

Propane / Air Mixer

- Model PA -

I. Summary of PA system

This System generates Propane + Air—13A Gas by mixing propane from a propane cylinder with air by venturi mixer.

At first, LP gas from the LPG cylinders flows through the high pressure hose and shut-off valve, then the first stage regulator reduces the pressure to $0.095\pm 0.01\text{MPa}$ (0.85 – 1.05 bar). The gas passes through the first stage regulator and then through the open-close valve and is ejected from the nozzle in the venturi mixer where the gas mixes with air at an exact ratio. This air is absorbed from the atmosphere through the air intake valve (which incorporates a filter). Then, the mixed gas passes and is stored in cushion tank.

The diaphragm in the open-close valve controller detects the pressure of the mixed gas in the cushion tank. This controller sends On/Off pressure signals to the open-close valve by opening or closing the valves in the controller. This is how the controller controls the ejection of LP gas in the venturi mixer.

The UPSO/OPSO (Over Pressure Shut Off/Under Pressure Shut Off) controller is linked with the outlet of first stage regulator. This controller checks whether the outlet pressure of the regulator is within range of the designed pressure. When the pressure is out of the range, the controller sends a shut off signal to the shut-off valve and shuts down the valve.



II. Main Parts in PA System

1) LP Gas

For this system the Propane content of the LP gas needs to be more than 95%. We also need to check the remaining quantity of liquid LP gas in cylinders. It is necessary that the remaining quantity is not less than 20% of a cylinder. If the remaining quantity in a cylinder were less than 20%, then the proportion of butane in the LP gas would increase and the calorific value of the mixed gas would increase to a value which is out of the specification.

2) High Pressure Hose

These High Pressure LP gas hoses connect the cylinders to collecting devices.

3) Collecting Device

This is a pipe which connects to several high pressure hoses. Ball valves with built-in check valve are used as connectors to each high pressure hose.

4) Pressure Decompression Valve (Appurtenance Regulator)

This regulator is used for reducing the possibility of LPG re-liquefaction. High pressure gas flows between the cylinders and the first stage regulator in the PA system. If gas consumption is stopped and the atmospheric temperature decreases, re-liquefaction can happen and gas LPG returns to liquid LPG between cylinders and the regulator. When the gas consumption is resumed after this stoppage, this liquid LP gas rushes into the nozzle orifice in the regulator and turns to gas LPG at the outlet of the nozzle rapidly. It leads a much high pressure at the regulator outlet. As a result, safety devices in the PA system start to work and the shut-off valve stops the gas supply. In order to reduce the frequency of this phenomenon, this regulator takes the preliminary action of decompressing the high pressure gas from the cylinders .

5) Inlet Valve

This valve can be used for emergency shut down, and control of the gas supply into the system - the gas supply stops or starts by manually activating this valve.

6) Shut-off Valve

The abnormal negative pressure at the mixing part in the Venturi mixer ($-1.5 \pm 0.5 \text{ kPa}$ / $-10 \div -20 \text{ mbar}$) and the working pressures sent by the UPSO/OPSO controller, the OPSO controller, and the over pressure shut off valve when they detect abnormal pressures close the valve. It stops LP gas supply coming from the cylinder automatically – it can be reset once the problem has been resolved by manually pushing the valve reset button.

7) First Stage Regulator

This regulator controls and reduces gas pressure from the cylinders to a stable ejecting pressure, $0.095 \pm 0.01 \text{MPa}$. (0.85 – 1.05 bar).

8) Open-Close Valve

This valve receives the pressure signals from the Open–Close Valve Controller, which detects a change of pressure in the cushion tank. It cycles opening and closing the valve and controls the gas supply to the venturi mixer.

9) Air Intake Valve

This valve, mounted at the inlet of air suction part in venturi mixer, opens on production of the mixed gas and closes in order to prevent back flow of the mixed gas to the outside and stopping the operation. (This valve incorporates a mesh filter to ensure no foreign bodies are drawn into the system).

10) Venturi Mixer

This mixes the LP gas and air at designed ratio by ejecting LP gas through the internal nozzle, supplied from the first stage regulator at very high speed and sucking up surrounding air.

11) Cushion Tank

This tank temporarily holds the mixed gas from the venturi mixer. This can reduce the frequency of the opening and shutting of the open-close valve and regulate any temporary disorder of the proportion of the mixed gas's composition. During use, the maximum pressure here is 16kPa (160 mbar) in the specification.

12) Open-Close Valve Controller

It checks the gas pressure in the cushion tank and controls the open and shut operations for the open-close valve. When the gas pressure in the cushion tank decreases to $5 \sim 7 \text{kPa}$ (50 – 70 mbar) due to gas consumption, this draws the in-tank pressure from the cushion tank into the open-close valve and open the valve. When the gas pressure in the cushion tank increases to $14 \sim 16 \text{kPa}$ (140 – 160 mbar), this then closes the open-close valve.

13) UPSO/OPSO Controller

When the outlet pressure of the first stage regulator increases to maximum pressure set $0.15 \text{MPa} \pm 0.02 \text{MPa}$ (1.5 bar) or decreases to minimum pressure set $0.05 \text{MPa} \pm 0.02 \text{MPa}$ (0.5 bar), this draws the outlet pressure from first stage regulator and triggers the shut-off valve and the shut-off valve stops the gas supply from cylinders.

14) OPSO Controller (Over Pressure Shut Off Controller)

If the outlet pressure of the open-close valve (ejecting pressure) increases to $0.15\text{MPa}\pm 0.02\text{MPa}$, (1.5 bar) this controller shuts the shut-off valve.

15) Over Pressure Shut Off Valve

This is a part of CR controller. If the gas pressure in the cushion tank increases to $23.0\pm 3\text{kPa}$ (230 mbar) on gas ejection, this controller shuts the shut-off valve.

16) Second Stage Regulator (Low Pressure Governor)

This regulates the mixed gas pressure from the cushion tank to $2.0\pm 0.5\text{kPa}$ (15-25 mbar) and supplies the mixed gas to the gas consumption devices.

17) Outlet Valve

For emergency, gas supply stops by shutting this valve. Also use for closing down the system.

18) Time Counter

This counts the total opening time of the air intake valve to use a calculation of the quantity of gas consumption. By calculating the quantity of gas consumed, we can know the quantity of the remaining liquid LP gas for ensuring that this does not fall below 20% of a cylinder filling volume. (Time counter is not standard equipment on the PA-13A30NA.)

19) Cover

This gives protection to the PA system from rain, snow and other foreign bodies.