GLOBAL
power technologies

5030
THERMOELECTRIC GENERATOR

Operating Manual

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1 GENERAL INFORMATION

1.1 Introduction

The 5030 is a highly reliable, low maintenance power source that converts heat directly into electricity without any moving parts.

The 5030 generator uses propane (C_3H_8) or natural gas (CH_4) as a fuel and will automatically ignite whenever gas pressure is present. It generates 30 watts of DC power at 2.0 volts. The limiter converter (L/C) converts the 2.0 volts to a more useful 12 or 24 volts and maintains the voltage at an adjustable level.

Features of the 5030 include the following:

Spark Ignition (SI) The 5030 comes standard with the spark Ignition (SI) feature. This provides a spark to ignite the burner whenever fuel pressure is present. The SI uses a rechargeable lead acid battery. The battery charge is maintained by the 5030.

Automatic Shutoff (SO) The automatic shutoff includes a valve in the gas line that is held open by a thermocouple in the exhaust stream. In the event that the flame goes out the thermocouple allows the valve to close preventing the accumulation of gas vapors.

Fuel Filter When clean commercial fuel is used a fuel filter is not required but for applications where dirty fuel is a possibility an in line fuel filter is recommended.

1.2 Physical Description

Figure 1 shows the 5030 with its dimensions labeled. The overall dimensions of the 5030 are as follows:

Length	348 mm	13.7 in.
Width	356 mm	14.0 in.
Height	450 mm	17.7 in.
Weight	20 kg	44.5 lb
Shipping Weight	45 kg	102 lb
Mounting Holes	203 mm wide x 70 mm deep	8 in. wide x 2.75 in. deep

Specifications and dimensions subject to change without notice.

1.3 Definition of Terms

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

Power Unit: The hermetically sealed portion of the generator that contains the thermoelectric materials and the cooling fins.

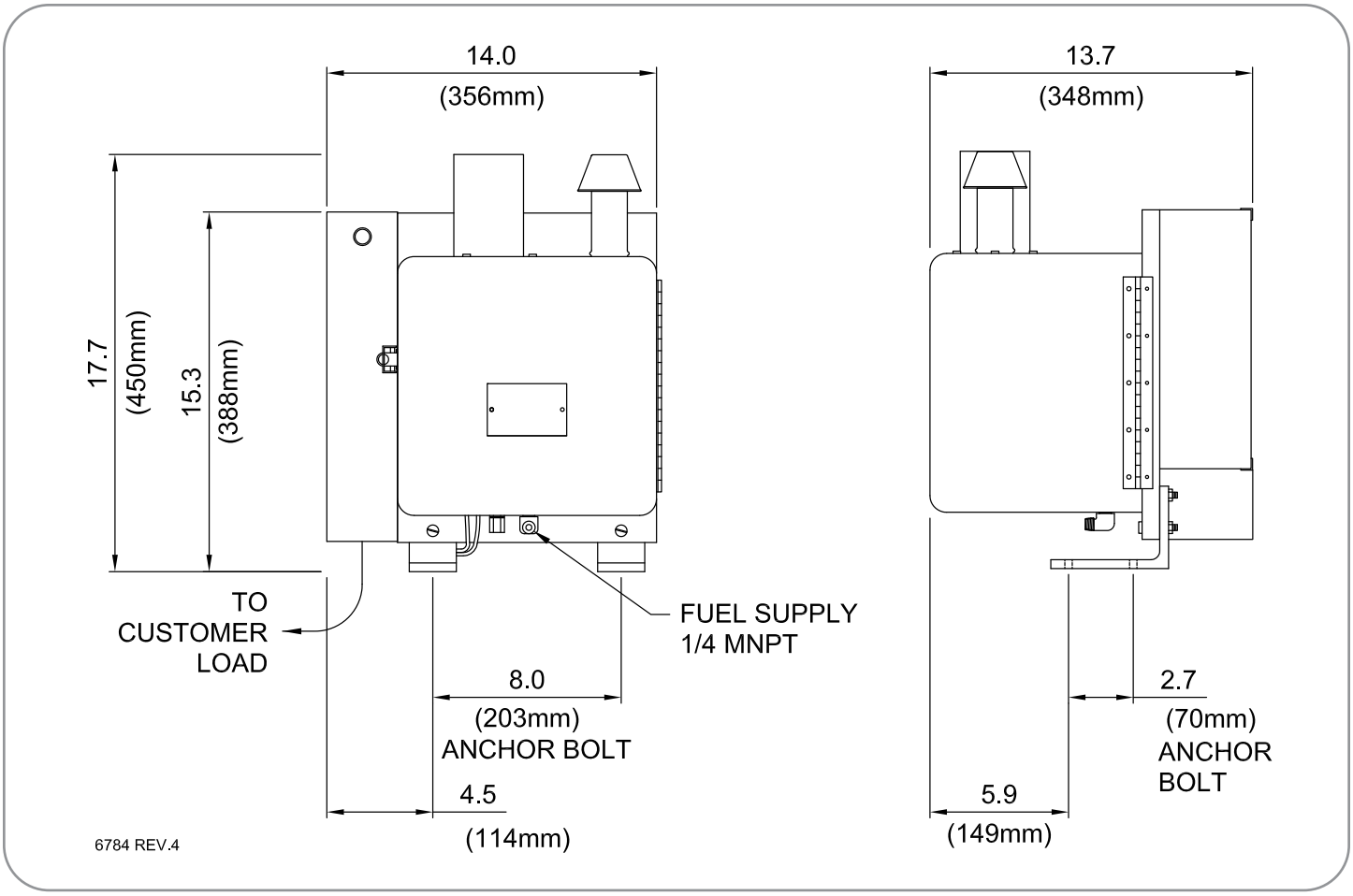


Figure 1 5030 Dimensions

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

Matched Load: A condition of load where the load voltage of the generator is one-half of the open circuit voltage and the load resistance is equal to the internal resistance of the generator.

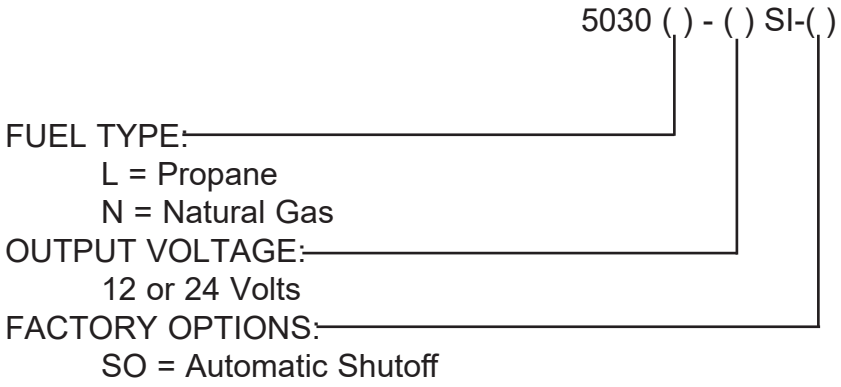
Precision load: The precision resistor contained on the generator that provides the optimum load condition. The voltage across the resistor is defined as Vset and is used to analyze generator electrical performance.

1.4 Data Plate

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

Fuel Type: An “X” will be marked in the appropriate box to indicate whether the generator is configured to burn natural gas (CH_4) or propane (C_3H_8). Suitable orifices are available if it is necessary to change the fuel type.

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



Fuel Pressure, Power, Voltage: The fuel pressure, gross power output and open circuit setup voltage have been included for reference only. These are the conditions that were achieved at the Global Power Technologies (GPT) factory prior to shipping. Note that the fuel pressure is recorded in kPa (psi) and that the pressure gauge must be adjusted for altitude as described in section 2.6.8.

1.5 Fuel Consumption

The 5030 is designed to operate on commercial propane (C_3H_8) or clean dry natural gas (CH_4) with an un-fluctuating heating value of not less than 28 megajoules/m^3 (750 BTU/ft^3). (See Appendix 1, Gas Specifications.) While the use of sweet line or well head gas is common, fluctuating heating values or condensates may damage the generator. This may invalidate the warranty.

The fuel consumption of the 5030 at rated power is listed in the table below for various fuels.

Fuel Consumption at Rated Power	Propane (C_3H_8)	Natural Gas[c] (CH_4)
lb/hr[a]	0.14	-
gal/day[a]	0.8	-
kg/day[a]	1.5	-
L/day[a]	3.0	-
ft^3/day[b]	28.4	74.4
m^3/day[b]	0.8	2.1

NOTES:

a. Fuel consumption of liquid propane is assuming measurement of the fuel at 15ºC (60ºF).

b. Fuel consumption of gases, in ft^3/hr and m^3/hr are at atmospheric pressure and 15ºC (60ºF).

c. Natural gas is assumed to have an energy content of 37.3 GJ/m^3 or 1000 BTU/ft^3.

1.6 Fuel Considerations

Clean Fuel The fuel used to operate the GPT model 5030 must be clean. See the gas specification in section 4.1. If dirty fuel is anticipated then a customer supplied in line fuel filter is recommended.

Low Temperatures When using propane (C_3H_8) at temperatures below -35ºC (-30ºF) special consideration must be given to vaporization of the fuel.

Supply Pressure A minimum gas supply pressure of 105 kPa (15 psi) must be supplied to the regulator inlet of the generator. A maximum of 172 kPa (25 psi), the rating of the pressure regulator, is allowed.

2 OPERATION

2.1 Assembly

The 5030 is packaged ready to operate requiring minor assembly. No special tools are required beyond standard screwdrivers and wrenches. Four 1/4 inch bolts are required to fit through the platform onto which the 5030 is to be mounted. The fuel connection is made to the male 1/4 MNPT fitting provided.

2.1.1 The 5030 can be mounted on any stand with four 5/16” holes spaced 203 mm (8.00 in.) wide X 70 mm (2.75 inch) deep. The stand should be sturdy enough to keep the 20 kg (44.5 lb) 5030 stable in the environmental conditions that may be expected and allow a minimum of 15 cm (6 inch) clearance under the cooling fins. The stand requires four 1/4” bolts long enough to fit through the mounting plates. Set the generator on the stand so that the holes line up and insert and tighten the bolts.

2.1.2 Connect the fuel supply to the TEG fuel inlet (1/4 MNPT) using proper procedures and thread sealant. Please note that all fuel installations should be done in accordance with local regulations.

