Alternate Energy Systems, Inc.

A Corporation devoted to Energy-Oriented Needs

GraviBlend®-3 Gravitometer

- **For Mixtures of Propane/Air, Butane/Air, and Propane-Butane/Air.**
- **Display and 4-20 mA Output for Specific Gravity.**
- **7-inch color high-resolution LCD display with touch screen operator interface for Specific Gravity, Wobbe Index Number, and Heating Value.**
- **Fast response time suitable for LPG/Air Mixers.**
- **Excellent Accuracy (+/- 1.5 %).**
- **No Reference Gas required.**
- **AutoCalibration Feature.**
- **Alarm Outputs.**
- **Options:**
  - **Integrated controller for automatic specific gravity control in combination with AES-POM mixers.**
  - **Remote monitoring through Ethernet.**
  - **Configuration for Oil Well Gas.**
  - **Custom Solutions.**

GB-3; Standard Version with
Color Touch Screen LCD Display

GB-3E; Ex-proof Version with Remote Sensor.

GB-3P; Portable Version
Metal Case with Carrying Handle

What are Gravitometers ?

Gravitometers measure the Specific Gravity (S.G.) of a gas, relative to air. If the test gas is an LPG/Air mixture, the S.G. is an indicator for the quality of the produced gas. Maintaining a consistent SG value of the LPG/ Air mixture is important in applications where variations in the heat content of the gas would change the heat output of a burner or furnace, and where this change in heat output would have a negative effect on the process.

Ideally, the signal from the Gravitometer is looped back to a positioner/actuator at the mixing valve. This positioner/ actuator would then change the gas/air ratio to correct any variations in the S.G. of the mixed gas. Alternate Energy Systems offers these Gravitometer/Actuator Combinations as our AccuBlend™ option for all Piston Operated Mixers (POM-10 to POM-60).

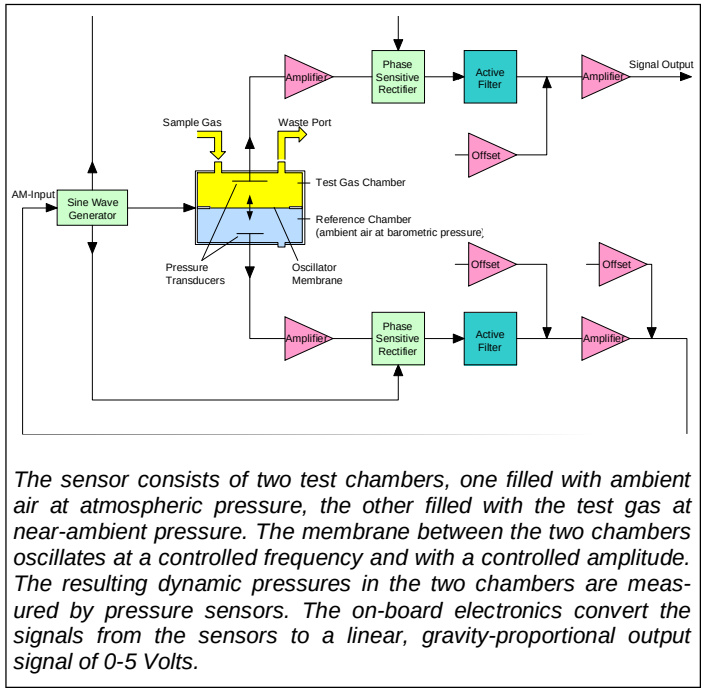
How do Alternate Energy Systems' Gravitometers work ?

GraviBlend®-3 is a new device, specifically designed for use in propane/air mixing systems. It measures the relative density of the mixed gas and operates on the principle that the travel of ultrasonic sound in a specially designed and temperature-controlled chamber is affected by the density of the test gas. GraviBlend®-3 units have actually two test chambers, one filled with ambient air at atmospheric pressure, the other filled with the test gas at near-ambient pressure.

