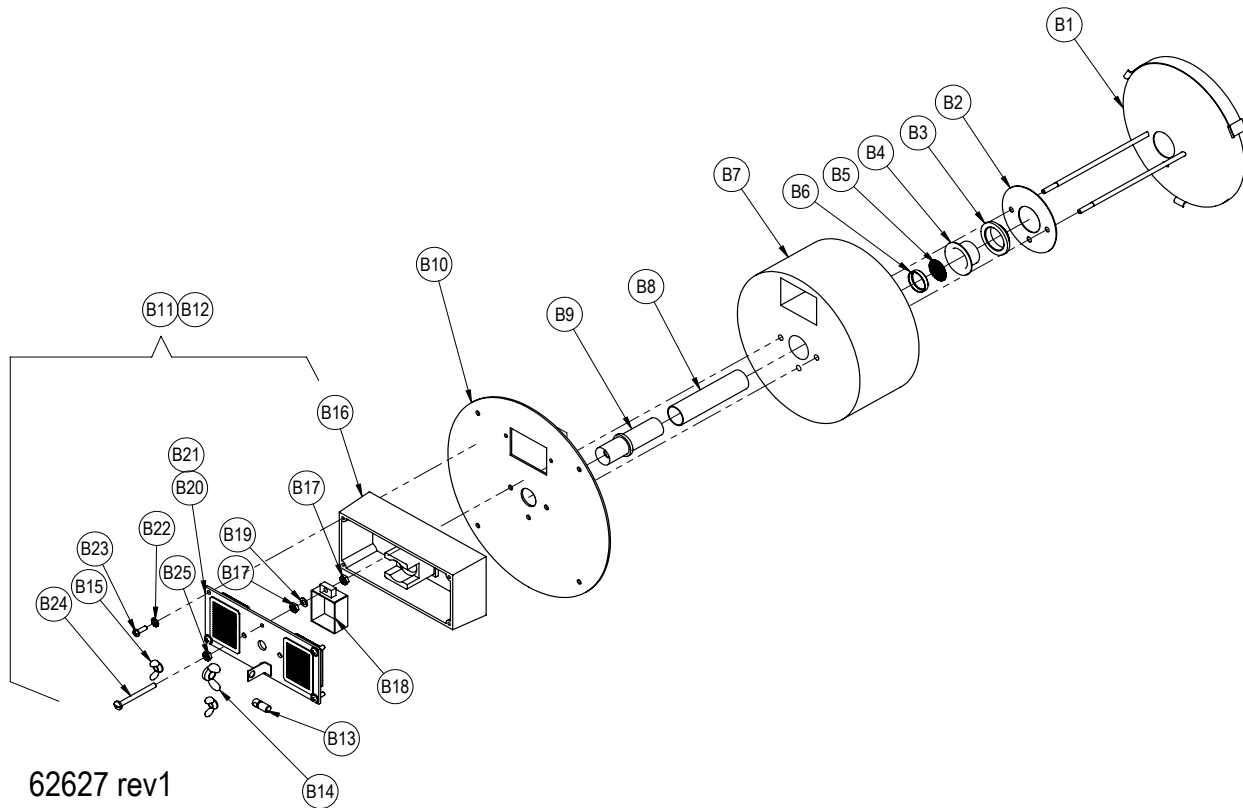


Figure 31 Model P-5050 Burner

Item	Part No.	Description
B1	4000-62117	BURNER BACK ASSY, P-5050/P-5100
B2	4000-62115	INSULATION SUPPORT, P-5050/P-5100
B3	4000-00701	SPACER, INSULATION
B4	4000-00693	SCREEN HOLDER, 5015/5030/5060/5120/1120
B5	4000-01008	BURNER SCREEN ASSY, 5060/P-5050
B6	4000-00694	INSERT RING, BURNER, 5120/5060/5030/1120
B7	4000-61869	INSULATION BLOCK, P-5050/P-5100
B8	4000-61871	SPACER, VENTURI, P-5050/P-5100
B9	4900-62004	VENTURI, P-5050
B10	4000-61870	BURNER COVER, P-5050/P-5100
B11	4500-62118	AIR BOX ASSY, W INTAKE ARRESTORS, P-5050/P-5100
B12	4900-63988	AIR BOX ASSY, NON FA,P-5050/P-5100
B13	4900-07004	PIN, MOUNTING, SI ELECTRODE
B14	2756-07005	NUT, WING, 5/16-18, SS
B15	2710-00601	NUT, WING, 10-32, SS
B16	4500-61862	AIR BOX, MACHINED, P-5050/P-5100
B17	2710-63957	NUT, LOCK, HEX, 10-32, 316SS, McMASTER CARR 95885A420
B18	4900-63954	AIR SHUTTER ASSY, P-5050/P-5100
B19	2810-27901	WASHER, BOWED, 5 MM, A2 SS, Spaenaur 681-821
B20	4900-61990	LID WITH ARRESTORS, ASSEMBLY, P-5050/P-5100
B21	4900-61988	LID ASSY, NON FA, P-5050/P-5100
B22	2808-00472	WASHER, Lock, EXT. #8, SS
B23	2508-07324	SCREW, Mach, P-H-P, 8-32 X 1/2, SS
B24	2510-63956	SCREW, MACH, P-H-S, 10-32 X 2" SS
B25	2710-00609	NUT, HEX, 10-32, SST