2.1.3 Check all gas connections for leaks with a commercial leak detector fluid such as Snoop.

2.2 Set Up

Before setting up the generator it must first be determined how much electrical power is required. If less than full power is required then the generator can be set up for this lower power level resulting in some savings in fuel consumption. **To ensure reliable combustion the 5030 should not be set for less than 20 watts gross output.** If the generator is producing more electrical power than is being used then the excess power will be disposed of within the converter limiter. To set up the generator a voltmeter capable of reading to at least two decimal places will be required. A meter capable of reading to three decimal places is preferred.

2.3 Wiring

All electrical connections to the 5030 are made at a seven position terminal strip located inside the converter limiter at the bottom of the circuit board as shown in Figure 2. Figure 3 shows the wiring of the 5030. The 5030 is shipped with the power unit connected to the converter limiter and electrical power is available at terminals 1 & 2. To disconnect the power unit from the converter limiter, remove the cover and disconnect the TEG(-) lead from the common terminal post. The TEG(+) lead is connected to the VIN+ terminal post. The open circuit voltage can now be read from the negative and positive leads.

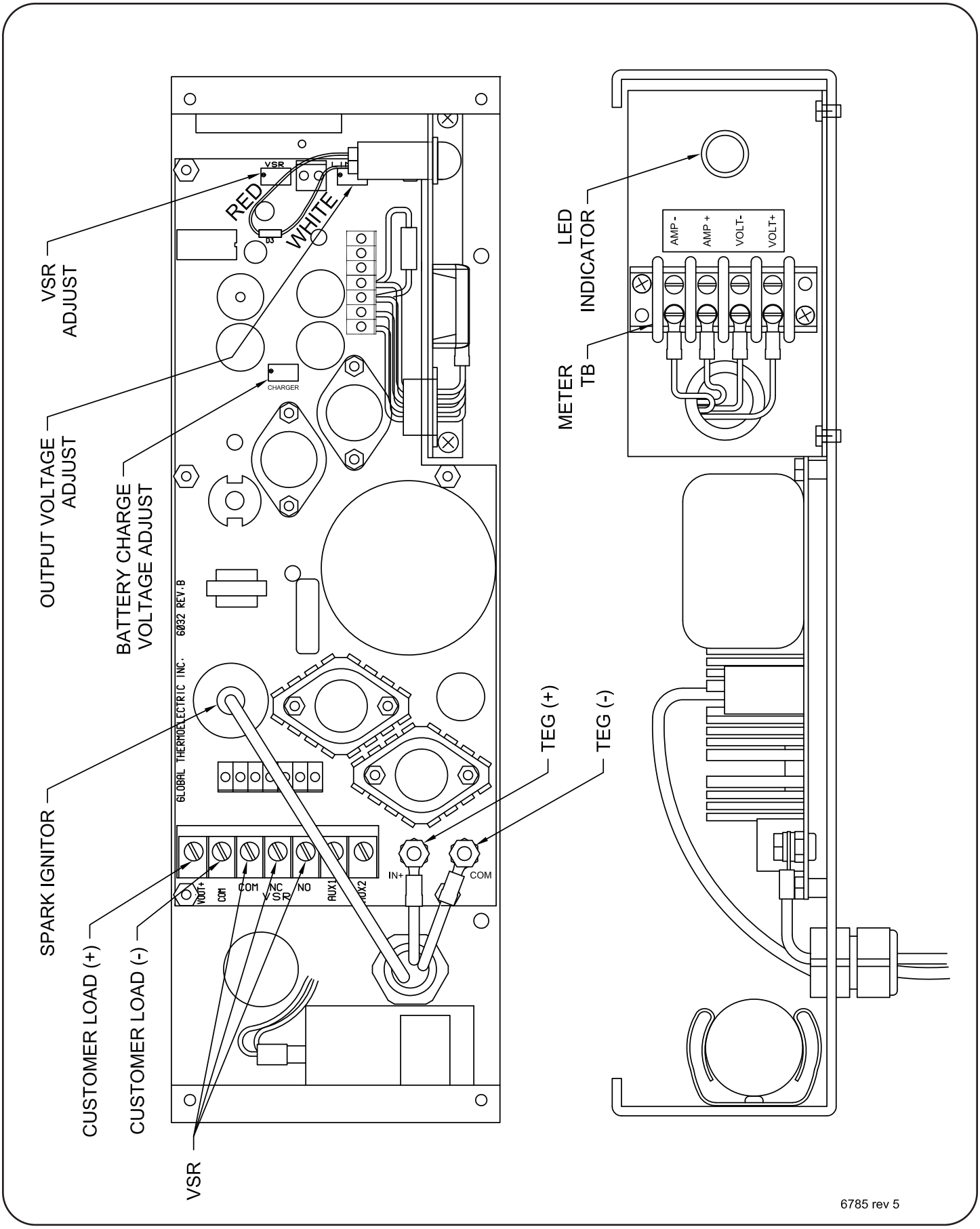


Figure 2 Wiring Details

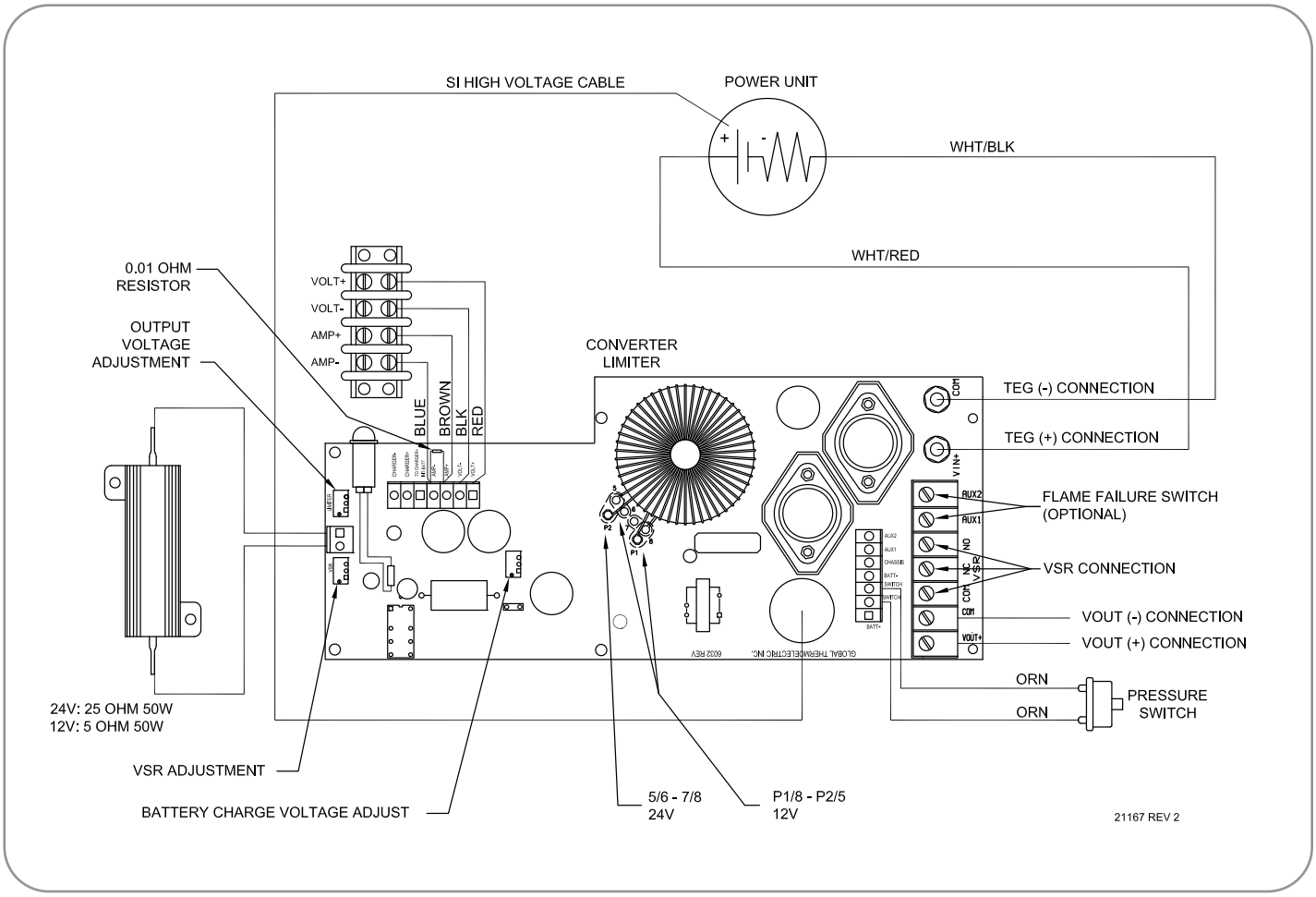


Figure 3 Wiring Diagram, 5030 TEG

2.4 Electrical Properties

The electrical properties of the 5030 generator are very dependent on the resistance of the load to which it is connected. Maximum power is generated at a load of 0.11 ohms. This is called matched load. The converter limiter included with the generator is designed to always present a load of 0.11 ohms to the generator. If for any reason this converter limiter is not used then consideration must be given to the resistance of the load used.

The converter limiter included with the 5030 can trigger alarms or other processes in the event of a low voltage. Low voltages can be caused by overloads, lack of fuel or a faulty generator. This detection is achieved by a Voltage Sensing Relay (VSR). The use of the voltage sensing relay is described in the 30 WATT CONVERTER LIMITER manual.

TEG Operating Normally LED Indicator works in conjunction with the voltage sensing relay and turns on providing a visual indication when the output voltage is above the preset minimum. Note that during the open circuit voltage test, this green LED remains off as the power unit has been disconnected from the power electronics unit.

2.5 Ambient Temperature and Rated Power

The power output from the 5030 will be slightly affected by the ambient temperature (the air temperature) around the generator.

The rated power is the power that the 5030 should produce at a specific ambient temperature. The 5030 is rated at 30 watts gross power when operating at an ambient temperature of 24ºC (75ºF). As the ambient temperature rises, the gross power will decrease, and as the ambient temperature decreases, the gross power will increase.

2.6 Start Up

2.6.1 With the fuel pressure turned off, record the ambient temperature, the rated V_{oc} (as noted on data plate located on inside of cover) on the “PERFORMANCE LOG”, provided at the back of this manual.

2.6.2 Referring to Figure 2, disconnect the TEG(-) lead from the terminal post. Connect a voltmeter capable of reading to at least two decimal places to the TEG(-) and TEG(+) leads.

2.6.3 Make sure that all of the connections in the fuel system are still tight, checking for leaks with a commercial leak check fluid.

WARNING: Do not test for fuel leaks with a match or any open flame.