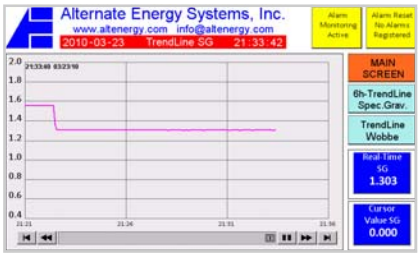
A membrane between the two chambers oscillates at a controlled frequency and with a controlled amplitude. The resulting dynamic pressures in the two chambers are measured by sensors. The output signals from these pressure sensors are processed by the integrated electronics. The signal from the gas-filled chamber is then compared against the signal from the air-filled reference chamber, and a linear output signal is created. This output signal is directly proportional to the relative Specific Gravity of the Propane/ Air mixture, with air as 1. To minimize temperature effects, the sensor is kept at a constant temperature of 113°F (45°C).

Features

GraviBlend®-3 is a precision on-line instrument, designed for continuous, unattended measurement of gasses with specific gravities between 0.2 and 2.2. This allows the use of the instrument in straight propane/air systems, as well as in systems where the LPG is a mixture of propane and butane. The instrument measures the relative density of propane-air mixtures. From this data, Heating Value and Wobbe Index Number are calculated and indicated.



The sensor consists of two test chambers, one filled with ambient air at atmospheric pressure, the other filled with the test gas at near-ambient pressure. The membrane between the two chambers oscillates at a controlled frequency and with a controlled amplitude. The resulting dynamic pressures in the two chambers are measured by pressure sensors. The on-board electronics convert the signals from the sensors to a linear, gravity-proportional output signal of 0-5 Volts.



All GraviBlend®-3 versions offer a local trend recording feature. Up to 96 hours of data are stored in system memory. A standard SD card stores more than 2 years of data. The data can be read with Microsoft Excel.

Measurement data is provided through a front panel LCD display. All GraviBlend®-3 have a high-resolution 7-inch color LCD display with touch screen operator interface. A scaled, linear DC 4-20 mA signal (tied to S.G.; 4-20 mA = 0.4 to 2.0 SG) and a 96-hour trend chart are standard.

GraviBlend®-3 provides the user with rapid time response and superb accuracy for signaling controllers in blending plants and for reporting gas properties. It is used in propane applications such as standby and peak shaving equipment or within gas distribution systems.

GraviBlend®-3 is practically solid-state; the only moving part is the oscillating membrane between the two sensor chambers. The unit is small, durable, lightweight, rugged and robust. All components in the GraviBlend®-3 have been field-proven with other products for several years. Reliability is built in from the start.

Indicators and Output Signals

A 7-inch high-resolution color LCD display with touch screen operator interface in the front panel displays the measurement results. Specific Gravity, Wobbe Index, and Heating Value are displayed simultaneously. During initial setup, the display unit is also used for the input of setpoint data and the input of the LPG properties.

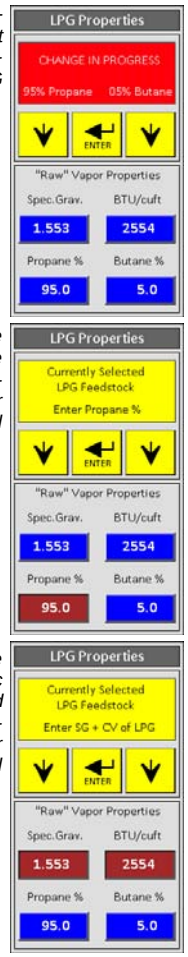
The user can select from one of three methods to enter the properties of the liquid LPG: select one of 20 pre-defined LPG mixtures; enter the propane-percentage in the LPG; or enter Calorific Value and Specific Gravity of the "raw" LPG vapor. The GraviBlend®-3 then accurately measures the S.G. of the vapor/ air mixture, and calculates Calorific Value and Wobbe Index Number.

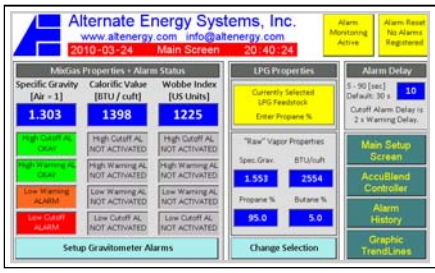
LPG Properties Selection Screens

Use the arrow-keys to select one of 21 pre-defined LPG mixtures.

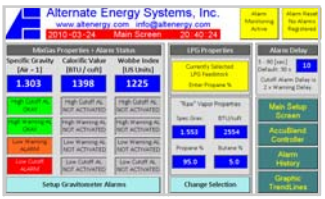
Select the "Enter Propane Percent" function and enter the desired value.