11.3 Model P-5050 Fuel System

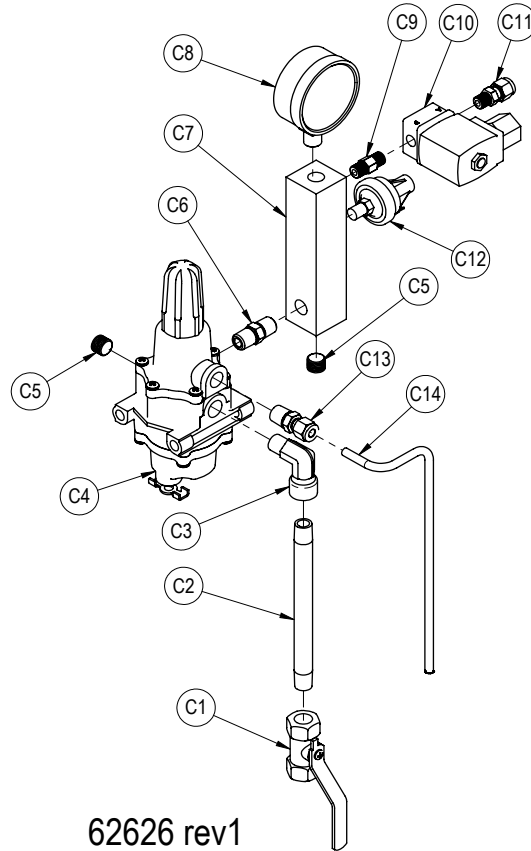


Figure 32 Model P-5050 Fuel System

Item	Part No.	Description
C1	3094-24653	VALVE, BALL, 1/4 NPT, BRASS, CG/CSA/UL APP'D, 600# WOG
C2	3041-62069	NIPPLE, 1/4 NPT X 6" LG. BRASS
C3	3034-21569	ELBOW, Street 1/4 NPT, B-4-SE
C4	3100-63312	REGULATOR, FISHER 67CFR, 0-20 PSI, UL 144 & UL 252, P-5050/P-5100
C5	3052-58949	PLUG, 1/4" NPT X 7/8" STEEL, UMBRAKO 1105766
C6	3044-00501	NIPPLE, HEX, 1/4 NPT X 1 1/8, BRASS
C7	4200-61991	MANIFOLD BLOCK, FUEL SYSTEM, P-5050/P-5100
C8	3200-00691	GAUGE, Pressure, 0-15 PSI
C9	3041-07996	NIPPLE, HEX, 1/8 NPT, 316 SS, SS-2-HN
C10	3094-27927	VALVE, Solenoid, Burkert, 6013, 463305, 2mm ORIFICE 2WAY NC 1/8FNPT, Brass
C11	3021-20977	CONNECTOR, 1/4 TB X 1/8 MNPT, SS-400-1-2
C12	3400-06471	SWITCH, PRESSURE 1.6 PSI, 76056-DB 1.6-0.5
C13	3021-00380	CONNECTOR, 1/4 TB X 1/4 MNPT, 316 SS, SS-400-1-4
C14	4200-61865	VENT TUBE ASSY, REGULATOR, SS P-5050/P-5100
C15	3400-22363	FILTER KIT, FISHER 67 CFR (Not Shown)

11.4 Model P-5050 Optional Stainless Steel Fuel System

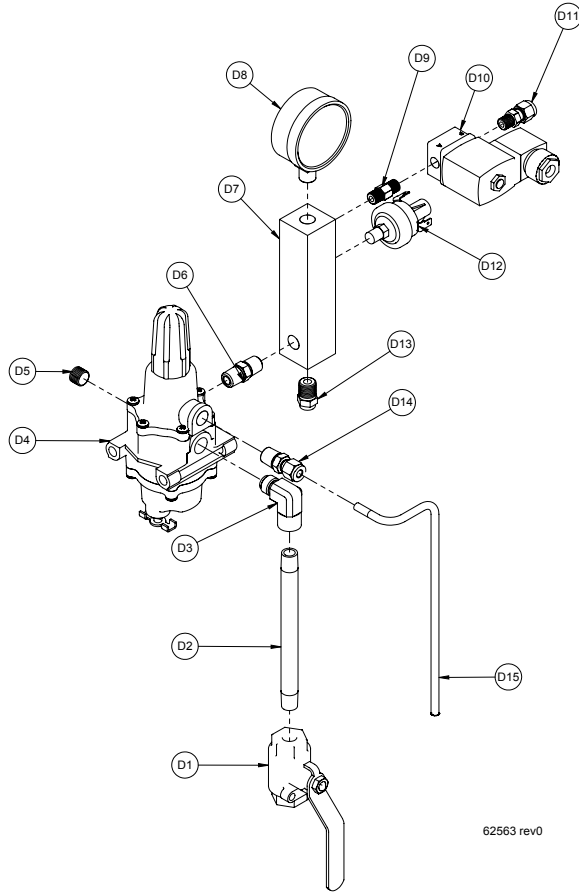


Figure 33 Model P-5050 SS Fuel System

Item	Part No.	Description
D1	3091-21689	VALVE, BALL, 1/4" 2000 LB, 316 SS, V-TEK V2
D2	3041-62559	NIPPLE, 1/4 NPT X 6" L, SS
D3	3031-02356	ELBOW, STREET, 1/4 NPT, SS
D4	3100-22364	REGULATOR, FISHER 67CFR, 0-20 PSI, SOUR GAS
D5	3051-20428	PLUG, 1/4 NPT, HEX, 316 SS, SS-4-P
D6	3041-02359	NIPPLE, HEX, 1/4 NPT X 1.5 LG, 316 SS
D7	4200-61991	MANIFOLD BLOCK, FUEL SYSTEM, P-5050/P-5100
D8	3200-00691	GAUGE, Pressure, 0-15 PSI
D9	3041-07996	NIPPLE, HEX, 1/8 NPT, 316 SS, SS-2-HN
D10	3091-62558	VALVE, SOLENOID, BURKERT 6013, 6013-A02,0BBVANM81-5-012/DC-02,PD02, 2mm ORIFICE 2WAY NC 1/8 FNPT, SS
D11	3021-20977	CONNECTOR, 1/4 TB X 1/8 MNPT, SS-400-1-2
D12	3400-61849	SWITCH, PRESSURE, 1.6 PSI, NO, PLATED STEEL, HOBBS 76056-00000016-05
D13	3021-00380	CONNECTOR, 1/4 TB X 1/4 MNPT, 316 SS, SS-400-1-4
D14	4200-61865	VENT TUBE ASSY, REGULATOR, SS P-5050/P-5100
D15	3400-22363	FILTER KIT, FISHER 67 CFR (Not Shown)