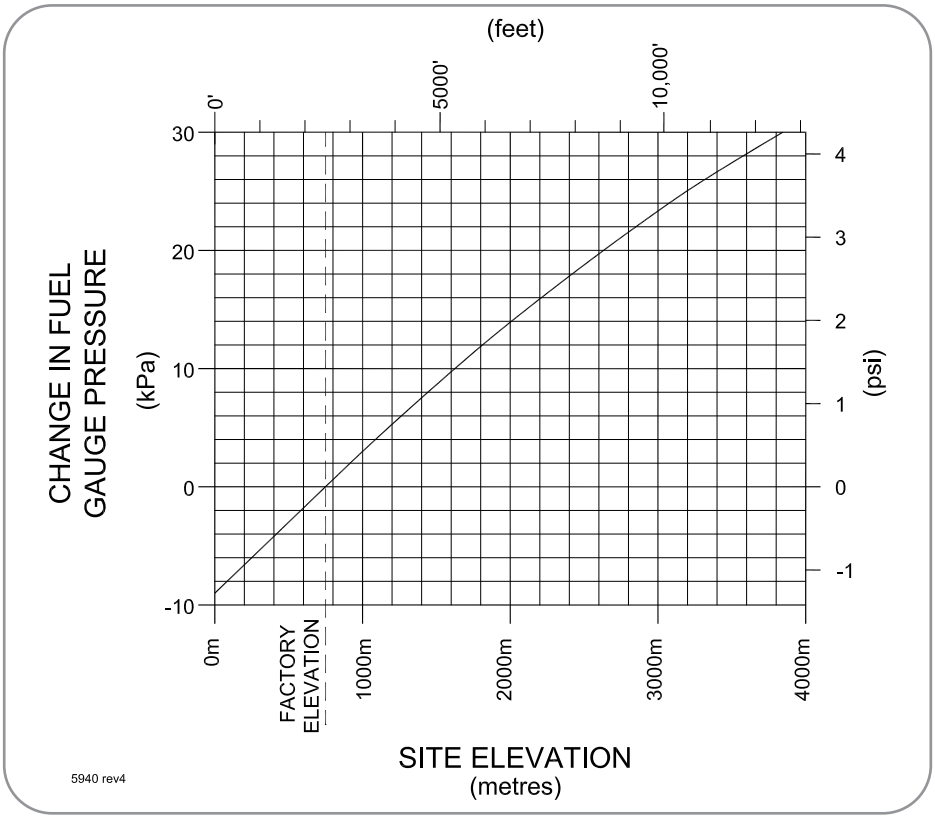


Figure 4 Altitude adjustments

2.6.4 Ensure that the spark ignitor contact wires are connected to the pressure switch (C8, Figure 7). Loosen the ignitor rod wing nut and push the ignitor rod (A8, Figure 5) in until it touches the power unit and then pull it out about 5 mm (1/4 inch). Test the spark ignitor by shorting the contacts on the pressure switch and listen for the sound of the spark.

2.6.5 Confirm that the regulator inlet pressure is between 105 kPa (15 psi) and 172 kPa (25 psi).

2.6.6 Turn on the gas pressure and then fully push in the button on the shutoff valve (C11, Figure 7) to supply pressure to the pressure valve and gauge. The spark ignitor should begin clicking and the sound of combustion should begin. In some cases it is necessary to allow the fuel line to bleed out all of the air. Hold the button down for about one minute after combustion begins and then release. If the sound of combustion quits then push the button down again until combustion is sustained.

NOTE: It is necessary to push the button firmly before releasing it.

2.6.7 Check that the gas pressure is still close to where it was set at the factory. This pressure is marked on the front cabinet (see section 1.4). The pressure gauge reading will vary with altitude due to changes in atmospheric pressure and so it may be necessary to correct the factory reading for altitude. Figure 4 shows the correction for variation from the factory altitude of 750 m (2460 ft). If the fuel pressure reading differs from the value shown on the cabinet and after correcting for altitude then adjust it to be close to the indicated pressure or slightly lower.

2.6.8 After ignition of the burner, record the time on the Performance Log, at the back of this manual. The voltage will begin to rise and at no time should this voltage exceed 4.0 volts.

WARNING: Should these values ever exceed these limits then overheating may cause irreparable damage to the power unit invalidating the warranty.

2.6.9 After ignition, allow the temperature of the generator to stabilize for one hour and then record the V_{oc} voltage in the Performance Log.

CAUTION: When the TEG is operating, surface temperatures in the vicinity of the thermopile, burner, exhaust stack and around the cooling fins may be in excess of 100ºC. Avoid contact of skin and clothing with these areas when operating in and around the TEG.

2.6.10 At this point it may be necessary to adjust the air shutter for optimum combustion. The burner should be stable, with the V_{oc} voltage reading very constant. Loosen the locking nut and turn the air adjusting screw 1/2 turn clockwise. This will increase the amount of air in the air/fuel mixture. Allow the generator to stabilize for about 15 minutes. If the voltage increased during this time proceed to section 2.6.12. If the voltage decreased during this time this indicates an air rich condition, and the air shutter should be returned to the original position until the voltage begins to rise again. Now turn the air adjusting screw 1/2 turn counterclockwise. Allow the generator to stabilize for about 15 minutes. If the voltage increased during this time proceed to section 2.6.12.

NOTE: If the voltage meter used is only capable of reading 2 decimal places then it may take a few minutes to see a change in voltage.

If both actions resulted in a drop in voltage then the original position was already close to optimum and the air adjusting screw should be tightened in that position and proceed to section 2.6.13.

2.6.11 After the voltage has stabilized, continue to open or close the air shutter (depending on which direction caused a rise in voltage) until the point resulting in maximum voltage is found. The generator should be allowed to stabilize for 15 minutes between each adjustment.

2.6.12 After the air shutter is adjusted, then adjust the fuel up or down until rated V_{oc} is achieved. The fuel should be adjusted in 1.4 kpa (0.2 psi) increments allowing the generator to stabilize for 15 minutes between adjustments. After the regulator is adjusted re-tighten the lock nut.

2.6.13 Once V_{oc} is obtained then:

Reconnect the TEG(-) lead to the terminal post.
Connect the voltmeter to the output terminals 1 & 2 marked customer load. See Figure 2. This voltage should read 10 to 18 volts for the 12 volt option or 22 to 30 volts for the 24 volt option.

The converter limiter has been factory set at 14.1 volts or 27.0 volts respectively but can be adjusted as described in the 30 WATT CONVERTER LIMITER manual.

2.6.14 The 5030 is now ready to be connected to the load. Connect the load across terminals 1 & 2.

Once the load is connected and the TEG is started and allowed to warm up, use a voltmeter to measure the voltage between Volt+ and Volt - on the Meter TB (terminal block). Record this result. Now measure the voltage between Amp+ and Amp- on the Meter TB and record this result. The power being delivered to the load can be calculated as follows:

Power = Volt reading * Amp reading (in volts) divided by 0.01

ie Power = 14.2 * 0.015 divided by 0.01 = 21.3W

3 SERVICE

3.1 Maintenance and Repair

The 5030 Generator is designed to require a minimum amount of maintenance when using commercial fuel. Sections 3.2 and 3.3 describe the preventative maintenance required for trouble free operation. Should more than these key items require maintenance or repair a complete parts list is included.

3.2 Orifice

Part number 4200-00686 (Natural Gas) or 4200-00687 (Propane)
Check every 10,000 hours (annually)
Replace every 25,000 hours (3 years)

To check the orifice remove the flexible fuel line from the back of the burner using two 9/16" open ended wrenches. Remove the orifice and visually check it for any obstructions. When clean fuel is used (or a fuel filter) the orifice should be good for several years.

WARNING: When replacing the orifice make sure the connections are well tightened to prevent any leakage.

3.3 Battery

Part number 2400-27019
Replace every 50,000 hours (Approximately 5 years)

Replace the rechargeable "D" size lead acid battery in the limiter converter enclosure.