Select the "Enter Specific Gravity and BTU/cuft" function and enter the desired values.





GraviBlend®-3 high-resolution color LCD display with touch screen operator interface offers simultaneous display of Specific Gravity, Heating Value, and Wobbe Index.



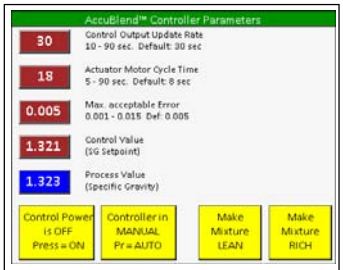
The status display of the GraviBlend™-3 with high-resolution color LCD display monitors four alarms per for each parameter (SG, CV, Wobbe).

Alarm Signals

The GraviBlend®-3 is constantly monitoring 12 separate setpoints. Out-of-range conditions activate alarm outputs with "dry" contact ratings of 2A. All alarm setpoints can be configured for various process conditions. Monitored are the Low/High "Pre-Alarm" points and the Low/ High "Cutoff-Alarm" points of S.G., Wobbe Index, and Heating Value.

Tie-In with AccuBlend™

The GraviBlend®-3A version is equipped to directly drive the electric motor of the AccuBlend™ actuator on an AES POM LPG/Air blender. The two units together will maintain constant mixed gas properties, compensating for any fluctuations in the ratio of the LPG/Air mixture.



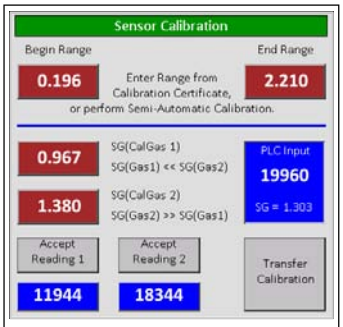
Setup Screen for GraviBlend®-3 gravitometers with AccuBlend™ Automatic Gas Properties Controller.

AutoCalibration Feature

The standard range of the density cell used in the GraviBlend®-3 gravitometers is 0.2 ... 2.2.

Since the main interest in an application may be concentrated on a much narrower range (for example 1.0 to 1.3 in LPG/Air Mixing Systems), AES has developed a method that provides a simple-yet-powerful routine that recalibrates the entire system in only a few steps.

Because the calibration procedure includes the entire system (from density cell to signal converter to PLC input), the overall system accuracy will be greatly improved.



AutoCalibration setup screen on all GraviBlend®-3 gravitometers.

After entering the specific gravities of the two calibration gasses apply CalGas 1, wait a few seconds for the input reading to stabilize, then press the "Accept Reading 1" button. Repeat the procedure for CalGas2; then press the "Transfer Calibration" button.

The new sensor calibration range, optimized for the span between the two calibration gasses, is shown below the "Transfer Calibration" button.

For typical LPG/Air blending systems, easy-to-obtain calibration gasses would be Nitrogen (SG=0.967) and Argon (SG=1.38). Gravitometers for use with Natural Gas could be calibrated using Methane (SG=0.555) and Nitrogen.

Power Supply

All GraviBlend®-3 versions are powered by AC 110/220 V 60/50 Hz. The voltage of 110/220 is field-selectable. The two-wire output signal of the DC 4 - 20 mA circuit is internally powered.

In GB-3 and GB-3E models, zero and span are fixed to the output signal of the SG sensor.

In GB-3P models, the analog output can be assigned to Specific Gravity, Heating Value, or Wobbe Index through the operator interface. The scaling can be set separately for each process value.

