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Blendaire

LPG/Air Mixer

Models B20 – B1700

Operations & Maintenance Manual

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1. Introduction

DESCRIPTION

The **BLENDAIRE** is the ALGAS-SDI second generation “parallel pipe” design Synthetic Natural Gas (SNG) mixer. The **BLENDAIRE** is designed to mix LPG vapor and air to simulate the combustion characteristics of natural gas. During operation, the **BLENDAIRE** controls & responds to changes in discharge pressure due to consumption changes. When operating in a piped network, as network pressure decreases, the SNG flow rate will increase to maintain pressure. Alternatively, when the network pressure rises, for example as consumption is reduced, the SNG flow will decrease. The SNG discharge pressure is established by the LPG regulator installed upstream of the **BLENDAIRE**. LPG vapor and air flow rates are measured by flow meters. The ratio of these two flow rates is then compared to the calculated ratio of flow rates required to achieve a Wobbe value match to the natural gas being simulated. Adjustment of the ratio is made by adjusting the air flow only. As the flow of SNG increases or decreases, the Air Flow Control Valve modulates to maintain the correct and constant mixing ratio between the LPG and air.

There are two separate flow paths into the **BLENDAIRE**, one for air and one for LPG vapor, (See Figure 1). The air inlet piping contains manual shutoff valve, check valve, flow conditioner, flow meter, pressure transmitter, and a flow control valve. A required air regulator installed upstream sets the pressure into flow control valve. The LPG vapor inlet piping contains manual shutoff valve, check valve, flow conditioner, flow meter, pressure transmitter, and a safety shutoff valve. A required LPG vapor regulator upstream sets the mixed gas pressure at the outlet of the **BLENDAIRE**. The mixed gas line includes a static mixer section, safety shutoff valve, line pack pressure transmitter, and a manual shutoff valve (See Figure 2). The line pack pressure transmitter automatically starts the mixer to an adjustable cut in pressure set point and maintains mixed gas pressure above this set point until desired line pressure is reached due to decreased demand.

The **BLENDAIRE** utilizes a state-of-the-art PLC control technology designed by Algas-SDI to communicate with sensors and actuators and control the mixing ratio into the single gas line. Adjustments to operating/control parameters are performed via the Human Machine Interface (HMI).

The **BLENDAIRE** achieves extremely high accuracy and stability in the mixing process. Equally important, operation of the mixer is very simple. Once set up, the operation is fully automatic requiring minimum human intervention.

In addition to high accuracy and stability, the **BLENDAIRE** maintains a high level of safety through the use of automatic safety shut-off valves and closure of the flow control valve.