3.4 5030 TEG Parts List

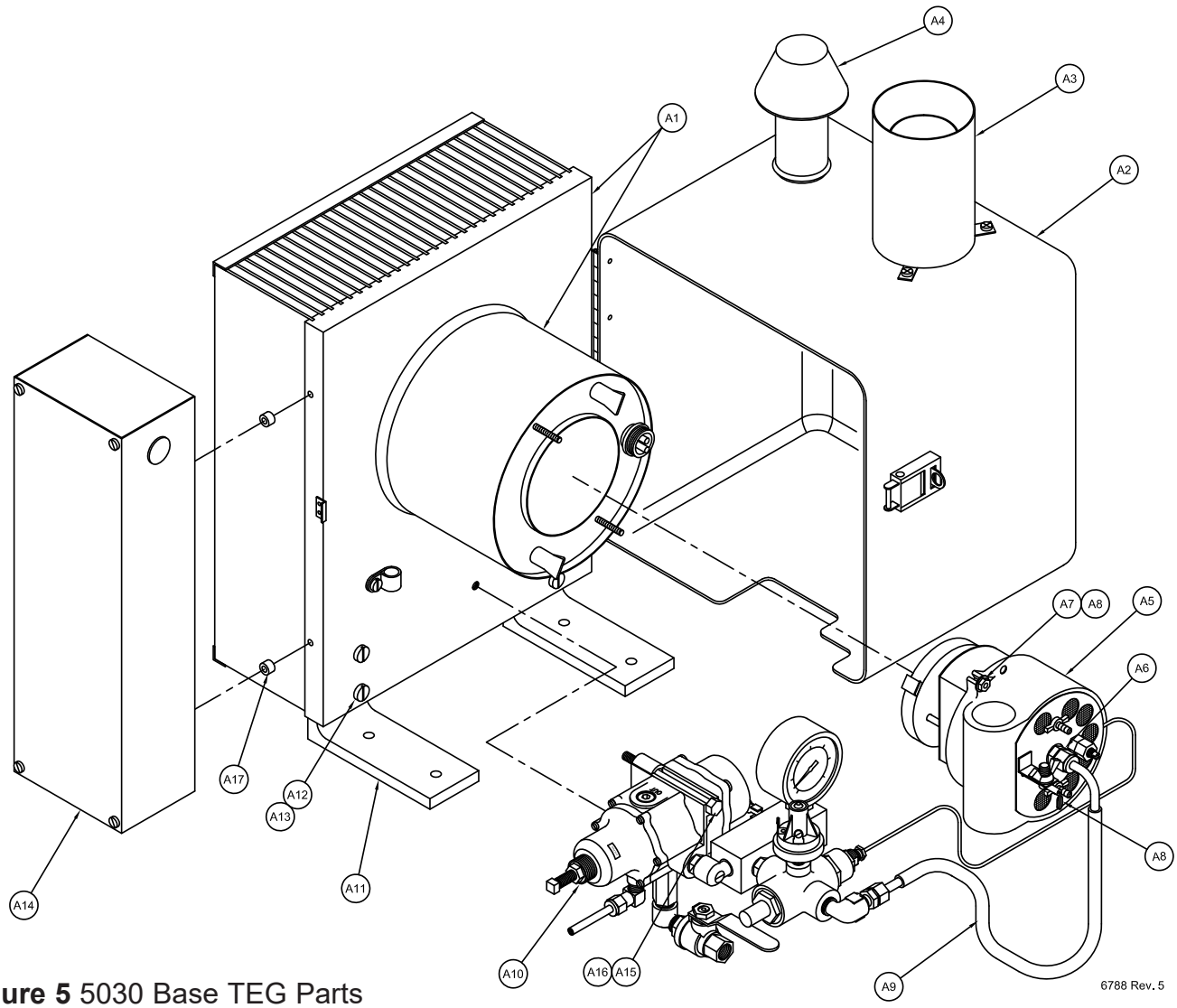


Figure 5 5030 Base TEG Parts

Item	Part #	DESCRIPTION
A1	7900-08904	Power Unit, 5030
A2	6200-06424	Cover Assy, 5030 (Includes Item A3 & A4)
A3	4500-00790	Exhaust Stack Assy, 5030
A4	4500-00755	Intake Stack Assy, 5030
A5	6100-00872	Burner Assy, 5030 (see Figure 6)
A6	4200-00687	Orifice Assy, Propane, #5, 0.0105
	4200-00686	Orifice Assy, Natural Gas, #4, 0.0145
A7	2708-00606	Nut, Hex, 8-32, SS
A8	4900-06768	Electrode, Spark Ignitor
A9	4200-23005	Fuel Line Kit, 5030
A10	6400-22381	Fuel System Assy, SI-SO, SS Option (see Figure 7)
	6400-22382	Fuel System Assy, SI-SO, SS Option

3.4 5030 TEG Parts List (cont'd)

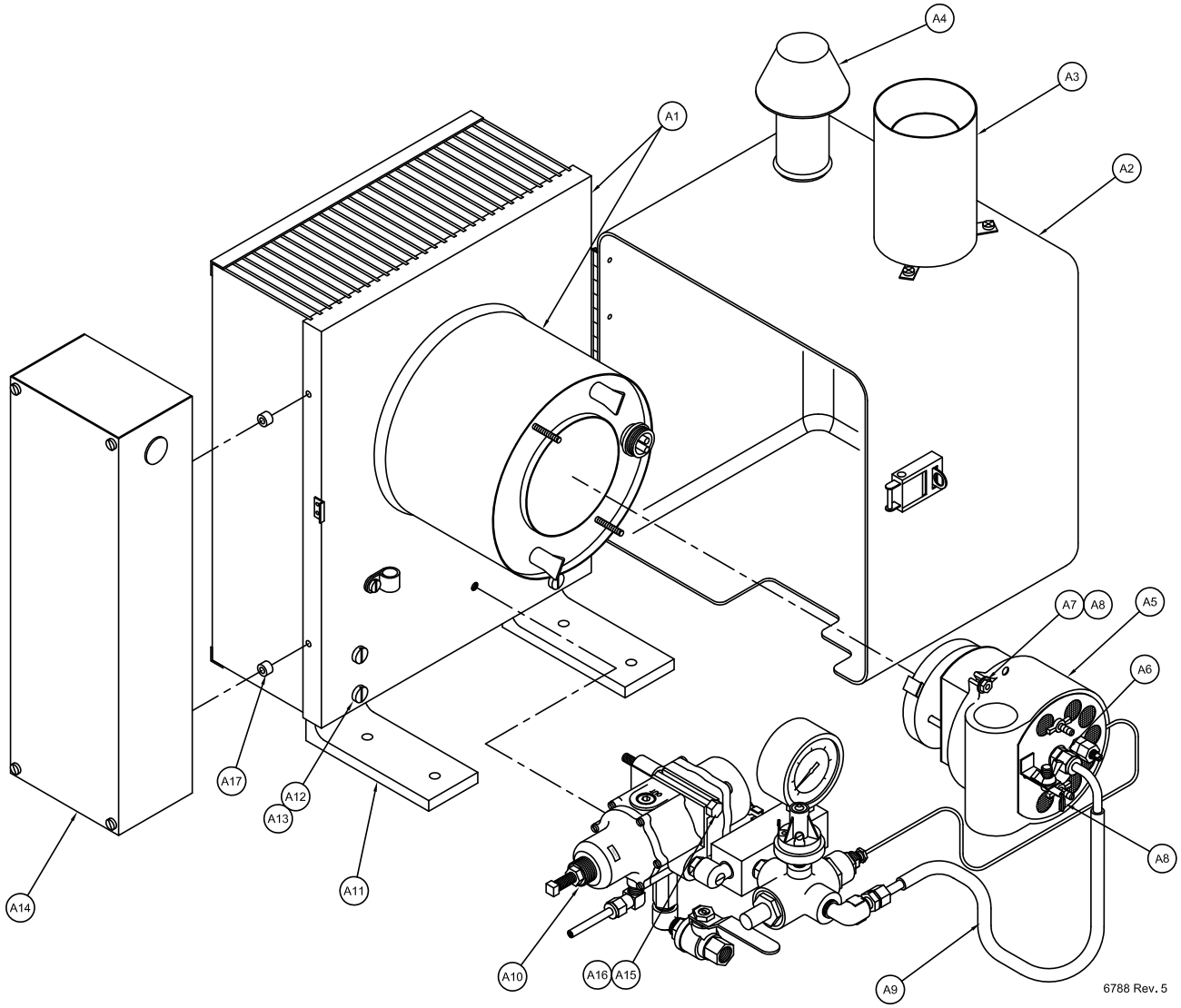


Figure 5 5030 Base TEG Parts

Item	Part #	DESCRIPTION
A11	4100-00794	Leg, 5030
A12	2514-07323	Screw, P-H-P, 1/4-20 X 1 1/2, SS
A13	2714-00611	Nut, Hex, 1/4-20, SS
A14	6300-06782	Converter Limiter, 12V
	6300-06758	Converter Limiter, 24 V
A15	2514-02105	Screw, Cap, HEX-HD, 1/4-20 X 3 1/2 LG., SS
A16	2814-00473	Washer, Lock, EXT, 1/4, SS
A17	2900-60391	SPACER, 1/4" LG, 0.192 ID X 3/8 OD, 18-8 SS

3.5 Burner Parts

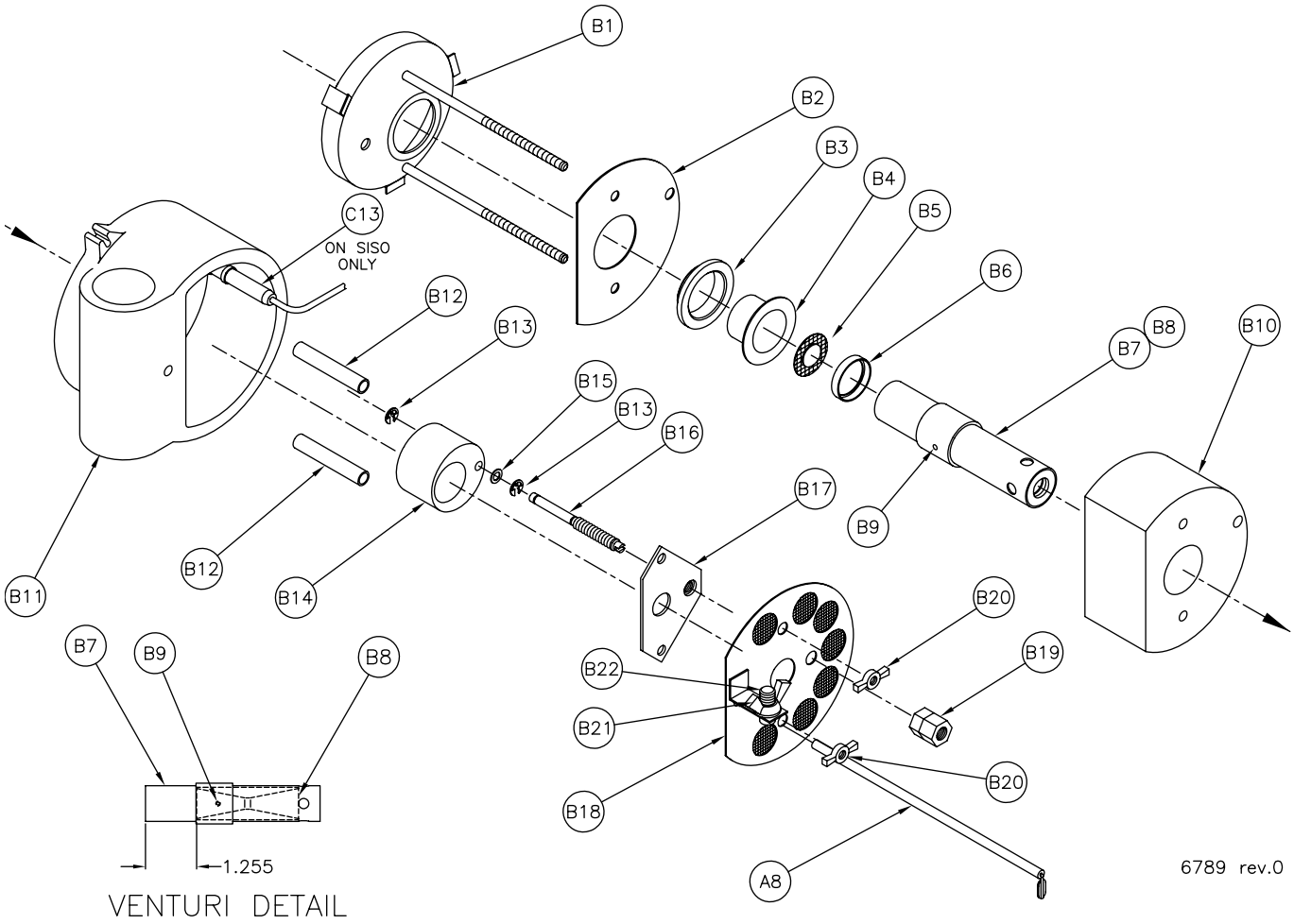


Figure 6 Burner Parts

Item	Part #	DESCRIPTION
B1	4000-07440	Burner Back Assy, 5030
B2	4000-00829	Support, Insulation Block
B3	4000-00701	Spacer, Insulation
B4	4000-00693	Screen Holder
B5	4000-01008	Burner Screen Assy, 5030
B6	4000-00694	Insert Ring, Burner
B7	4000-00864	Venturi Tube Holder, 5030
B8	4000-00863	Venturi, 5030
B9	2506-00479	Screw, Set, SOC. HD, 6-32 X 1/8, SS
B10	4000-00828	Insulation Block
B11	4000-00827	Burner Cover