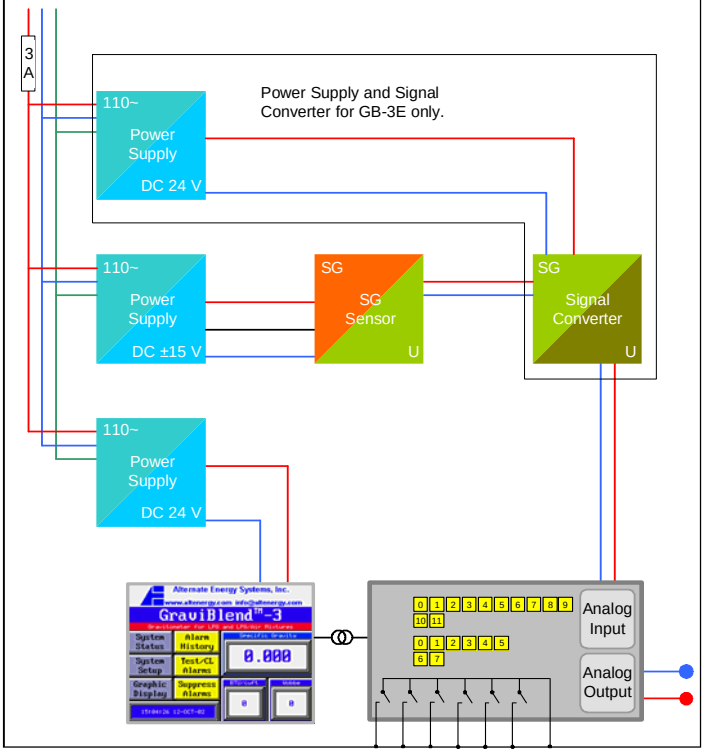
Communication Options

Standard versions (GB-3) and explosion-proof versions (GB-3E) of the GraviBlend®-3 offer remote access through a built-in VNC server.

The VNC-client software is included as an open license and can be installed on as many PCs as desired.

Signal Processing and Electrical Schematics

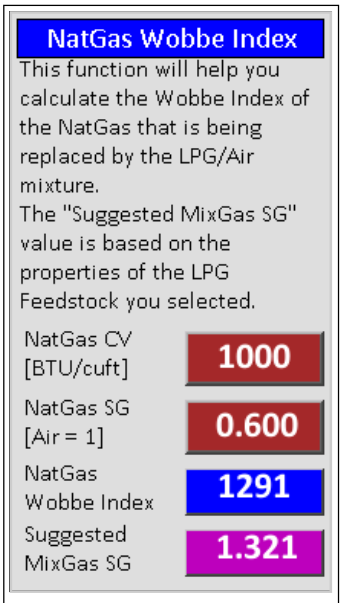
The 0-5V output signal from the SG sensor is connected to the analog input card of the Signal Processor (Allen-Bradley PLC). In GB-3E versions, where the sensor may be some distance away from the Signal Processor, it is first converted to an industry-standard signal of 4-20 mA. The PLC processes the signal and communicates with the operator interface, which indicates the measured Specific Gravity, and the calculated Calorific Value and Wobbe Index Number. The PLC also monitors several user-adjustable setpoints and activates alarm contacts, if the actual values are outside their assigned range. A scaled analog output is available for external equipment, such as recorders.



NatGas-Wobbe Calculation

All GraviBlend®-3 versions offer a utility that calculates the Wobbe Index of the to-be-replaced NatGas and also display the suggested Specific Gravity of the LP/Air blend that has a matching Wobbe Index, making the two gasses compatible and interchangeable.

The accuracy of the calculation of the Suggested Specific Gravity of the LP/Air blend is based on the selected LPG properties.



After entering the NatGas properties, the system calculates the Wobbe Index of the NatGas, and suggests the Specific Gravity of the LP/Air blend that will replace or augment the Natural Gas.

System Piping Concept

The diagram below shows the piping configuration of a GraviBlend®-3 unit. The example shown is for the explosion proof configuration, with the SG sensor and the voltage-to-current converter in a separate, explosion-proof enclosure (in the lower right hand corner of the diagram). A third enclosure, typically mounted in a control room or another, non-hazardous location, holds the PLC, the operator interface, and all power supplies.

In standard units and in portable units, all components, including the SG sensor, the PLC, the operator interface, and the power supplies, share the same, non-explosion-proof enclosure.

A pressure regulator is installed close to the point from where the sample gas is taken, reducing the pressure to approximately 10"W.C. This reduces the gas volume in the connection line, increasing the gas throughput through the sensor, and thereby improving the sensor's response time to changing gas properties.

The sample gas must then pass through a stainless steel filter, which removes any solid contaminants which could potentially harm the SG sensor.