11.5 Model P-5050 Electrical

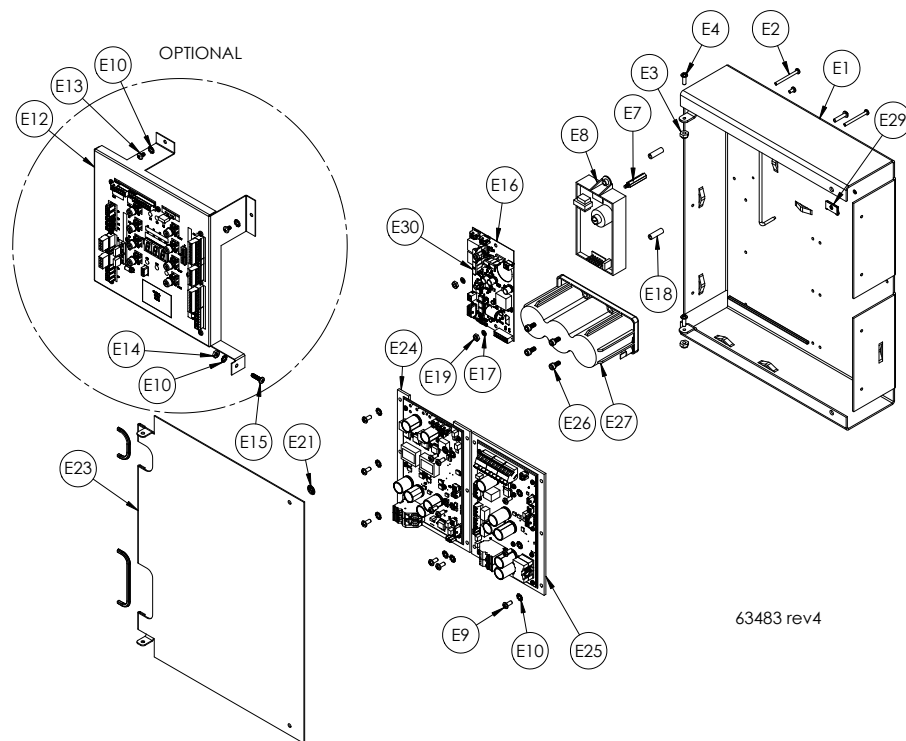


Figure 34 Model P-5050 Electrical

Item	Part No.	Description
E1	4900-63035	BACK PAN, ELECTRICAL ENCLOSURE, P-5050/P-5100
E2	2506-56227	SCREW, MACH, P-H-P, 6-32 X 1.5" LG, SS
E3	2708-56922	NUT, NyLock, 8-32, SS
E4	2508-07324	SCREW, Mach, P-H-P, 8-32 X 1/2, SS
E7	2900-63136	STANDOFF, 6-32 M/F, 1/4" HEX, ALUM, 1.12" LG
E8	2400-63096	SI BOARD, CHANNEL PROD, 2021-90, MICRO 50N-12-3-3-7-10-0-
E9	2508-00254	SCREW, Mach, P-H-P, 8-32 X 3/8, SS
E10	2808-00472	WASHER, Lock, EXT. #8, SS
E12	6300-63205	TEG CONTROLLER ASSY, P-5050/P-5100
E13	2508-07410	SCREW, Mach, P-H-P, 8-32 X 1/4, SS
E14	2708-00606	NUT, Hex, 8-32, SST
E15	2508-52307	SCREW, MACH, P-H-P, 8-32 X 5/8", SS
E16	2400-64264	PCB ASSY, SI CONTROLLER
E17	2806-25984	WASHER, Lock, Internal, #6, SS
E18	2900-63137	SPACER, NYLON, 0.8125"LG, #6 HOLE DIGIKEY 492-1112-ND
E19	2706-00604	NUT, Hex, 6-32, SST
E20	2506-54087	SCREW, MACH, P-H-P, 6-32 X 1/4, SS
E21	2900-63960	WASHER, RETAINING, SOUTHCO 09-6-1
E22	2900-63959	SCREW, FAST LEAD , KNURLED, SS, SOUTHCO 09-13-102-26
E23	4900-63039	DEAD FRONT, ELECTRICAL ASSY, P-5050/P-5100
E24	2400-63126	PCB ASSY, LC DC/DC CONVERTER, MEDIUM POWER, P-5050/P-5100
E25	2400-64879	PCB ASSY, LC DC/DC LIMITER, MEDIUM POWER, P-5050/P-5100
E26	2508-58437	SCREW, CAP, HEX SOCKET, 8-32 x 3/8", 18.8 SS
E27	2400-24559	BATTERY, 6V, 5.0Ahr, Monobloc, AEI 108539
E28	2400-63199	HIGH TEMP BATTERY, ASSY, P-5050/P-5100 (OPTIONAL)
E29	2900-63961	NUT, CLIP-ON, SOUTHCO 09-43-101-24
	4900-65163	WIRING HARNESS, VOLTAGE SENSING RELAY (VSR), OPTION P-5050/P-5100 (OPTIONAL) NOT SHOWN
E30	2400-66222	Fuse, 3A, 32V, Gray mini Atm

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 35 for locations and description of the major components of the CP Interface Cabinet.

12.1.1 Meter

The dual Scale meter displays voltage at the terminal block, and current when the PUSH TO READ AMPS button is depressed. The meter is accurate to +/- 3% of full scale.