3.5 Burner Parts (cont'd)

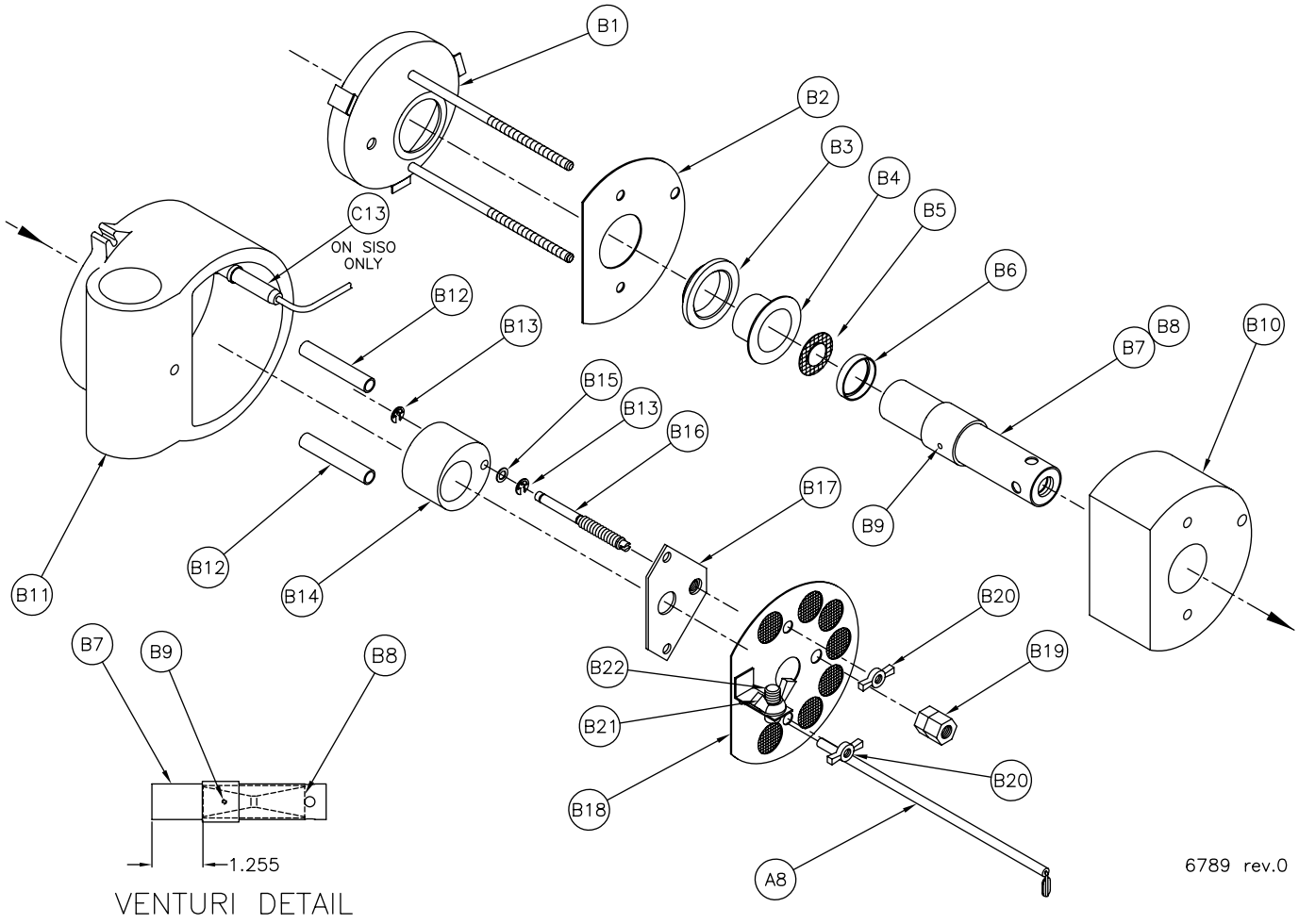


Figure 6 Burner Parts

Item	Part #	DESCRIPTION
B12	4000-01005	Spacer
B13	2900-07267	E-Ring, Bowed, SS
B14	4000-00990	Air Shutter
B15	2810-00569	Washer, Flat, #10, SS
B16	4000-00700	Venturi Adjusting Screw, 5030
B17	4000-00871	Venturi Plate Assy 5030
B18	4000-07230	Air Filter Assy, 5030
B19	4000-00758	Nut, Lock, Venturi Adjust Screw
B20	2710-00601	Nut, Wing, 10-32, SS
B21	2756-07005	Nut, Wing,5/16-18, SS
B22	4900-07004	Pin, Mounting, Electrode