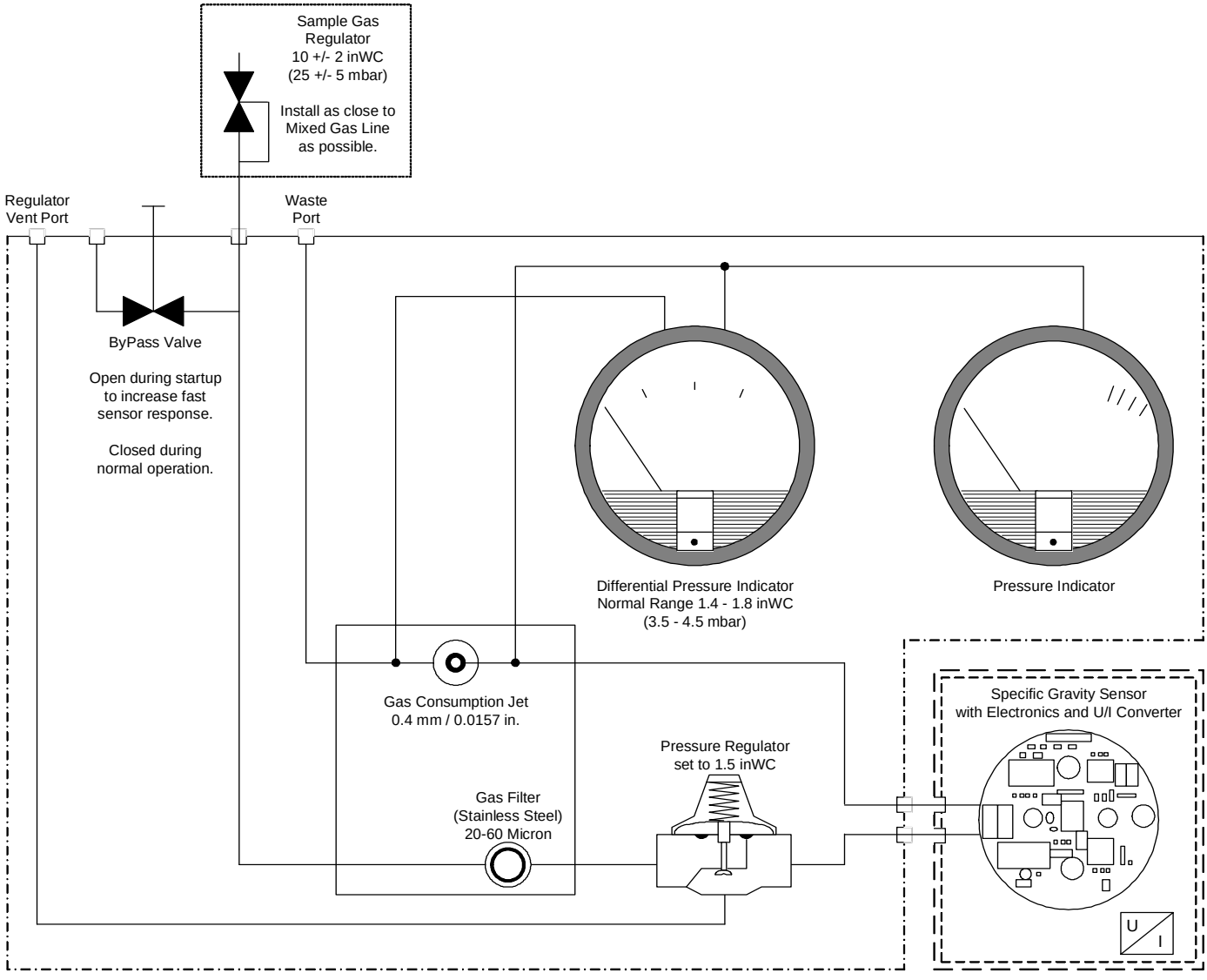
A manual bypass valve in the sample gas line can be opened during setup to increase the gas throughput even further. This valve should be closed during normal operation.

Before the sample gas enters the SG sensor, the pressure is reduced by the pressure regulator inside the enclosure to approximately 1.5"W.C. Use the pressure gauge on the right, which is connected to the outlet port of the SG sensor, to verify correct pressure settings.

The sample gas then passes through a Consumption Jet before it exits at the Waste Port. The orifice size of the Consumption Jet (typically 0.4 mm / 0.0157 in) determines the gas flow through the sensor, and may be changed to adapt the system to a wide range of performance requirements.

The pressure gauge on the left side indicates the differential pressure across the Consumption Jet and should normally read slightly below the sensor supply pressure (1.5"W.C.). If the reading approaches the zero, the Waste Port may be blocked, or the Consumption Jet requires cleaning.

