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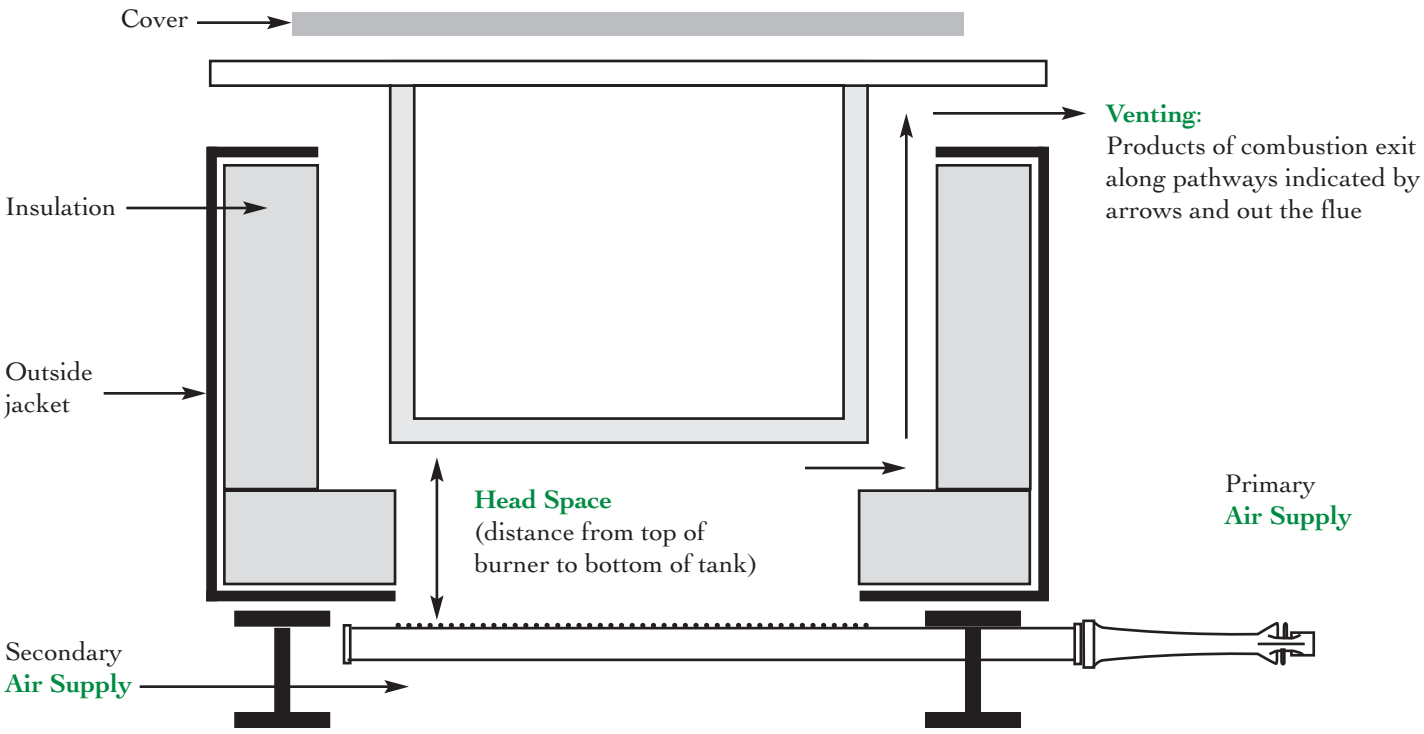
Design Considerations for Venturi Burners

Successful design for Venturi (atmospheric or air/jet) burners requires attention to four fundamental aspects of combustion: gas supply, air supply, head space and venting. This booklet provides a general overview of the role each plays in safe, efficient combustion, as well as some practical guidelines for designing standard installations.