3.6 Fuel System - SI-SO, Parts List

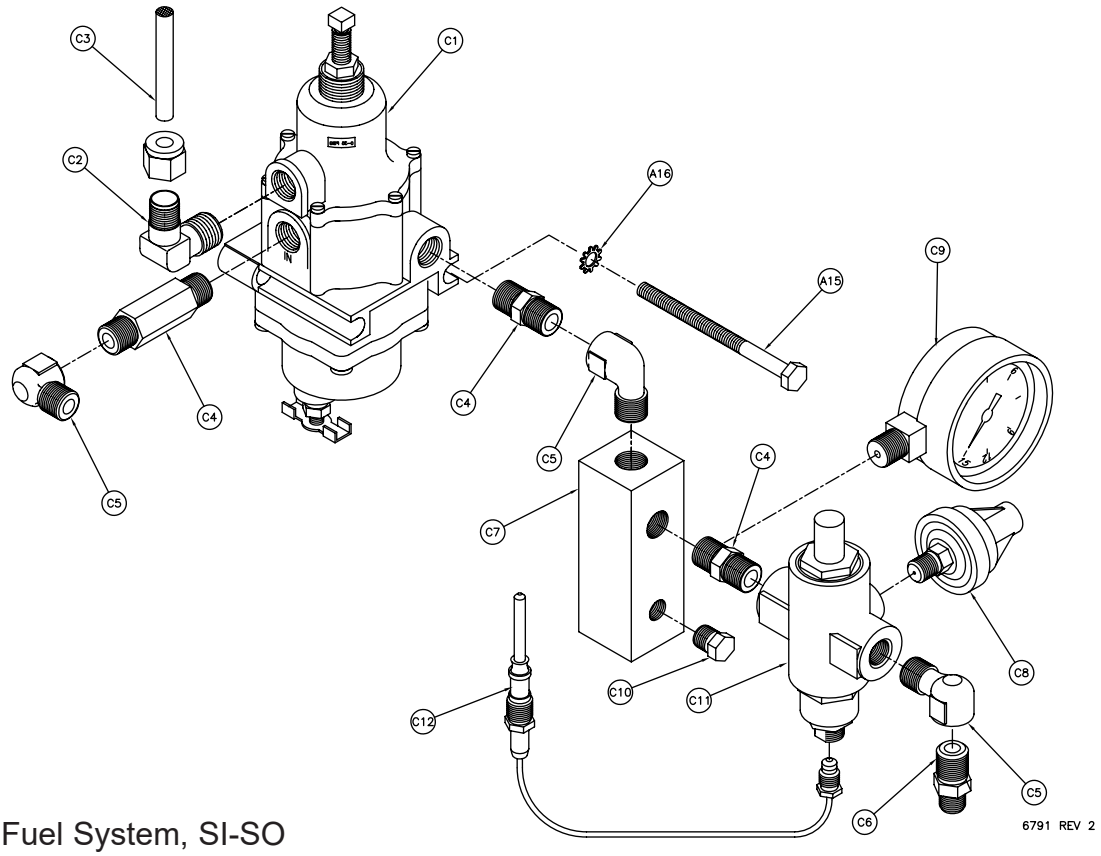


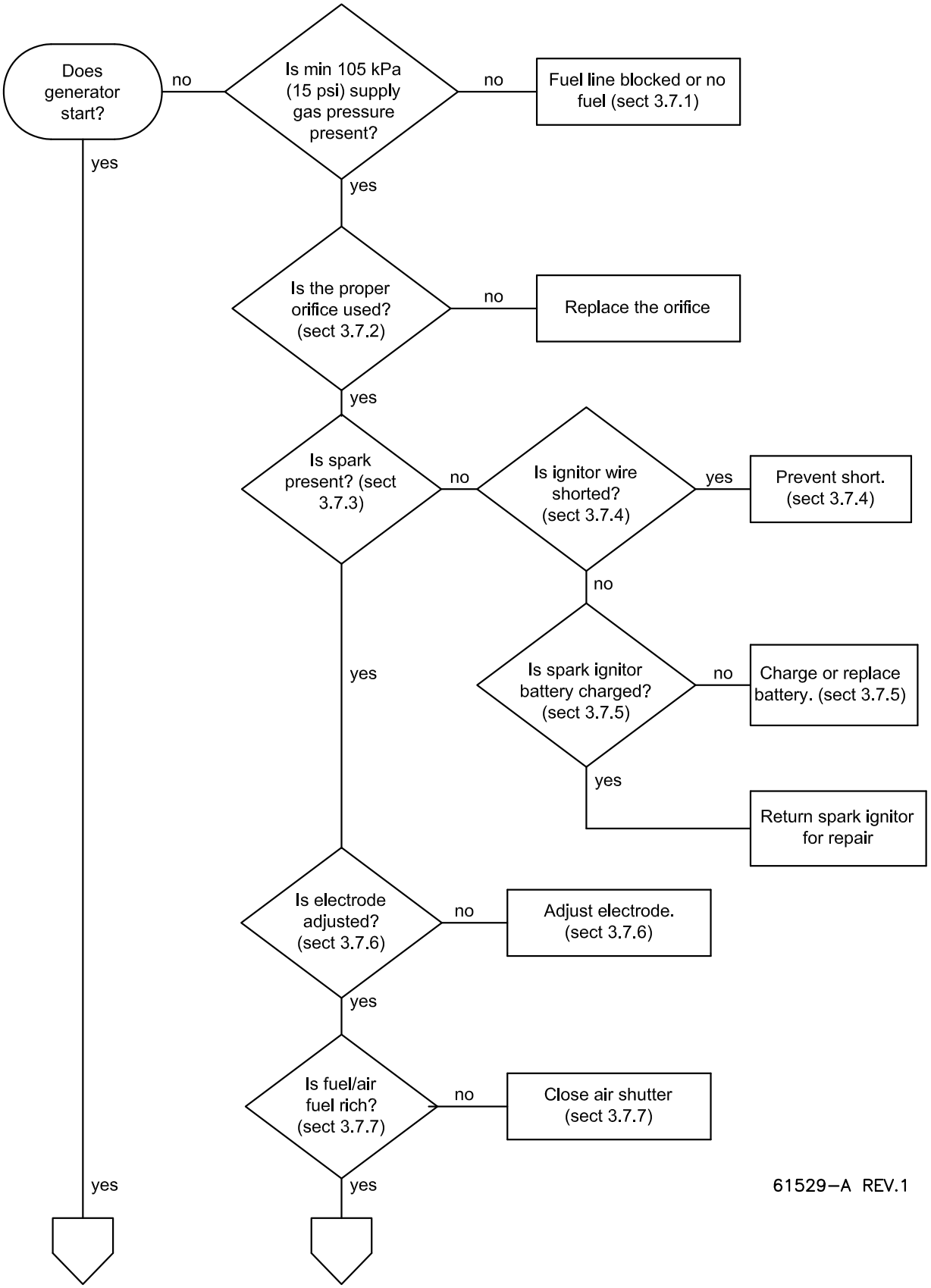
Figure 7 Fuel System, SI-SO

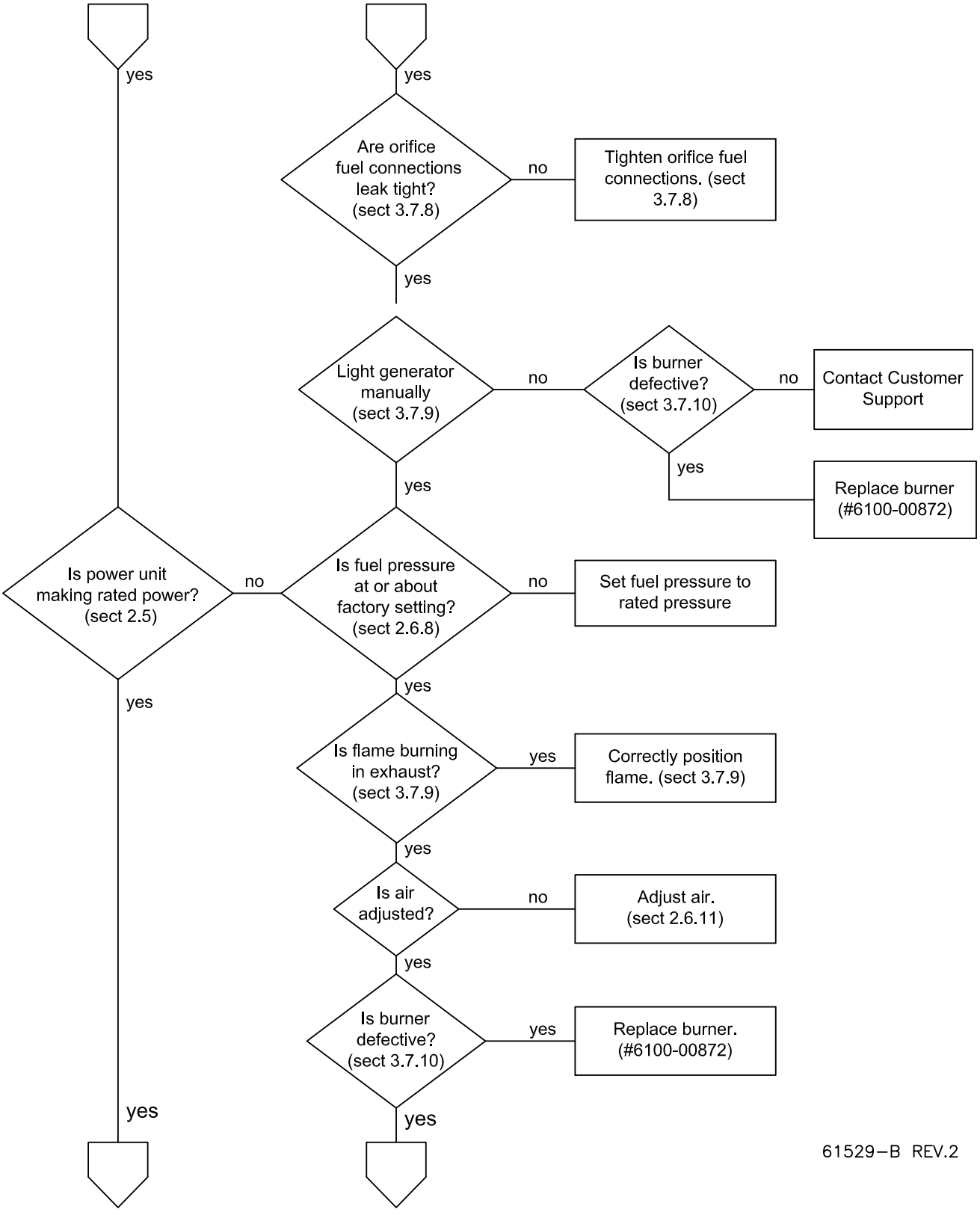
Note: Alternate parts are for Stainless version of fuel system.

Item	Part #	DESCRIPTION
C1	3100-22360	Regulator, Fisher, 67CFR, 0-20 PSI
	3100-22365	Regulator, Fisher 67CFR, 0-20 PSI, SOUR GAS
C2	3031-20071	Elbow, 1/4 TUBE X 1/4 MNPT, SS
C3	4200-20122	Vent Tube Assy, 5030
C4	3044-00501	Nipple, Hex, 1/4 NPT X 1 1/2, BRASS
	3041-02359	Nipple, Hex, 1/4 NPT X 1 1/2, SS
C5	3034-00384	Elbow, Street, 1/4 NPT, BRASS
	3031-02356	Elbow, Street, 1/4 NPT, SS
C6	3021-00380	Connector, Male, 1/4 TUBE TO 1/4 NPT, 316SS
C7	4200-02100	Manifold Block
C8	6400-06471	Pressure Switch, Hobbs 76056
C9	3200-00691	Pressure Gauge, 0-15 PSI
	3200-07289	Pressure Gauge, 0-15 PSI, SS
C10	3054-00432	Plug, HEX-HD, 1/8-27, BRASS
	3051-07290	Plug, HEX-HD, 1/8-27, SS
C11	3090-00176	Valve, Shutoff, BASCO H19T1-3
C12	3400-00177	Thermocouple, Johnson K16RA-24C (order separately)
C13	4200-22888	Fuel Filter Kit (not shown)

3.7 Troubleshooting

The following flow chart is designed to isolate problems that can occur with the generator. For further explanation of the comments refer to the appropriate section.




yes
yes
Are orifice fuel connections leak tight? (sect 3.7.8)
no
Tighten orifice fuel connections. (sect 3.7.8)
yes
Light generator manually (sect 3.7.9)
no
Is burner defective? (sect 3.7.10)
no
Contact Customer Support
yes
Replace burner (#6100-00872)
yes
Is power unit making rated power? (sect 2.5)
no
Is fuel pressure at or about factory setting? (sect 2.6.8)
no
Set fuel pressure to rated pressure
yes
yes
Is flame burning in exhaust? (sect 3.7.9)
yes
Correctly position flame. (sect 3.7.9)
yes
Is air adjusted?
no
Adjust air. (sect 2.6.11)
yes
Is burner defective? (sect 3.7.10)
yes
Replace burner. (#6100-00872)
yes
yes
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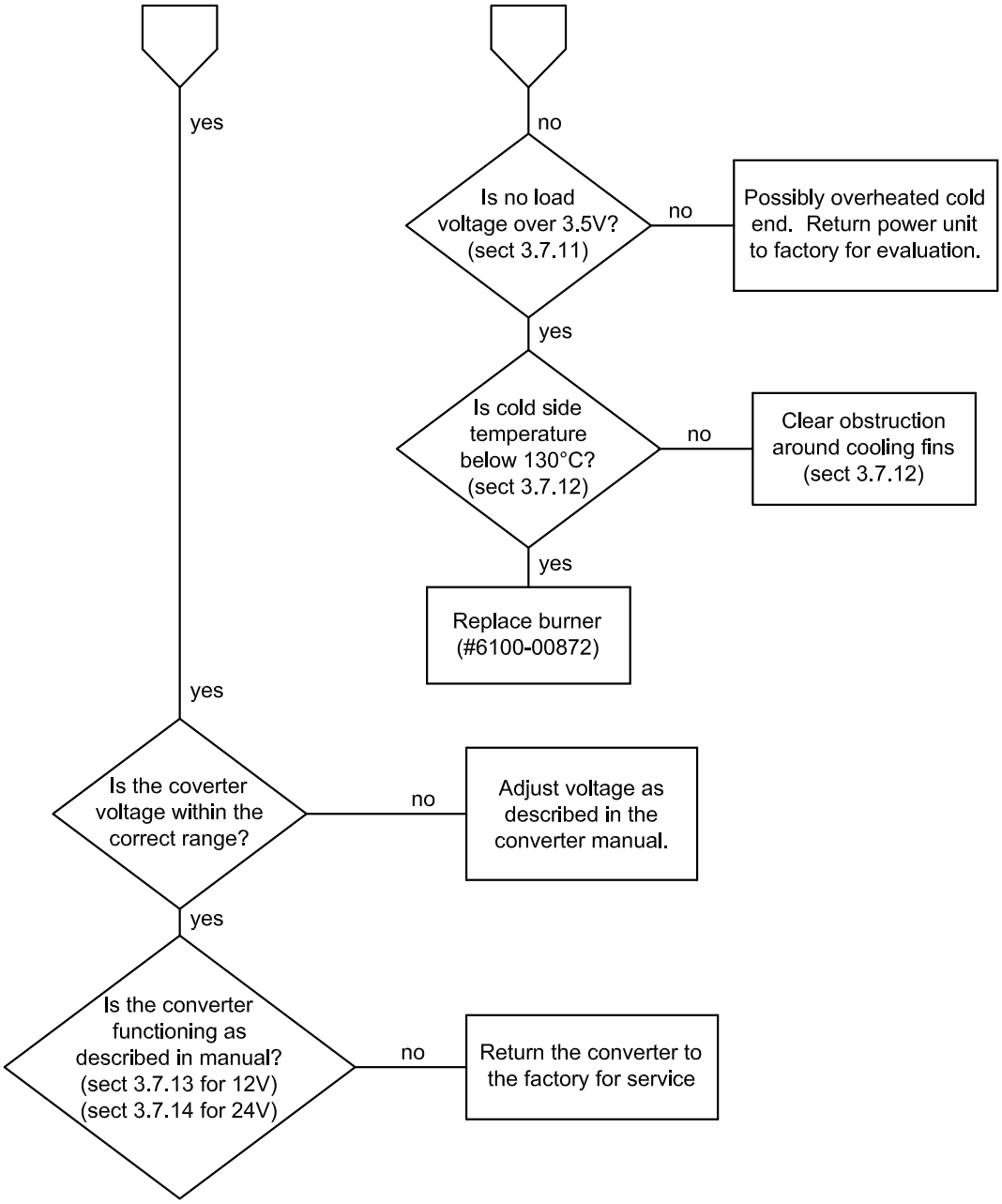
yes
no
Is no load voltage over 3.5V? (sect 3.7.11)
no
Possibly overheated cold end. Return power unit to factory for evaluation.
yes
Is cold side temperature below 130°C? (sect 3.7.12)
no
Clear obstruction around cooling fins (sect 3.7.12)
yes
Replace burner (#6100-00872)
yes
Is the coverter voltage within the correct range?
no
Adjust voltage as described in the converter manual.
yes
Is the converter functioning as described in manual? (sect 3.7.13 for 12V) (sect 3.7.14 for 24V)
no
Return the converter to the factory for service