Figure 1 - General Layout

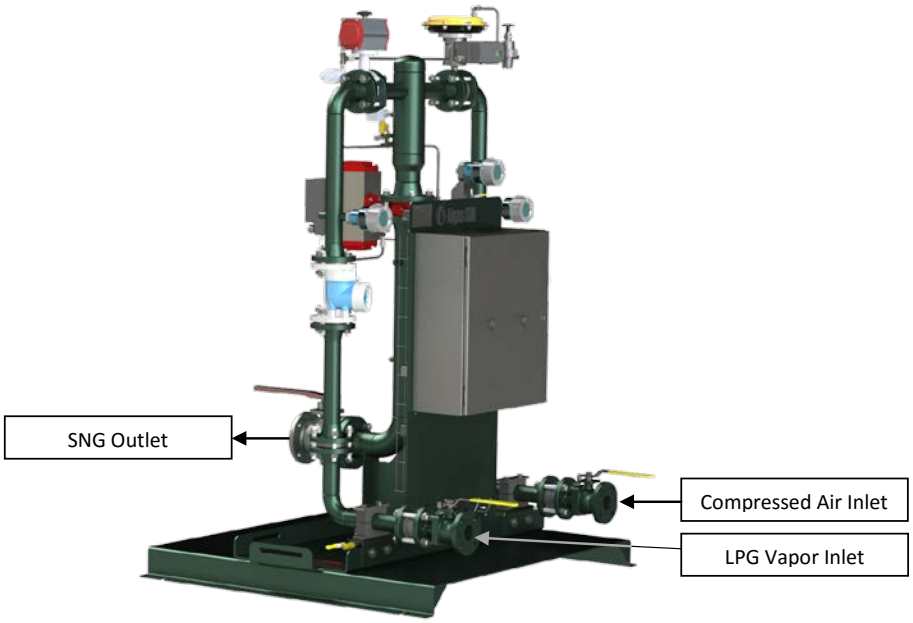
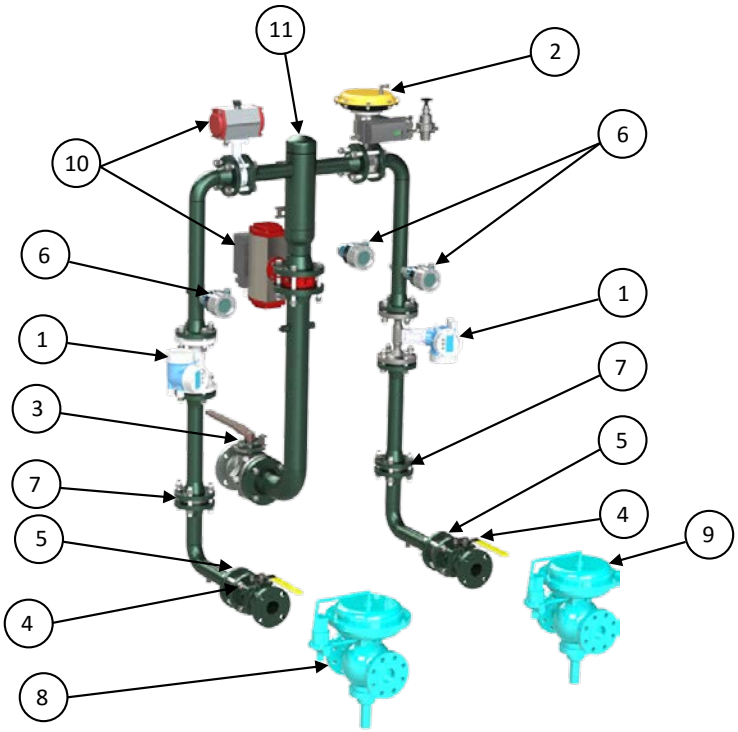


Figure 2 - Component Diagram



2. Major Components

1 – FLOW METER

The Flow Meter monitors the volumetric flow of gas through the pipe.

2 - AIR FLOW CONTROL VALVE

The Air Flow Control Valve is used to adjust the flow of air to match the flow of vapor given a fixed mixing ratio.

3 - MANUAL OUTLET SHUT-OFF VALVE

Manual Shut-Off Valve allows system to be shut off manually at the outlet pipe and allows the operator to manually control the outlet flow rate when starting the system.

4 - MANUAL INLET SHUT-OFF VALVE

Allows system to be shut off manually at each inlet pipe to isolate mixer from the rest of the system.

5 - CHECK VALVE

The Check Valve ensures the flow of gas moves in one direction.

6 - PRESSURE TRANSMITTER

The Pressure Transmitter relays information to the remote control box to prevent low LPG pressure from forcing lean mixtures.

7 - TEMPERATURE TRANSMITTER

The Temperature Transmitter determines if LPG gas vapor is at safe operating temperature. The system will shut down if LPG vapor temperature is close to dewpoint. The chart at the end of this section has the dewpoints for propane, N-butane and Isobutane.

8 - VAPOR REGULATOR

This regulator sets the downstream mixed gas pressure.

9 - AIR REGULATOR

This regulator sets the air pressure to the flow control valve. A typical differential is for air to be 7.5 psi above the gas pressure.

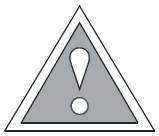
10 - AUTOMATIC SAFETY SHUT-OFF VALVE

The Automatic Safety Shut-Off Valve is located at the outlet and vapor inlet and will automatically close if there is an alarm condition, lack of electricity or if the air supply is low.