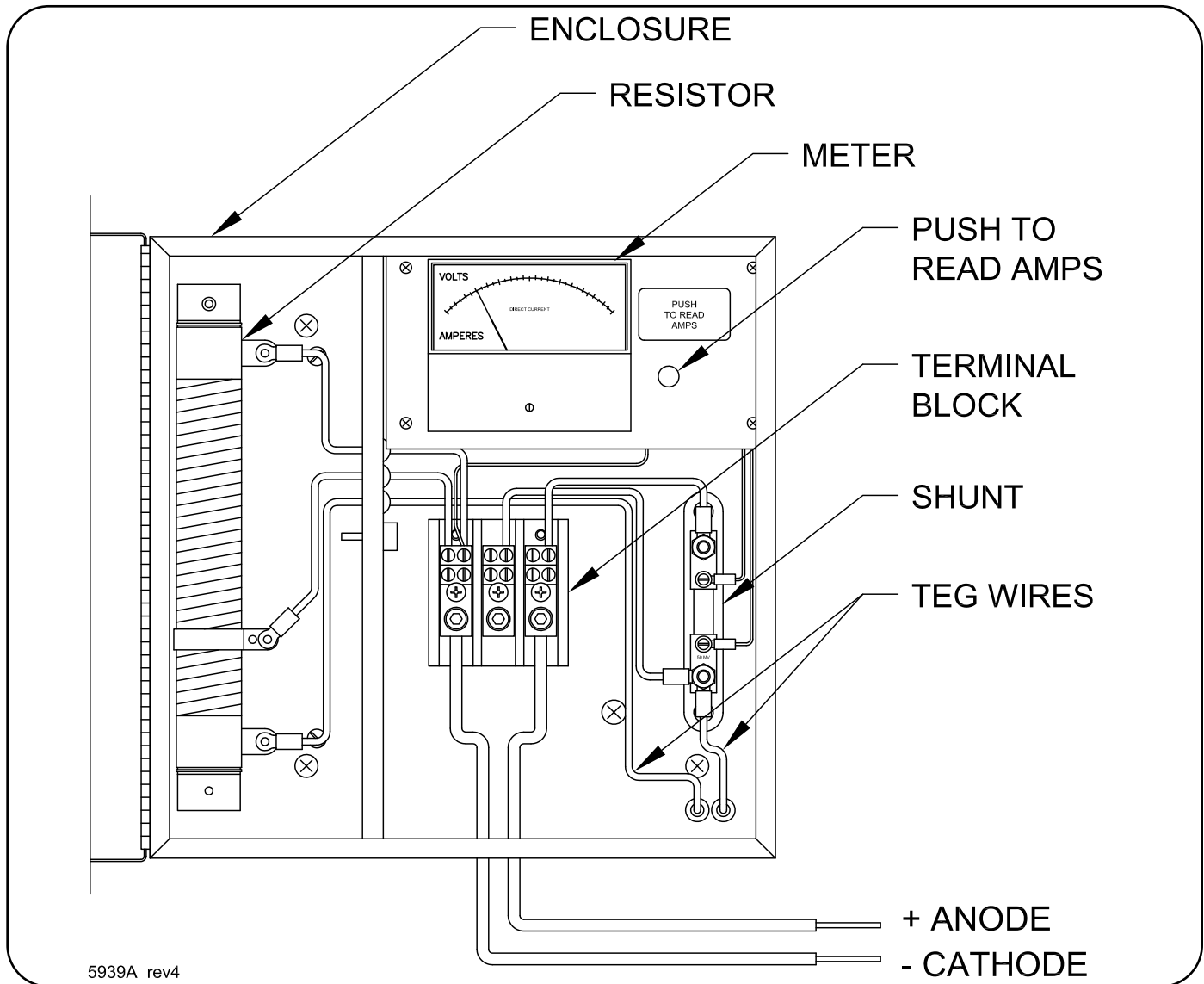


Figure 35 Cathodic Protection Interface Cabinet

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 36 for series connection and Figure 37 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. 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