Basic Venturi Burner Requirements

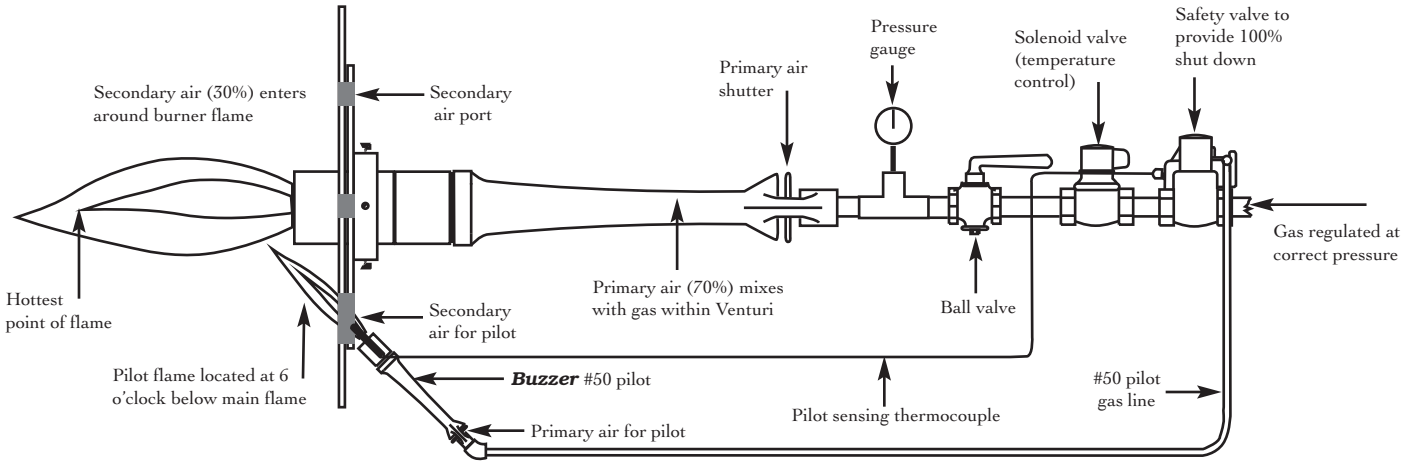


Gas supply

In order for a Venturi burner to operate at full capacity, the gas supply piping must provide the burner with a sufficient volume of clean gas at the correct operating pressure. As a rule of thumb, a standard Venturi burner can be supplied with a half length of pipe (ten feet) of the same size as the burner's gas connection. For multiple burners, this would be the size of the manifold connection.

However, if the gas supply pipe is longer than ten feet, includes more than two 90º ells, or services a number of pieces of equipment simultaneously, you may require a larger diameter pipe, as well as a gas pressure regulator, to provide a consistent supply of gas to the burners. Sudden decreases in gas pressure can cause pressure switches and/or safety valves to shut burners down at inopportune times and will result in inefficient heat-up and recovery times. These types of fluctuations in the gas supply in complex installations can be eliminated by installing a second stage gas pressure regulator at the burner. To ensure a clean supply of gas to the burner, use a simple "Y" strainer. A strainer, made of brass or bronze, filters any impurities or solids from the gas supply, preventing orifices or pressure regulators from becoming clogged.

Venturi burners require sufficient primary and secondary air



Air supply

All Venturi burners require sufficient quantities of both primary and secondary air for safe, efficient combustion. Primary air is the air entrained into the Venturi mixing tube via the kinetic energy created by the gas stream passing through the orifice. Primary air is mixed with the gas inside the Venturi body. Secondary air is the air that enters the combustion chamber and mixes with the burner flames to complete combustion. A ***Buzzer*** Venturi air mixer can provide up to 75% of the air needed for complete combustion when operating on low "household" pressure gas; the remainder must come from an ample secondary air supply. This is the principal reason why no Venturi burner will operate properly in a sealed-in combustion chamber.

Insufficient primary air results in low flame temperature (inefficiency) and will eventually cause carbon build-up on the bottom of your tank or heated working surface. The build-up then acts as an insulator, further decreasing the efficiency of the system. Insufficient primary air is evidenced by candle-yellow tips on your burner flames. Usually a simple adjustment - *opening the primary air shutter located at the front of the Venturi* - provides adequate primary air. However, insufficient primary air can also be caused by an oversized orifice, which will pass more gas than the Venturi mixer can supply with air. For instance, this can

easily occur when attempting to operate a pipe burner set up for natural gas on propane. In such a case, the gas orifice must be reduced.