11 - STATIC MIXER

This device induces blending of two separate streams of gases into a consistent mixture.

3. Installation



WARNING

The equipment described in this manual is designed to operate with LP-gas, a flammable fuel under pressure. The nature of the application involves inherent hazards that could result in injury. ONLY a trained and fully qualified person should service this equipment.

The **BLENDAIRE** mixer should be installed in an area suitable for its use. The mixer must be placed on a level pad with no pits or depressions so no gas will accumulate. Care must be taken in the entire operating area so that LPG is never near or below its dewpoint in the system at any time. Heat tracing may be required depending upon location, LPG content and pressure. Mount each **BLENDAIRE** unit on a concrete pad strong enough to support its weight (See equipment drawing).

Every unit is equipped with Auto-Ratio-Adjust, however, a gas quality-measuring device suitable for the specific operating conditions is required for activation. The total response time, including sample lag time, should be kept to a minimum. This can be done by keeping the sample mixed gas line from the pipe to the instrument as short as possible.

CAUTION

Always consult with local codes and authorities prior to installing equipment.

The following equipment must be installed for proper operation of the blending systems:

1. Air supply
2. Vapor supply
3. Mixed gas outlet
4. Instrument air supply
5. Process controls

AIR SUPPLY

1. Air filters may be required on the air supply and instrument air. The user must determine the cleaning schedule for the filters. Dirty air will cause problems in the mixing systems. Oil carryover must be less than 2 PPM. Particulates greater than one micron must be removed. Temperature must be less than 130F. Dewpoint must be 2 deg. F below the temperature of air entering the mixer.
2. An air dryer for the incoming air supply will be required if water vapor could condense in the air supply lines.
3. A properly sized first-stage air pressure regulator is required to be installed upstream of the mixer compressed air inlet. The air supply pipe to this regulator must not be more than 150 psi.

VAPOR SUPPLY

1. A properly sized first-stage gas supply pressure regulator is required to be installed upstream of the mixer LPG vapor inlet. This regulator reduces the operating pressure to approximately 4-10 psi (0.23-0.67 kg/cm^2) over desired mixed gas pressure.
2. If the LPG has a heavy end content, filters must be provided upstream of the regulator on the vapor inlet pipe to each **BLENDAIRE**. The user must determine the cleaning schedule for the filters. A drip leg to drain the heavier particles should be provided immediately upstream of the first stage regulator.
3. Heat tracing must be placed over the vapor supply pipes if the ambient temperature falls within 10°F of the dewpoint of the LPG gas. Electric heat tracing is preferred with an appropriate controller. All heat tracing must be suitable for the class of hazardous location in which it is to be installed. Always consult with the appropriate authorities and all applicable codes.

MIXED GAS OUTLET

1. The temperature of the pipe must be kept above the dewpoint of the air/gas mixture. Heat tracing over the outlet pipe may be required as well.
2. A check valve must be installed in utility gas line if it is to be connected to utility gas main into plant.

NOTE

See the LPG gas dew points given in Appendix B

PROCESS CONTROLLERS

1. The **BLENDAIRE** comes with a local PLC control panel suitable for hazardous area classification and a remote HMI panel suitable for General Location.
2. The **BLENDAIRE** utilizes 4-20mA, 24 VDC to provide power and communicate with the devices on the mixer. 120VAC is used to control safety solenoids on the mixer.
3. See wiring Diagram for wire type and required field connections.

INSTRUMENT AIR SUPPLY

1. All safety shutoff valves and flow control valve operate on air and are closed when the air supply is cut off if a safety shutdown is triggered.
2. An instrument air regulator installed on the mixer must be supplied with clean, compressed instrument air of minimum 100 psi and no more than 150 psi.

CONFIGURATION OPTIONS

The BLENDAIRE is designed with flexibility in mind. Various configurations allow inlets and outlet on same side of equipment, on the opposite side of the equipment and 90 degrees apart from each other.