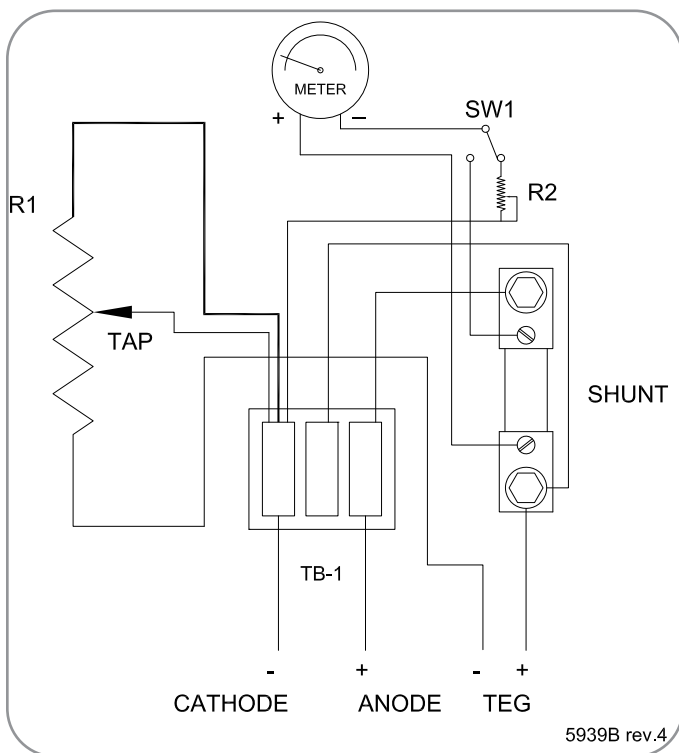


Figure 36 CP Interface System,
Series Wiring Diagram

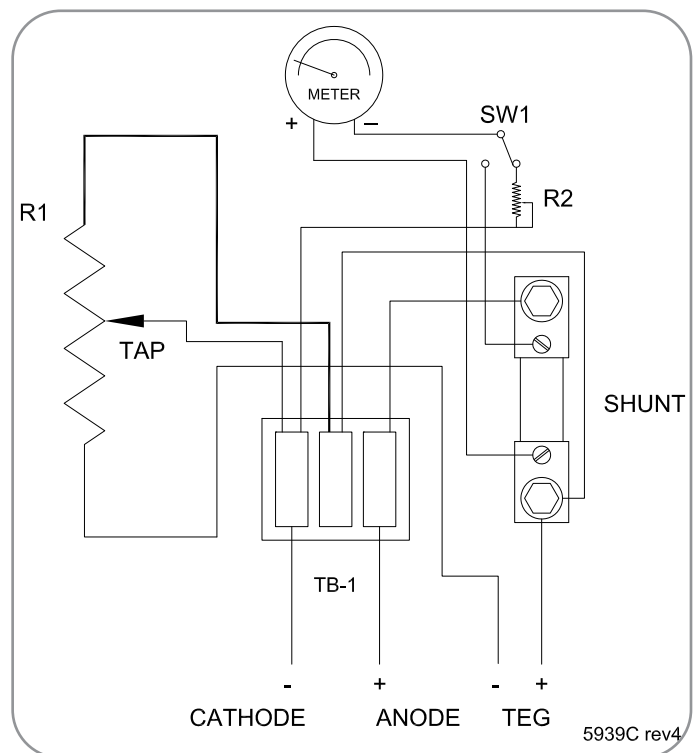


Figure 37 CP Interface System,
Parallel Wiring Diagram

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

GPT TEG	Item	System Description
P-5050-6.7	6300-65206	CP Interface Assembly, P-5050-6.7V
P-5050-12	6300-65207	CP Interface Assembly, P-5050-12V
P-5050-24	6300-65245	CP Interface Assembly, P-5050-24V
P-5100-6.7	6300-65208	CP Interface Assembly, P-5100-6.7V
P-5100-12	6300-65209	CP Interface Assembly, P-5100-12V
P-5100-24	6300-65246	CP Interface Assembly, P-5100-24V