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3.7.1 ***No Fuel:*** Ensure that all valves are open and that the fuel line is not kinked. Ensure that the fuel filter is not blocked and that the regulator is not clogged. In extreme cold temperatures (-40ºC) propane fuel has a very low vapor pressure and will fail to supply fuel without an external pressurization system. If the shutoff option is present, ensure that the shutoff valve is functioning properly. Refer to section 1.4.

3.7.2 ***Fuel Orifice:*** Verify that the proper orifice is present for the fuel used. The orifice is stamped with a number. A #4 orifice should be used with natural gas and a #5 for propane. Remove the orifice and hold it up to a light. The hole should appear clean and round. Replace the orifice if it is suspect.

3.7.3 ***Spark Ignition Check:*** Remove the high voltage spark ignition wire from the electrode and using a non-conductive instrument hold the ignitor tip approximately 1/4 inch from the metal cabinet. Using a metal object short the contacts on the pressure switch to create a spark. Sparks should occur at a rate of about 1 or 2 per second.

3.7.4 ***Shorted Ignitor Wire:*** If the sound of a spark can be heard but no spark is formed at the electrode tip then the high voltage spark wire is shorting to the cabinet. Even if no spark can be heard a short may still exist. With the pressure switch contacts closed listen and look for a spark along the length of the wire. If possible, reposition the wire away from the cabinet or position a non-conductive obstacle in between the wire and the cabinet. Strips of electrician's tape work well to isolate the wire. If the insulation is worn then the wire should be replaced. If the electrode ceramic is cracked then this is often a path for a spark to ground. Replace electrode.

3.7.5 ***Spark Ignitor Battery:*** The most common reason for a faulty spark ignitor is a dead battery. This can occur during long periods of storage, from a faulty charging circuit or if the generator is allowed to run open circuit for more than a few hours. The battery can be removed and charged at 300 milliamps or the generator can be manually ignited and allow the generator to charge the battery automatically. The converter limiter must be connected to the generator to charge the battery (TEG(-) and TEG(+) leads connected to terminal posts). If the battery does not charge while the generator is operating then either the charging circuit is faulty or the battery should be replaced. The charging circuit can be checked by measuring the voltage on the battery leads with the battery disconnected. If the measured voltage is not close to 2.3 volts try adjusting the charging voltage using the pot shown in Figure 2. If the voltage is still not 2.3 volts then the converter limiter should be returned to the factory for repair.

3.7.6 ***Electrode:*** To adjust the position of the electrode loosen the wing nut to allow the electrode to be pushed in freely. Push the electrode in until it touches the burner plate. Next pull the electrode about 5 millimeters (1/4 inch) out and re-tighten the wing nut.

3.7.7 ***Fuel/Air Mixture:*** The mixture of the fuel to the air is adjusted with the air adjustment screw protruding from the burner cover. To adjust the air shutter loosen the locking nut and turn the adjusting screw.

If the generator is having difficulty igniting it is sometimes easier to ignite in a fuel rich condition or in other words with the air shutter fully closed or almost fully closed.

3.7.8 ***Fuel Connections:*** Even though the generator was checked for leaks before leaving the factory all fuel connections should be checked for leaks before starting the generator to verify that no leaks have been formed in shipping. If a leak is present in the fuel connection between the flexible fuel line and the orifice holder on the burner cover then the leaking fuel is drawn into the air intake. Fuel leaking into the air intake can create a mixture that is so fuel rich that ignition is not possible.

3.7.9 ***Manual Ignition:*** Manual ignition of the generator is accomplished by holding a flame over the exhaust port of the generator. When this is done the flame will commonly occur in the exhaust of the burner rather than in the combustion zone where it should be. If the flame is allowed to warm the burner the flame will usually "pop" into the burner zone on its own. If this does not happen then close the air shutter and turn the fuel pressure very low. If it is possible to quickly turn the fuel supply off and on again this will sometimes cause the flame to move into the burner. If the burner still will not ignite, contact your customer service representative.

3.7.10 ***Burner:*** If no other cause for low power can be found then a visual inspection of the burner may be required. Allow the generator to cool then remove the flexible fuel line leaving the orifice in place. Disconnect the wires from the pressure switch, remove the spark ignitor electrode (A8, Figure 5) and remove the two nuts holding the burner in place (A7, Figure 5) then remove the burner. See Figure 6. Inspect the parts for any tears, holes or corrosion and replace them if they are defective. Check the venturi, if it looks corroded it should be replaced.

3.7.11 ***Open Circuit Voltage:*** The unloaded voltage from the thermopile is an indication of the temperature difference between the cold side and the hot side. At normal operating conditions the open circuit voltage should be about 4.0 volts. Values lower than 3.8 volts generally indicate that the thermopile is not hot enough and values higher than 4.0 volts generally indicate that the thermopile is too hot. NEVER ALLOW THE VOLTAGE TO EXCEED 4.0 VOLTS.

3.7.12 ***Cooling:*** The fin base temperature is measured by inserting a thermocouple between the cooling fins near the centre of the thermopile. In a 25ºC (77ºF) ambient the fin base temperature is typically 120ºC (248ºF) but it should never exceed 170ºC (338ºF). If the temperature is too high then the generator cooling fins are obstructed. Ensure that the fins are not blocked with debris or other obstructions and that at least 15 cm (6 inch) of clearance is present below and above the fins.

3.7.13 ***Converter Limiter analysis (12 VOLT):*** After V_{oc} is at the correct voltage, connect the TEG(-) lead to the terminal post and measure the power on the output of the limiter converter as follows:

3.7.13.1 Measure the output voltage between terminals 1 & 2 and ensure that it is in the 10 to 18 volt range. Adjust the voltage as described in the limiter converter manual until the output voltage is above 14.0 volts. If this can be achieved, then the converter limiter is probably fine. To actually measure the power produced proceed as follows.

3.7.13.2 Connect the output from the converter limiter across a resistor (capable of dissipating 30 watts) in the 5 to 7 ohm range. Measure the voltage across the output, and calculate the power as follows:

$$P = \frac{V^2}{R}$$

P = Power (watts)
V = Measured voltage across resistor (VDC)
R = Resistor value (ohms)

As long as the limiter converter is producing 21 watts (or 70% of rated power) then it is functioning properly.

3.7.14 **Converter Limiter Analysis (24 VOLT):** After V_{oc} is at the correct voltage, connect the TEG(-) lead to the terminal post and measure the power on the output of the limiter converter as follows:

3.7.14.1 Measure the output voltage between terminals 1 & 2 and ensure that it is in the 24 to 30 volt range. Adjust the voltage as described in the converter limiter manual until the output voltage is about 27 volts. If this can be achieved, then the converter limiter is probably fine. To actually measure the power produced proceed as follows.

3.7.14.2 Connect the output from the converter limiter across a resistor (capable of dissipating 30 watts) in the 20 to 24 ohm range. Measure the voltage across the output, and calculate the power as follows:

$$P = \frac{V^2}{R}$$

P = Power (watts)
V = Measured voltage across resistor (VDC)
R = Resistor value (ohms)

As long as the limiter converter is producing 21 watts (or 70% of rated power) then the limiter converter is working.

4 Limiter Convert Option, 30 Watt

4.1 General Information

4.1.1 Product Application

This manual contains information pertaining to the 30 Watt L/C series converter limiter which is designed for use with a model 5030 thermoelectric generator.

4.1.2 Product Description

The 30 Watt L/C consists of two separate circuits operating together. The first is a DC to DC converter that switches the input voltage to a different output voltage. The second circuit is a shunt type voltage limiter that regulates the output of the generator. See figure 8 for physical description.

4.1.3 Product Specifications

Short Circuit Protection is designed into the 30 Watt L/C. A momentary short circuit will not damage the generator or the converter limiter. If extended short circuit durations are anticipated, an in-line fuse should be placed on the output of the converter limiter. Use 3 Amp slow blow for both the 12 and 24 volt configurations.

Reverse Current Protection is standard on all 30 Watt Converter Limiter. A diode in series with the output prevents current from flowing back through the converter when the generator is shut off.

Voltage Sensing Relay provides a set of contact to indicate an alarm condition when the output voltage drops below a preset minimum.

TEG Operating Normally LED Indicator works in conjunction with the voltage sensing relay to provide a visual indication that the output voltage is above the preset minimum. Note that when the TEG is started, this green LED remains off until the output voltage rises to the minimum set point.