Figure 3 – Inlets and Outlet on Same Side

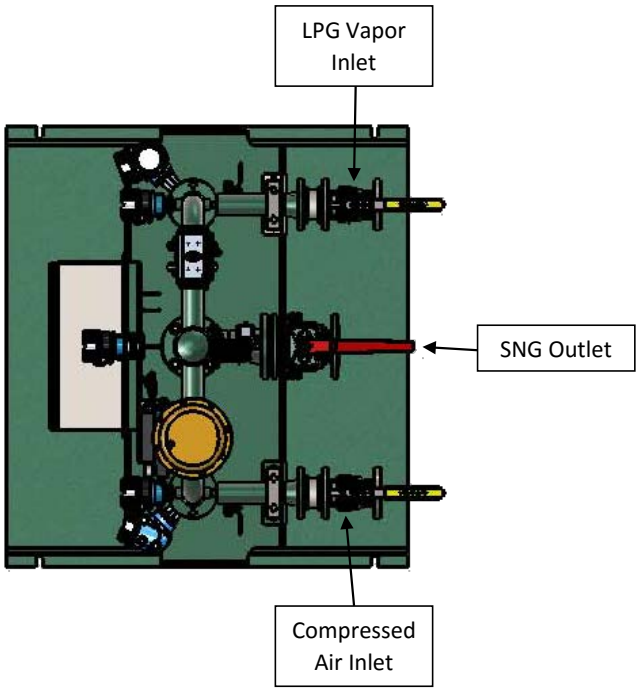


Figure 4 – Inlets and Outlet on Opposite Sides

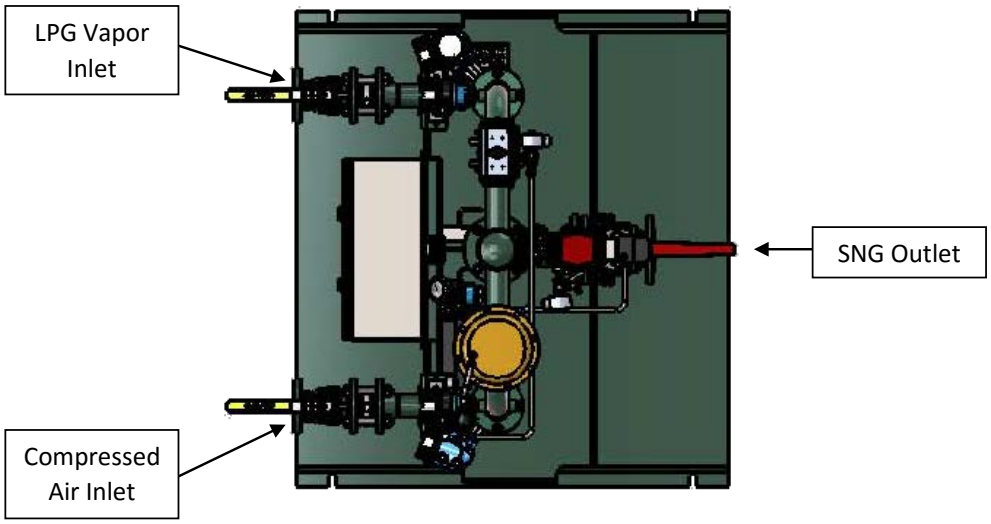
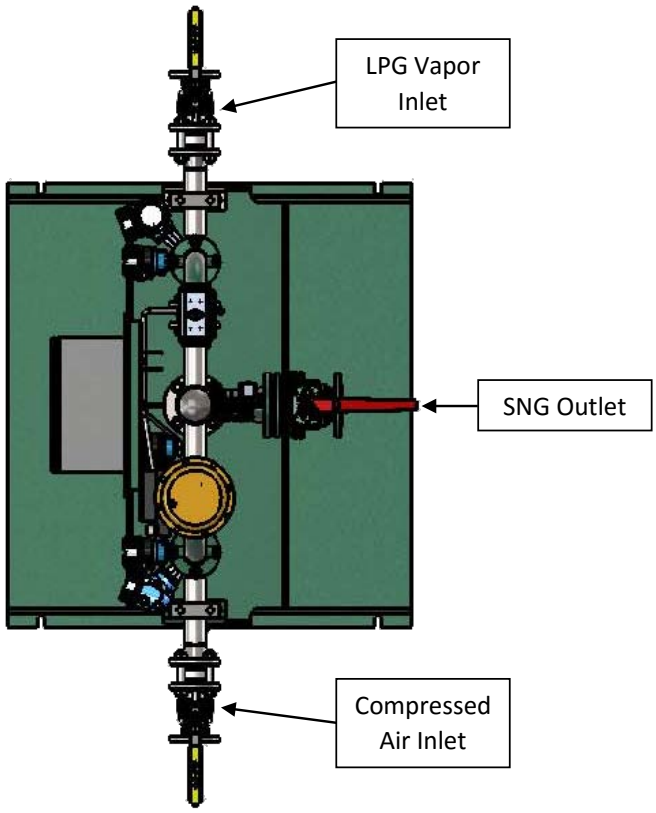