Note: Waste Port, Regulator Vent Port, and Bypass Vent Port will emit sample gas and must be vented to a well ventilated location.



GraviBlend®-3 Standard Configuration

The GraviBlend®-3 in standard configuration is not explosion proof and is intended to be installed inside the control room cabinets of typical water bath vaporizers, or other open-flame vaporizers. The single wall-mount enclosure contains all gravitometer components, including bypass valve, stainless steel filter, secondary pressure regulator, SG sensor, consumption jet, pressure and differential pressure gauges, power supplies, PLC, operator interface, etc.

The standard enclosure is a powder-coated carbon steel box. Stainless steel enclosures are available as an option.

The operator interface is a 7-inch high-resolution color LCD display with touch screen. Specific Gravity, Heating Value, and Wobbe Index Number are displayed simultaneously. The operator interface is also used to enter alarm settings, sensor calibration data, and to select the properties of the LPG feedstock from a list of pre-defined propane/butane mixtures, or to enter the known SG and CV of the feedstock, if the pre-defined mixtures do not closely enough match the actual values.

Instead of using the properties of the LPG feedstock from a list of pre-defined propane/butane mixtures, or entering the known SG and CV of the feedstock, the GraviBlend®-3 can also be configured to accept a 4-20 mA signal from an external Calorimeter as the input signal for the calculation of the Wobbe Index Number.

GraviBlend®-3
with Standard Enclosure

Note: Waste Port, Regulator Vent Port, and Bypass Vent Port will emit sample gas and must be vented to a well ventilated location.

Specifications

Environmental	Hazardous Area Ratings Enclosure Rating Operating Temperature Range	None NEMA 4X (indoor) 32 °F to 120 °F (0 °C to 50 °C)
Electrical	AC Line Power (field selectable)	AC 120/220 V 50-60 Hz, 3 A
Mechanical	Dimensions in inches (mm), H x W x D Weight in lbs (kg)	20 x 20 x 9 (500 x 500 x 230) 60 (27)
Analog Output	2-wire, source (internal power supply)	4 - 20 mA, DC 24 V @ 500 Ohm max.
Display	7-inch high-resolution (800 x 480) TFT color LCD with Touch Screen	simultaneous display of SG, WI, CV
Alarm Output Relays	Contacts for visual/audible alarm, “Any Warning or Cutoff” Contact for “Any SG Warning Alarm” Contact for “Any SG Cutoff Alarm” Contacts for “Low SG Warning” and “High SG Warning” Alarm Contacts for “Low SG Cutoff” and “High SG Cutoff” Alarm	Max Volts / Max Make / Max Brake / Max Contin. AC 240 V / 7.5 A/1800 VA / 0.75 A/180 VA / 2.5 A AC 120 V / 15 A/1800 VA / 1.5 A/180 VA / 2.5 A DC 125 V / 0.22 A/28 VA / 1.0 A DC 24 V / 1.2 A/28 VA / 2.0 A
Relative Density	Range Accuracy Repeatability	0.2 to 2.2 ± 0.03 units ± 0.01 units
Response Speed	Display Update Rate Analog Update Rate Warm-Up Time	< 1 sec. < 1 sec. 45 minutes (max.)
Reference Gas	Composition	Ambient air at barometric pressure
Sample Gas	Inlet Pressure Range Rate of Consumption	10 +/- 2 inWC (25 +/- 5 mbar) 0.3 SCFH (8.5 L/h) (approximately)

Weights and Dimensions are approximate. All Technical Data and Specifications are subject to change without notice.
GraviBlend is a registered Trademark of Alternate Energy Systems, Inc.
This product is protected by US Patent No. 6,539,775.

GraviBlend®-3E Ex-Proof Configuration

The GraviBlend®-3E in explosion-proof configuration consists of three separate enclosures.

The explosion-proof enclosure that holds the SG sensor and the voltage-to-current converter (Sensor Enclosure), and the enclosure that houses bypass valve, stainless steel filter, secondary pressure regulator, consumption jet, and pressure and differential pressure gauges (Pneumatic Enclosure), are installed close to the mixing system in the hazardous area. The third enclosure, holding power supplies, PLC, operator interface, etc. (Electronics Enclosure), must be installed at a non-hazardous location, typically in a remote control room.