Lack of secondary air will also cause soot and carbon to build up, again reducing the efficiency of the system. Lack of secondary air is evidenced by a hazy, undefined, soft-bluish flame which will often be visible exiting through the flue or opened oven/furnace doors. When designing your system, consider the burner's proximity to objects which could limit secondary air flow. Burners should not be located too close to the floor or adjacent walls. Skirting, if used, must permit sufficient secondary air flow: consider expanded metal, which readily admits air, rather than sheet metal. Even with careful planning, you will sometimes find it necessary to enlarge the secondary air ports.

Head Space

Head space is the distance between the top of the burner and the bottom of the surface being heated. Proper head space allows room for complete combustion to take place. With adequate head space, all burner flames are visible and well-defined. The inner cone of the flame should not strike the surface it is heating, as a crowded flame results in incomplete combustion. There should be no odor of gas.

As a rule of thumb, a single Venturi pipe burner should have head space equal to approximately two times the diameter of the burner pipe. For multiple burners, add ½" of head space for each additional burner pipe. For standard Venturi ring burners, head space should equal approximately 75% of the ring burner's outside diameter. These calculations should provide a good initial estimate. However, in order to permit minor adjustments to head space if required, it is always advisable to **secure burner support brackets with simple nuts and bolts**, rather than with spot welding.

Insufficient head space can be extremely dangerous, as it often prevents complete combustion, releasing unburned gas and flames into the work area. Insufficient head space is evidenced by undefined blue/yellow flames rolling out from under the tank or object being heated. Rolling flames can result in fire or personal injury. **Your design should readily allow for adjustment to the head space, and any problems must be promptly resolved.**

Venting

Once hot gasses and the products of combustion have heated the work, they must be properly vented from the appliance. As a rule of thumb, figure on a minimum of one square inch of flue venting per 6,500 BTU/hr **along the entire pathway that the products of combustion will travel**, including flue inlet and outlet. We always recommend rounding this figure up slightly, for safety. In addition to providing sufficient area, a properly designed flue vent is free of all obstructions. There must be a natural flow of the hot products of combustion upwards and out through the flue. The flue should be located at the highest possible point. This arrangement utilizes as much of the available heating surface as possible while preventing potentially dangerous back-up of the products of combustion. The products of combustion should then be collected by a draft hood or canopy and vented out of the building.

Your venting design should permit cool room air to enter the appliance at the lowest possible point, and then provide ample, unobstructed passage for the spent gasses and products of combustion upwards, to vent naturally through the highest possible point. Improper venting can be extremely hazardous, as it often prevents complete combustion and may permit the products of combustion to choke the workplace. Any evidence of insufficient venting must be addressed immediately. As local building codes vary widely, it is also essential to consult a local source for exact ventilation specifications. We further recommend the current NFPA 86 Standards for Ovens and Furnaces sections 3-4 "Ventilation and Exhaust System" as well as ANSI Standards Z21.30 "Installation of gas appliances and gas piping."

Any questions? The Hones family is ready to assist you in making the system you dream of a reality. From design through installation, we welcome your inquiries. For further information, please contact us.

Hones ***Buzzer*** Venturi gas burners offer:

Simplicity	No blowers or compressed air required for combustion; compatible with simple temperature and pilot controls.
Economy	Simple, efficient design minimizes cost of installation, operation, and maintenence
Quality	Hones commitment to superior construction ensures rugged, reliable equipment

Important safety note

We offer this basic design information to help you begin to develop a safe, efficient design. However, because each installation is unique in its requirements, please consult with your equipment suppliers, gas company, or other experts for the particulars of your system as your design emerges. The information contained herein is by no means exhaustive and cannot substitute for a thorough analysis of the specific requirements of each particular system. This booklet is not intended to be used as an installation manual.

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