Figure 5 – Inlets and Outlet 90 Degrees Apart



4. Start-Up

The following procedures must be performed to each **BLENDAIRE** system when they are first installed.

**Refer to Figure 2 – Component Diagram for item numbers.

STARTING THE MIXING SYSTEM (INITIAL ADJUSTMENT)

BLENDAIRE REGULATOR ADJUSTMENT PROCEDURE

1. Make sure all field connections to mixer are completed and leak tested. Make all electrical connections to mixer per customer drawing and electrical drawing.
2. Turn on mixer but do not start. Verify through mixer HMI screens all instruments are connected and reading.
3. Open valves to supply Instrument Air, LPG and AIR to mixer. Keep mixed gas outlet valve closed.
4. Verify pressure readings on mixer LPG and AIR pressure transmitters match data sheet. Adjust regulators as needed to set pressure to data sheet values.

NOTE

The LPG in the system must remain in the gaseous state at all times. The regulators will not operate properly if there is ANY liquid in the system. Perform all necessary procedures to eliminate liquid in the system.

5. Make adjustments to LPG and AIR regulators as required under flowing conditions. Initial regulator settings can be found in the QA and Data Sheets.

BLENDAIRE MIXING RATIO ADJUSTMENT PROCEDURE

Ratio adjustment is conducted through settings in the HMI on the control panel. Refer to the **BLENDAIRE** HMI user manual for ratio adjustment settings.

STARTING THE BLENDER

1. Apply power to the control panel.
2. Depress the **START** switch on the HMI panel**.**
3. The instrument air solenoid valve will be actuated and the outlet pressure should increase to operational pressure.
4. Start the system on a **FLARE STACK** to dispose of the initial gas.
5. Adjust the mixing ratio or Wobbe Index setpoint of the mixer to the desired value on the HMI screen.
6. If necessary adjust line pack cut-in and cutoff pressures to desired values. Refer to the **BLENDAIRE** HMI user manual for operating set point adjustments.

NOTE

If the start-up is done under cold conditions and liquid has entered the system, do not restart until all liquid has been removed. If this condition exists, it is an indication that the system needs adequate heat tracing.

7. The outlet pressure is maintained by the vapor pressure regulator.

NOTE

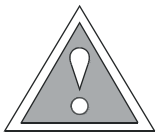
Do not change the output pressure from the design system pressure without changing the safety set points to the corresponding values

To restart the blender after a safety shutdown, determine and eliminate the cause of failure and begin the start procedure over.

8. During initial startup of mixer into an uncharged line flow rates can be very high. Alarms may occur during this charging phase until pressure in the line starts to equal the pressure outlet set point. Also, during this initial charging, nuisance tripping of excess flow valves on LPG tank may occur.

9. To reduce the flow rates during initial startup of mixer into an uncharged line, slowly open the mixed gas outlet valve allowing time for pressure in line to reach desired setpoint. This will help reduce nuisance alarm tripping during initial startup.