Although the maximum distance between the Sensor Enclosure and the Electronics Enclosure could be as much as 1200 ft. (400 m), it is recommended to install the Electronics Enclosure close to the mixing system, just outside the hazardous area, to allow for easy monitoring of the gas properties during setup.

The Pneumatic Enclosure must always be installed as close to the Sensor Enclosure as possible, reducing the tubing length between the two enclosures, and thereby reducing the amount of sample gas that must pass through the piping before the SG sensor can register changes in the gas properties.

The functions of the PLC and the operator interface are identical to the GraviBlend®-3 in Standard Configuration, including 96-hour trend recording and AutoCalibration Feature.

GraviBlend®-3E Components:
Pneumatic Enclosure; Sensor Enclosure (ex-proof);
Electronics Enclosure (for control room).

The 4-20 mA analog output signal is conveniently scaled to 0.4 to 2.0 Specific Gravity.

Note: Waste Port, Regulator Vent Port, and Bypass Vent Port will emit sample gas and must be vented to a well ventilated location.

Specifications

Environmental	Hazardous Area Ratings (Sensor Enclosure)	Class I, Groups C&D; Class II, Groups E,F&G; Class III
	Enclosure Rating	NEMA 4X
	Operating Temperature Range	32 °F to 120 °F (0 °C to 50 °C)
Electrical	AC Line Power (field selectable)	AC 120/220 V 50-60 Hz, 3 A
Mechanical	Dimensions in inches (mm), H x W x D	16 x 16 x 7 (406 x 406 x 178) (Electronics) 16 x 16 x 7 (406 x 406 x 178) (Pneumatic) 10 x 8 x 7 (254 x 203 x 178) (Sensor)
	Weight in lbs (kg) Electronics/Piping/Sensor	40 (18) / 40 (18) / 25 (12)
Analog Output	2-wire, source (internal power supply)	4 - 20 mA, DC 24 V @ 500 Ohm max.
Display	7-inch high-resolution (800 x 480) TFT color LCD with Touch Screen	simultaneous display of SG, WI, CV

Alarm Output Relays	Contacts for visual/audible alarm, “Any Warning or Cutoff”	Max Volts	Max Make	Max Brake	Max Contin.
	Contact for “Any SG Warning Alarm”	AC 240 V	7.5 A/1800 VA	0.75 A/180 VA	2.5 A
	Contact for “Any SG Cutoff Alarm”	AC 120 V	15 A/1800 VA	1.5 A/180 VA	2.5 A
	Contacts for “Low SG Warning” and “High SG Warning” Alarm	DC 125 V	0.22 A/28 VA		1.0 A
	Contacts for “Low SG Cutoff” and “High SG Cutoff” Alarm	DC 24 V	1.2 A/28 VA		2.0 A

Relative Density	Range	0.2 to 2.2
	Accuracy	± 0.03 units
	Repeatability	± 0.01 units
Response Speed	Display Update Rate	< 1 sec.
	Analog Update Rate	< 1 sec.
	Warm-Up Time	45 minutes (max.)
Reference Gas	Composition	Ambient air at barometric pressure
Sample Gas	Inlet Pressure Range	10 +/- 2 inWC (25 +/- 5 mbar)
	Rate of Consumption	0.3 SCFH (8.5 L/h) (approximately)

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GraviBlend®-3P Portable Configuration

The GraviBlend®-3 in "portable" configuration is the ideal instrument for service personnel. It combines all features of the standard version of the GraviBlend®-3 with portability and offers superior ruggedness over old-style mechanical instruments and their vulnerability to shock and vibration.

The metal enclosure with carrying handle contains all gravitometer components, including bypass valve, stainless steel filter, secondary pressure regulator, SG sensor, consumption jet, pressure and differential pressure gauges, power supplies, PLC, touch screen operator interface, etc.

The touch screen operator interface is a 6-inch color TFT LCD display. Specific Gravity, Calorific Value, or Wobbe Index Number are shown simultaneously. The operator interface is also used to enter sensor calibration data, and to select the properties of the LPG feedstock from a list of 20 pre-defined propane/ butane mixtures, or to enter the known SG and CV of the feedstock, if the pre-defined mixtures do not closely enough match the actual values.

For 2007, new features include "Gravitometer only" mode, and "Detect LPG Type" mode.

In "Gravitometer only" mode, the instrument measures the specific gravity of any non-corrosive gas in the range of 0.2 to 2.2.