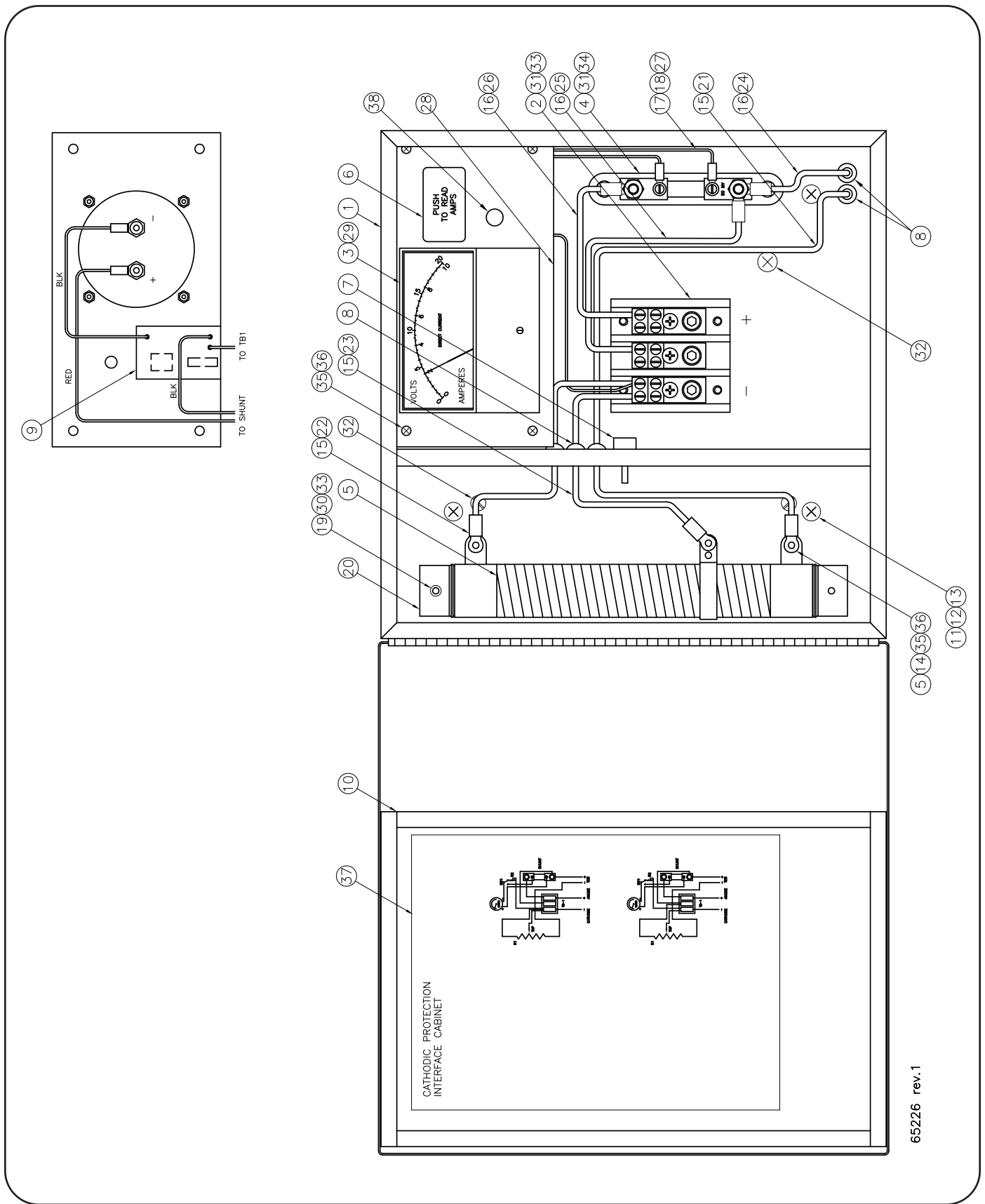


Figure 38 Cathodic Protection System Parts Identification

Figure 38 Parts Table

Item	Part No.	Description	QTY
1	4900-01839	Box, Cathodic Protection Shell	1
2	2200-06714	Terminal Block, Heavy duty, 3Pole	1
3	2420-06218	Meter Face, 0-15V, 0-30A (for panel #6300-65206 & 65208)	1
	2420-06219	Meter Face, 0-20V, 0-10A (for panel #6300-65209 & 65207)	
	2420-06220	Meter Face, 0-30V 0-5A (for panel #6300-06245 & 65246)	
4	2400-06217	Current Shunt, 30A, 50mV (for panel #6300-65206 & 65208)	1
	2400-06216	Current Shunt, 10A, 50mV (for panel #6300-65209 & 65207)	
	2400-06215	Current Shunt, 5A, 50mV (for panel #6300-65245 & 65246)	
5	2410-65210	Resistor, 0.5 OHM, 300 WATT, ADJUSTABLE	1
	2410-65211	Resistor, 1.5 OHM, 300 WATT, ADJUSTABLE	
	2410-65212	Resistor, 2.5 OHM, 300 WATT, ADJUSTABLE	
	2410-65213	Resistor, 8 OHM, 300 WATT, ADJUSTABLE	
	2410-65247	Resistor, 12 OHM, 300 WATT, ADJUSTABLE	
	2410-65248	Resistor, 50 OHM, 300 WATT, ADJUSTABLE	
6	3600-01931	Label, Push to Read AMPS	1
7	2900-03192	Plug, Bumper	1
8	2900-01947	Grommet, Rubber, 1/4" x 1/8"	5
9	4400-02284	CP Meter Adjust Assy	1
10	1600-01851	Weather Stripping, 3/8" x 1/8" THK	39
11	2514-00258	Screw, mach, P-H-P, 1/4 x 20 x 5/8, SS	4
12	2814-00473	Washer, Lock, ext, 1/4, SS	8
13	2714-00611	Nut, Hex, 1/4-20, SS	8
14	2708-00606	Nut, Hex, 8-32, SS	3
15	2010-00208	Term, Ring, Yellow, #10	3
16	2010-00201	Term, Ring, Yellow, 1/4	3
17	2010-00202	Term, Ring, Red, 1/4	1
18	2010-00213	Term, Ring, Red, #6	1
19	2810-00569	Washer, Flat, 0.203 ID, 0.049 THK	2
20	2400-00086	Mounting Hardware, 300 W Resistor	1
21	2110-00156	Wire, #10, wht/blk, TIN-PLT-COP	35
22	2110-00156	Wire, #10, wht/blk, TIN-PLT-COP	8.5
23	2110-02041	Wire, #10, brn, TIN-PLT-COP11	
24	2110-00157	Wire, #10, wht/red, TIN-PLT-COP	24
25	2110-00157	Wire, #10, wht/red, TIN-PLT-COP	8
26	2110-00157	Wire, #10, wht/red, TIN-PLT-COP	4.25
27	2120-00133	Wire, #10, red, TIN-PLT-COP	11
28	4900-02134	Meter Panel, CP, Brushed	1
29	2420-06226	Meter, GE/TCA, 251-324-ECXS	1
30	2510-00255	Screw, Mach, P-H-P, 10-32 x 3/8, SS	2
31	2510-00256	Screw, Mach, P-H-P, 10-32 x 1/2, SS	6

Figure 38 Parts Table (Cont.)

Item	Part No.	Description	QTY
32	2510-25071	Screw, Mach, P-H-P, 10-32 x 1/4, SS	6
33	2810-00469	Washer, Lock Spring, #8, SS	6
34	2810-00539	Washer, Lock, Spring, #10, CAD	2
35	2508-00254	Screw, Mack, P-H-P, 8-32 x 3/8, SS	7
36	2808-00468	Washer, Lock, Int, #8, SS	10
37	3600-04795	Label, Cathodic Protection Interface	1
38	Part of Item 29	Button, Red, 61F-675, For ALCO Switch	11

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 39.

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 40, Item G37.