5. Operation



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SAFETY OPERATING GUIDELINES

The process control panel monitors the following safety functions:

1. Regulated AIR pressure upstream of the Air Flow Control Valve.
2. Regulated LPG vapor pressure upstream of the Vapor Safety Shutoff Valve.
3. Air and LPG Vapor flow rates.
4. Calculated gas / air mix ratio.
5. Wobbe Index or specific gravity from Gas Quality Feedback Device.

SHUTTING DOWN THE BLENDER

1. Push the STOP button on the HMI panel or local control panel.
2. Close the outlet valve.
3. If the unit is to be serviced perform the following:
    a. Close the air inlet isolation valve and the vapor inlet isolation valve, and instrument air inlet isolation valve.
    b. Disconnect the power supply to the BLENDAIRE.
    c. Safely vent all residual pressure in both inlet spools and mixed gas spool.

6. Maintenance

CAUTION

Turn off the LPG gas inlet valve to the mixer before performing any maintenance or repairs.

CAUTION

Before performing any work on the blender, follow all safety procedures for LPG gas; make sure there are no open flames or electrical sparks, and wear appropriate clothing. Turn off all electrical power to the mixer.

Blendaire Maintenance Schedule

DESCRIPTION	FIRST MONTH	EVERY MONTH	EVERY 6 MONTHS	EVERY YEAR	EVERY 2 YEARS
Flow Meters			Inspect housing seals & verify they're in good condition		Replace housing seals
Flow Control Valves			Perform visual inspection & verify operation		Rebuild actuator Replace main valve seal
Regulators	Inspect and clean lines.		Clean upper body		Clean and re-build
Safety Valve			Perform visual inspection & verify operation		Rebuild actuator Replace main valve seal
Pressure Transmitters			Re-calibrate & verify operation		Re-calibrate & verify operation; replace as necessary
PLC Controller Circuits			Perform visual inspection & verify operation		
PLC Controller Safeties	Check.		Perform visual inspection & verify operation		
Solenoid Valve			Perform visual inspection & verify operation	Clean valve	Rebuild valve
Control Lines				Clean and purge	

7. Troubleshooting

PROBLEM	CAUSE	SOLUTION
Mixer shuts down on high air pressure	First-stage air regulators are set too high or are malfunctioning.	Reduce air pressure setting or check/repair/replace first-stage air regulator
Mixer shuts down on high gas pressure	First-stage gas regulators are set too high or are malfunctioning.	Reduce gas pressure setting or check/repair/replace first-stage gas regulator
Mixer shuts down on low air pressure	Air compressor is turned off	Turn the air compressor on and ensure proper operation
	First-stage air regulator is set too low or is malfunctioning	Increase air pressure setting or check/repair/replace first-stage gas regulator
	Air inlet shut-off valve is closed	Open the valve
	Mixer is overdrawn on startup	Open mixed gas outlet valve slowly on initial start up
Mixer shuts down on low gas pressure	First-stage gas regulator is set too low or is malfunctioning	Increase gas pressure setting or check/repair/replace first-stage gas regulator
	The pump pressure to the vaporizer is low or pump isn't functioning	Check pump operation and incoming lines
	Vaporizer outlet valve is closed	Open the valve
	Gas inlet shut-off valve is closed	Open the valve
	Vaporizer shuts down on safety or is not up to temperature	Refer to vaporizer O&M to ensure proper operation
	Mixer is overdrawn on startup	Open mixed gas outlet valve slowly on initial start up
Safety shut off valves don't open on start	Instrument air pressure loss	Ensure instrument air supply valve is open and regulator pressure setting matches datasheet
	Safety solenoid valves malfunctioning.	Check wiring and/or repair solenoid valve(s)
Mixer shuts down on instrument under range or over range	Bad connection between instrument and PLC control box	Check all wiring between instrument and tighten any loose connections
	Instrument failed	Check instrument and repair/replace as necessary