GraviBlend®-3P

All gas connections are 1/4-inch hose adapters.

A scaled 4-20 mA analog output signal (0.4 to 2.0 SG) for external instruments is accessible from the front panel.

Universal Power Supply AC 90 V 50/60 Hz to AC 220 V 50/60 Hz.

All system functions are identical to the standard and ex-proof versions, including LPG selection, Specific Gravity, and Wobbe Index display; AutoCalibration feature.

In "Detect LPG Type", the instrument measures "raw" LPG vapor and displays the Propane/Butane ratio of the LPG.

Note: Waste Port, Regulator Vent Port, and Bypass Vent Port will emit sample gas and must be vented to a well ventilated location.

Specifications

Environmental	Hazardous Area Ratings Enclosure Rating Operating Temperature Range	None None (ATA approved) 32 °F to 120 °F (0 °C to 50 °C)
Electrical	AC Line Power (universal)	AC 90...220 V 50-60 Hz, 3 A
Mechanical	Dimensions in inches (mm), H x W x D Weight in lbs (kg)	7.5 x 15 x 15 (190 x 380 x 380) 18 (8)
Analog Output	2-wire, source (internal power supply)	4 - 20 mA, DC 24 V @ 500 Ohm max.
Display	7-inch high-resolution (800 x 480) TFT color LCD with Touch Screen	simultaneous display of SG, WI, CV
Relative Density	Range Accuracy Repeatability	0.2 to 2.2 ± 0.03 units ± 0.01 units
Response Time	Display Update Rate Analog Update Rate Warm-Up Time	< 1 sec. < 1 sec. 45 minutes (max.)
Reference Gas Requirements	Composition	Ambient air at barometric pressure
Sample Gas Requirements	Inlet Pressure Range Rate of Consumption	10 +/- 2 inWC (25 +/- 5 mbar) 0.3 SCFH (8.5 L/h) (approximately)

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Who is Alternate Energy Systems, Inc. ?

After working for other manufacturers of LPG vaporizers and LPG / air systems for several years, John E. Hallberg founded Alternate Energy Systems, Inc. in 1974 in Peachtree City, located just 20 minutes south-west of the Atlanta airport. He successfully set out to design and manufacture products which were superior to those of his competitors. As a result, AES became very quickly known as the innovative manufacturer of quality products. Soon, the customer list included a representative cross-section of the Fortune 500 companies in the U.S.

Through the years, AES has constantly added new products, and has further improved the design of existing products, keeping us ahead of the competition. Several designs, including those for LPG/Air mixing systems, were awarded national and international patents.

Today, AES is owned by Wolfgang Driftmeier. With his manufacturing background and his experience in sales and marketing, the company focus is clearly on "... offering the best product design, combined with quality workmanship, at a competitive price, to the full satisfaction of our customers, at all times ...".

AES is committed to serving customers in the U.S. through a network of sales specialists, technical support personnel, distributors and installers, and international customers in selected countries through qualified representatives.

Please visit our web site at www.altenergy.com for updated versions of all data sheets, price lists, application notes, a list of authorized distributors, and other documents that are only available online.

The AccuBlend™ Option

All AES patented Piston Operated Mixers (POM-30 to POM-80) can be equipped with this option. It consists of an electric actuator, mounted on top of the POM valve, and a dedicated PID controller. The PID controller receives the 4-20 mA signal from the GraviBlend® gravitometer, and compares this signal with a pre-set value, representing the correct mixture. If deviations are detected, the actuator changes the rotational position of the piston in the POM valve, thereby effectively correcting the mixture to meet customer requirements. When model GraviBlend®-3 with option "ACUCON" is used, the function of the PID controller is integrated into the microprocessor-controls of the GraviBlend®-3. Option "ACUCON" is available for S and E models.

Other Products from Alternate Energy Systems, Inc.

Water Bath Vaporizers
Hot Water Vaporizers
Steam Vaporizers

Electric Vaporizers
Electric Water Bath Vaporizers

Venturi Type LPG / Air Mixers
Patented Piston Operated LPG / Air Mixers

Complete Vaporizer / Mixer Systems
Peak Shaving Plants
Gas Stabilization Systems

Accessories for LPG / Air Systems
LPG Pump Packages

Service
Maintenance
Trouble Shooting

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