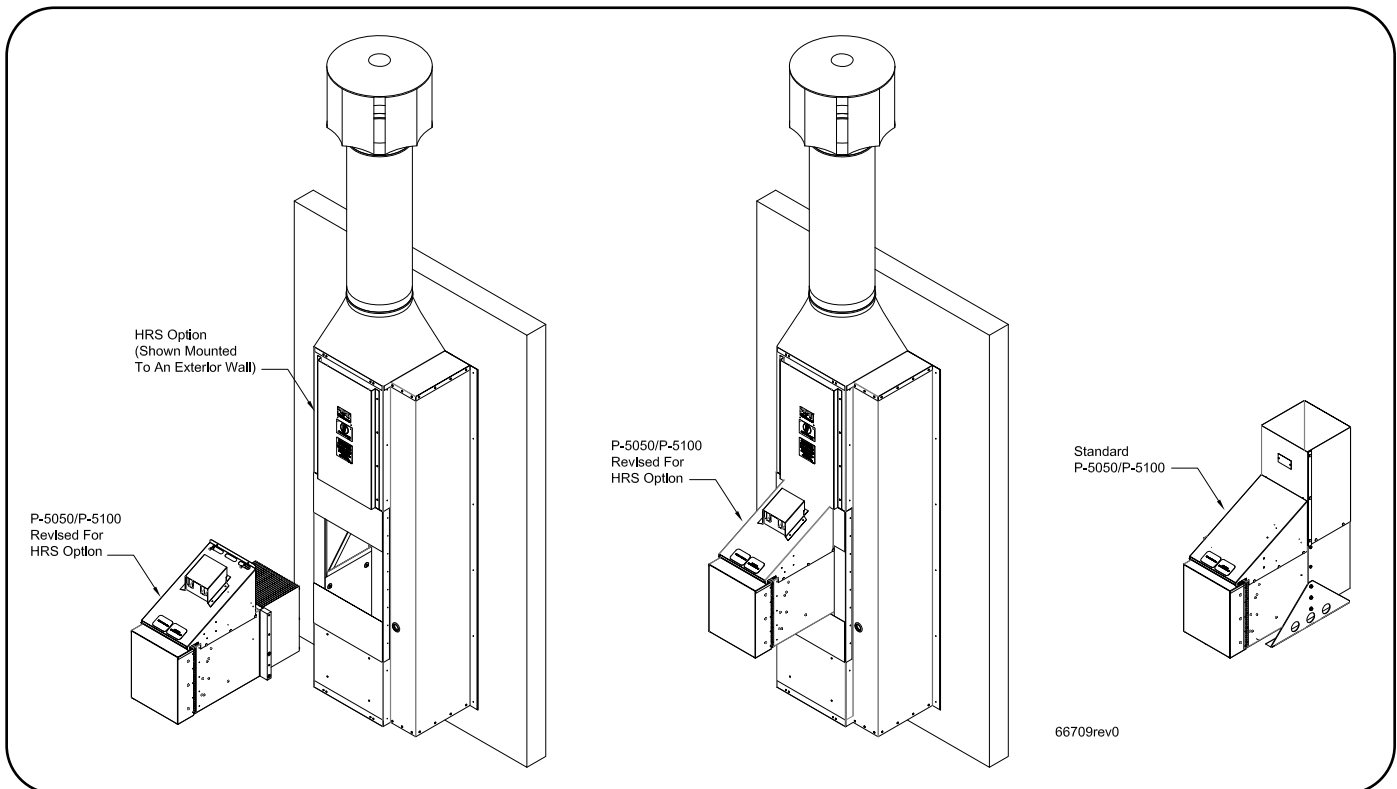


Figure 39 HRS Option Overview.

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 3900-66683 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-5050 HRS Configuration Parts

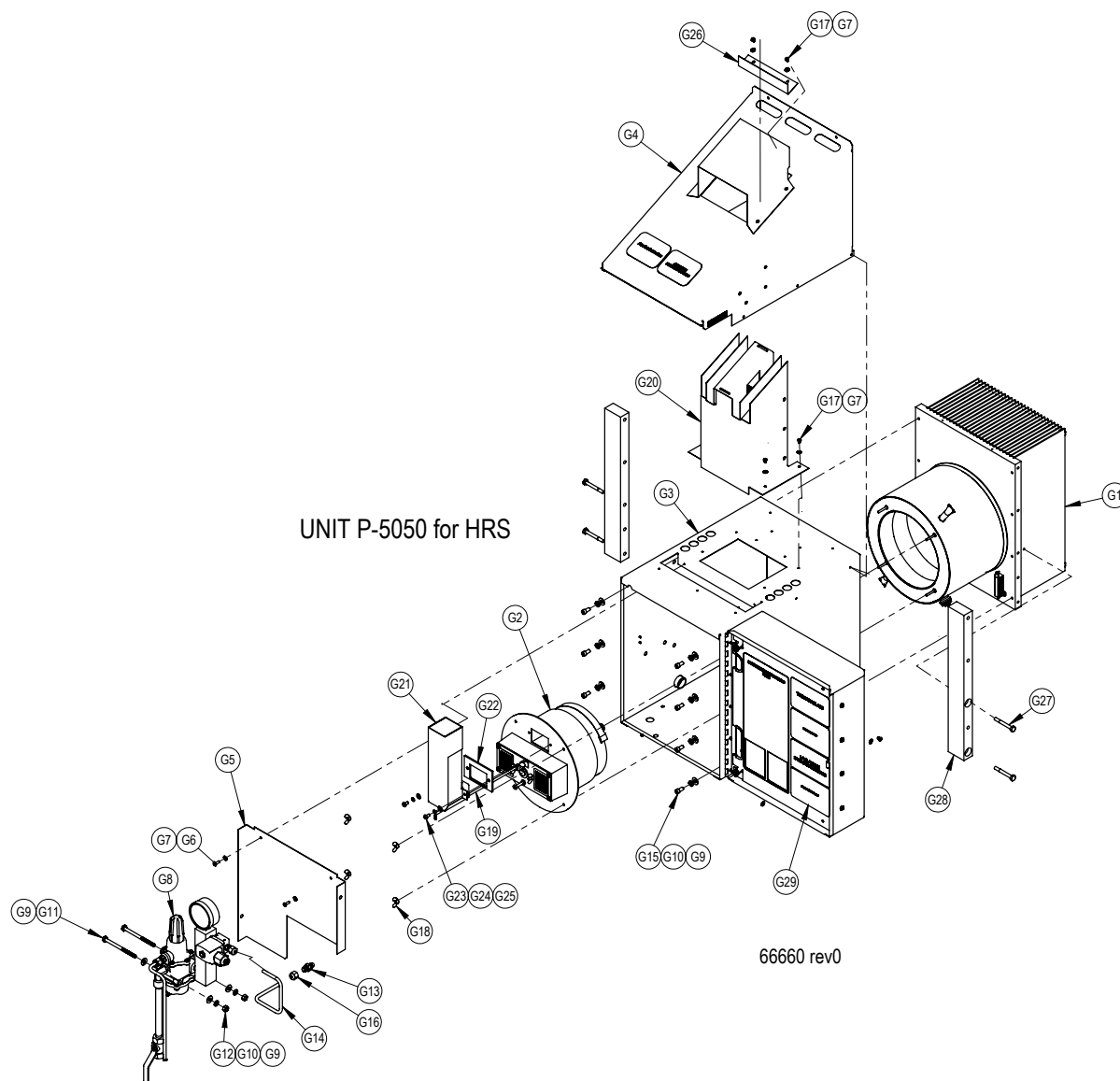
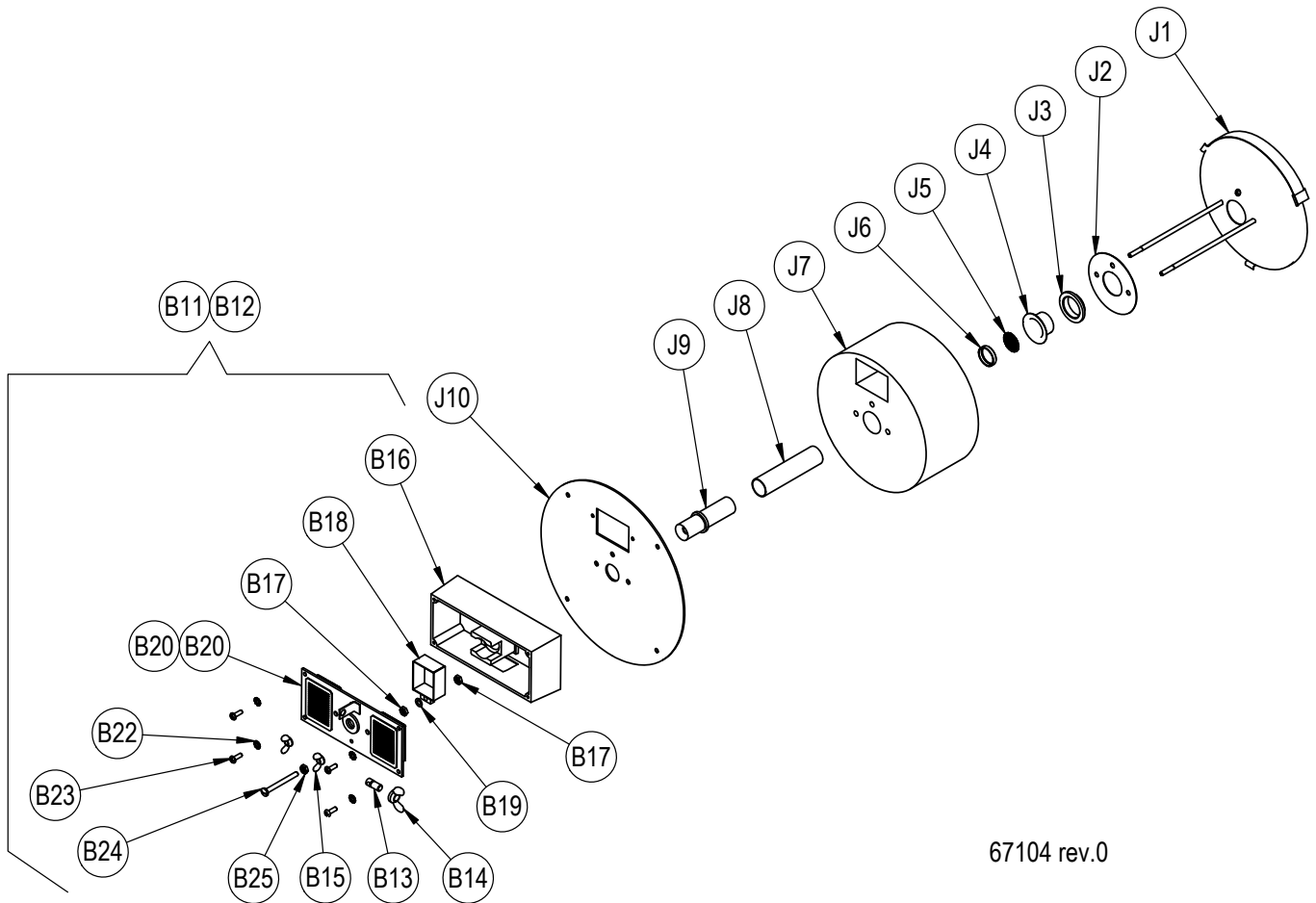