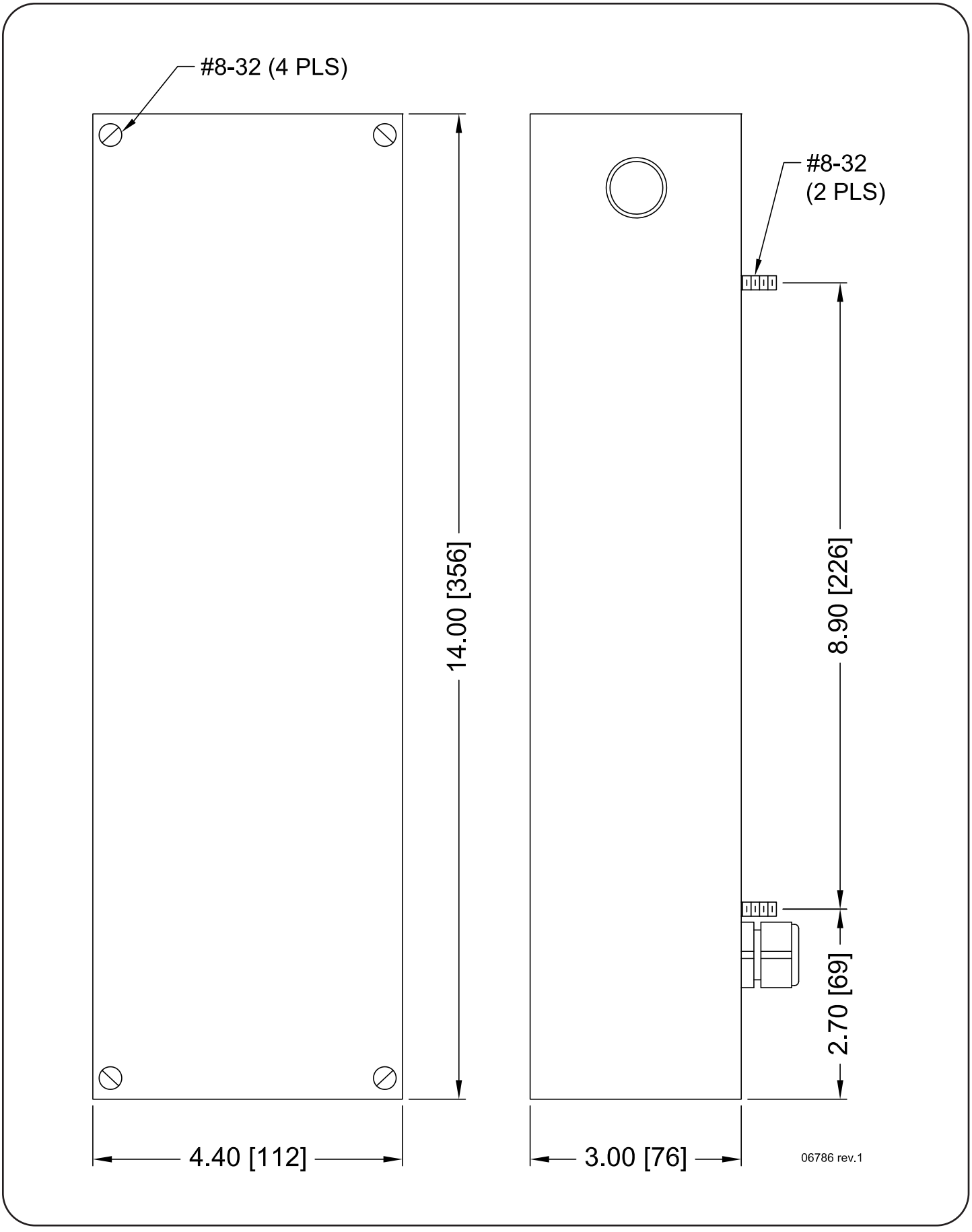

Figure 8 30 Watt Converter Limiter Physical Description

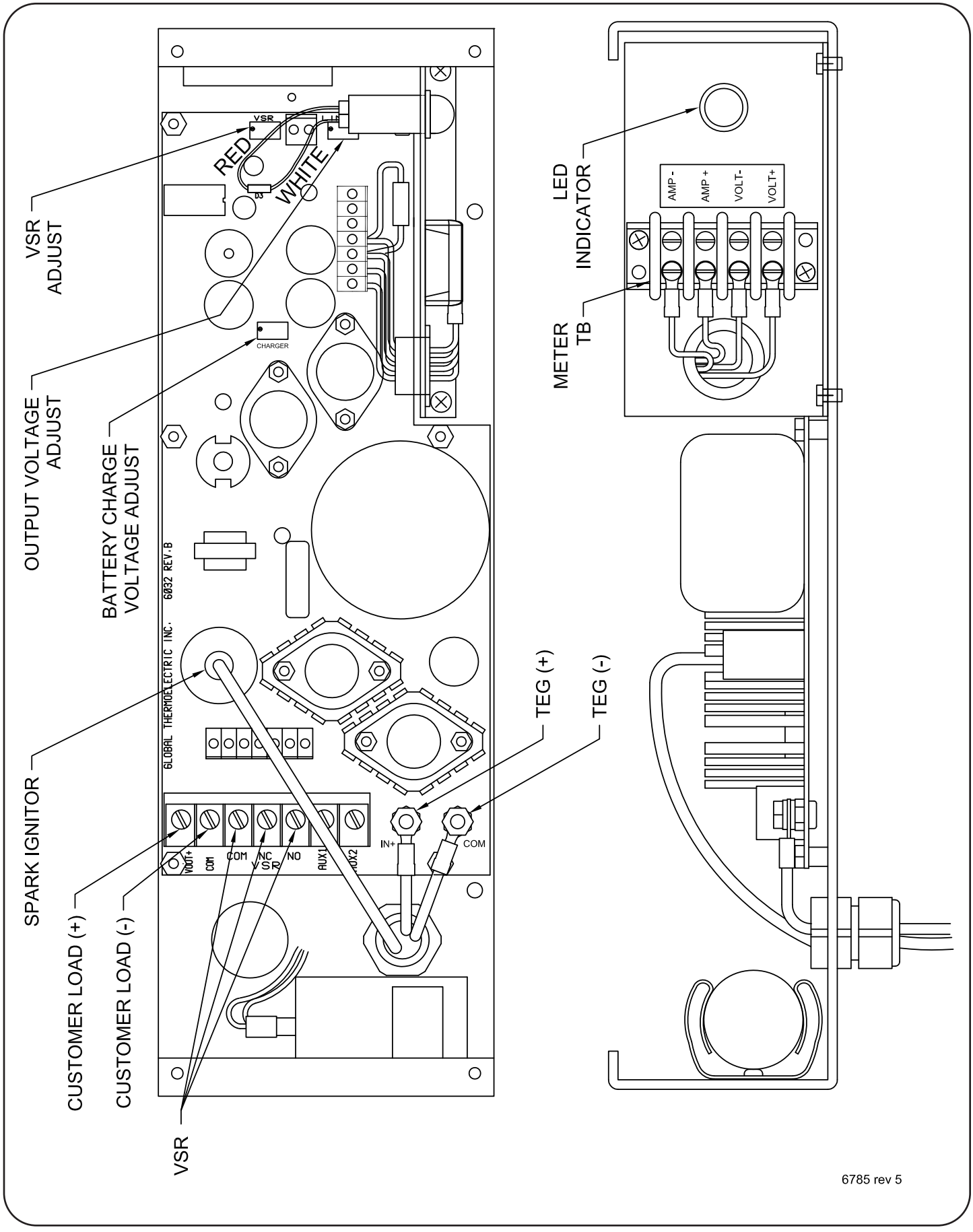

Figure 9 30 Watt Converter Limiter Connection & Adjustment Details

4.2 Operation

4.2.1 Preparation for Use

The Power conditioner is shipped ready for operation. If the converter limiter was shipped separately, it should be inspected for obvious dents or broken components. Notify the carrier if so.

4.2.2 Installation

The standard mounting location is on the left side of the generator. Screw the converter limiter to the generator. Feed the wires into the cabinet through the cutout provided at the bottom of the door. Refer to figure 9 to identify the input and output wires.

Remote mounting of the converter limiter is acceptable, but allow for 20 Amps between the generator and the converter limiter when sizing wire.

The converter limiter should always be mounted in an upright position to allow air to pass freely over the heat sink section. Spacers may be required on the back of the 30 Watt L/C to allow for clearance between the cabinet and the mounting surface for adequate air flow.

4.2.3 Protective Limiter

A protective limiter circuit is incorporated into the 30 Watt L/C to limit the input voltage. This setting can be measured across the TEG Positive and TEG Negative terminals with no load connected. The 30 Watt Converter Limiter is factory set at 1.8 Volts.

4.2.4 Output Voltage Adjustment

The 30 Watt Converter Limiter is factory set at 14.1 Volts or 27.0 Volts depending on the output ordered. To trim the output voltage use the output voltage adjustment pot shown in figure 9. The output voltage range cannot be switched between 12 and 27 Volts.

4.2.5 Voltage Sensing Relay Adjustment

The VSR is factory set at 10.5 Volts for 14.1 Volt output and at 21 Volts for a 27.0 Volt output. Should this require adjustment, use the VSR adjustment pot in figure 9.

5 APPENDIX

5.1 Appendix 1, Gas Specifications

Gaseous fuels provided to Global Power Technologies' Thermoelectric Generators:(1)

1. Shall not contain any particulates larger than 30 μm diameter, including but not limited to sand, dust, gums, crude oil, and impurities.

2. Shall not have a hydrocarbon dew point in excess of 0ºC (32ºF) at 170 kPa_g (25 psi_g).

3. Shall not contain more than 115 mg/Sm^3 (2) (approx. 170 ppm) of H_2S.

4. Shall not contain more than 60 mg/Sm^3 (approx. 88 pmm) of Mercaptan Sulphur.

5. Shall not contain more than 200 mg/Sm^3 (approx. 294 ppm) of total Sulphur.

6. Shall not contain more than 10% [CO_2] and/or [N_2] by volume, nor vary more than +/- 1% [CO_2] and/or [N_2] during operation.

7. Shall not contain more than 120 mg/Sm^3 of water vapour.

8. Shall not contain more than 1% by volume of free oxygen.

9. Shall have a nominal gross heating value of:

Natural Gas:	37 MJ/Sm^3 (1000 BTU/cu.ft.)(1)
Propane/LPG:	93 MJ/Sm^3 (2500 BTU/cu.ft.)(1)
Butane:	108 MJ/Sm^3 (2900 BTU/cu.ft)(1)

10. Shall not exceed 60ºC (140ºF) in temperature.

Notes:

(1) - For gaseous fuels outside of these specifications, please contact Global Power Technologies (GPT).

(2) - Sm^3 = Standard cubic meter of gas at 101.325 kPa at 20ºC (NIST).

5.2 APPENDIX 2, PERFORMANCE LOG

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

Date	Time	Ambient Temp °C	Rated Power (Watts)	Rated V_{set} (volts)	Measured V_{oc} (volts)	Measured V_{out} Converter/Limiter	Fuel Pressure KPa	Open Circuit Voltage	Maintenance Repair Notes

5.2 APPENDIX 2, PERFORMANCE LOG

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

Date	Time	Ambient Temp °C	Rated Power (Watts)	Rated V_{set} (volts)	Measured V_{oc} (volts)	Measured V_{out} Converter/Limiter	Fuel Pressure KPa	Open Circuit Voltage	Maintenance Repair Notes