Figure 40 Model P-5050 HRS Configuration

Item	Part No.	Description
G1		See Fig 30
G2	6100-66654	BURNER ASSEMBLY, W/INTAKE ARRESTOR, HRS, P-5050
OR	6100-61564	BURNER ASSEMBLY, W/INTAKE ARRESTOR, P-5050
G3		See Fig 30
G4	4900-65697	RAIN CAP ASSEMBLY, HRS, P-5050/5100
G5 - G16		See Fig 30
G17	2508-07410	SCREW, MACH, P-H-P, 8-32X1/4, SS
G18		See Fig 30
G19	3600-62570	ELECTRODE ASSY, FLAME SENSING SI
OR	4900-58496	ELECTRODE ASSY, SI, 5220
G20 - G25		See Fig 30
G26	4900-65709	RAIN DEFLECTOR, HRS, P-5050/P-5100
G27	2514-65724	SCREW, HEX HD, 1/4-20 X 2, SS
G28	3600-62131	MOUNTING BAR, HRS, P-5050/P-5100

13.5 Model P-5050 HRS Burner Parts



67104 rev.0

Figure 41 Model P-5050 HRS, Burner

Item	Part No.	Description
J1	4000-62117	BURNER BACK ASSY, P-5050/P-5100
J2-J6		See Fig 31.
J7	4000-66630	INSULATION BLOCK, TOP ELECTRODE, P-5050/P-5100
J8-J9		See Fig 31.
J10	4000-66631	BURNER COVER, TOP ELECTRODE, P-5050/P-5100
J11	4500-66635	AIR BOX ASSY, TOP ELECTRODE, P-5050/P-5100
J12-J17		See Fig 31.
J18	4900-66632	LID W/ ARRESTORS, ASSEMBLY, TOP ELECTRODE P-5050/P-5100
J19-J23		See Fig 31.

14 TEG PERFORMANCE LOG

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

DATE	TIME	AMBIENT TEMP °C	REQUIRED POWER (W)	REQUIRED V _{SET} (V)	MEASURED V _{SET} (V)	MEASURED POWER (W)	FUEL PRESSURE	OPEN CIRCUIT VOLTAGE (V)		MAINTENANCE REMARK

14 TEG PERFORMANCE LOG

MODEL NO:

TEG SERIAL NO:

FUEL TYPE:

LIMITER/CONVERTER SERIAL NO:

CP INTERFACE SERIAL NO:

DATE	TIME	AMBIENT TEMP °C	REQUIRED POWER (W)	REQUIRED V_{SET} (V)	MEASURED V_{SET} (V)	MEASURED POWER (W)	FUEL PRESSURE	OPEN CIRCUIT VOLTAGE (V)	MAINTENANCE REMARK

14 TEG PERFORMANCE LOG

MODEL NO:

TEG SERIAL NO:

FUEL TYPE:

LIMITER/CONVERTER SERIAL NO:

CP INTERFACE SERIAL NO:

DATE	TIME	AMBIENT TEMP °C	REQUIRED POWER (W)	REQUIRED V _{SET} (V)	MEASURED V _{SET} (V)	MEASURED POWER (W)	FUEL PRESSURE	OPEN CIRCUIT VOLTAGE (V)		MAINTENANCE REMARK

