Universal Vortex, Inc.
A Thermal Solution...

The Vortex Pilot Gas Heater

- Adds up to 90°F to the pilot supply gas.
- Heats pilot gas as an outcome of the routine gas pressure reduction.
- Not sensitive to wet gas.
- No lost gas.
- No chance of overheating.
- No maintenance, EVER!
- Easy to install or retrofit in new or existing facilities.

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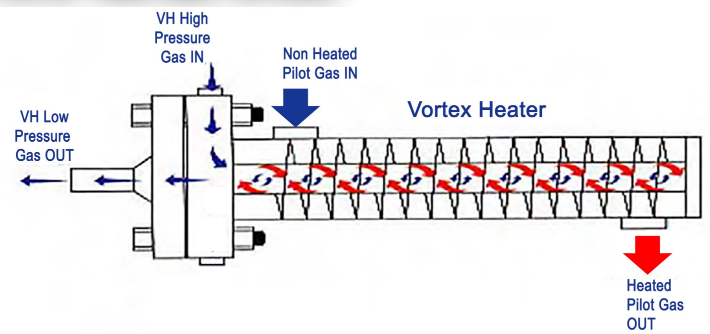
Principle of Operation

A high pressure gas as it passes through the Vortex Heater's (VH) inlet tangential nozzles undergoes pressure reduction and flow velocity increase. The VH converts this high kinetic energy flow into the low and high temperature vortex currents (Vortex Phenomenon). Since the high temperature vortex current is located close to the VH walls, the current's thermal energy is tranferred through the VH wall to the pilot gas flow passing through the heat exchanger setup on the VH walls. The depressurized gas flow is discharged from the VH to the low pressure line downstream of the pressure regulator



Installation and Start Up

The VPGH should be installed in the vertical position as shown in Pic.1. The recommended VH inlet pipe location is on the top of the main gas pipeline. Care should be taken to prevent pipe sealant or teflon tape from entering the VH inlet.

The VPGH installation schematic is shown in fig. 2. A FISHER 627M pilot should be installed with the pressure sensor connected to the low pressure line downstream of the regulator. The FISHER 627M mounting should provide over pressure protection of the downstream system and should shut off or close when the downstream pressure exceeds the set point. Otherwise the FISHER 627M should operate in the fully open position. It is recommended to maintain the FISHER 627M set point just above the set point of the pilot operated regulator.

Pilot load lines (both heated and unheated) and the Pilot as well as the Vortex inlet manifold should be covered on site with polyethylene foam pipe insulation 3/8" thick for thermal insulation, and after that wrapped with a polyethylene repair tape for waterproofing. Both foam pipe and tape are supplied by UVI (Insulation kit).

Pressure gauges upstream and downstream of the VH are recommended for the unit's startup. In the correct setting (no restrictions in the inlet or outlet lines), the upstream pressure gauge reading is equal to the main line's upstream pressure. Correspondingly, the reading at the VH outlet is equal to the main line's downstream pressure.

Operation

The gas flow with the pressure equal to the upstream main line pressure expands in the VH inlet nozzles, undergoes energy seperation (Vortex Phenomenon) and leaves the VH through its discharge orifice connected with the main line, downstream of the regulator. Since the VH flow is a fraction of the main flow, the VH discharge pressure will always be equal to the current downstream gas pressure. A pilot gas, taken upstream of the pressure regulator enters the VH heat exchanger, picks up the heat and with the same upstream pressure, is directed to the pilot. At the stations low flow, the VH performs as a primary regulator, providing for a main regulator shut-off and thus reducing the regulators maintenance.

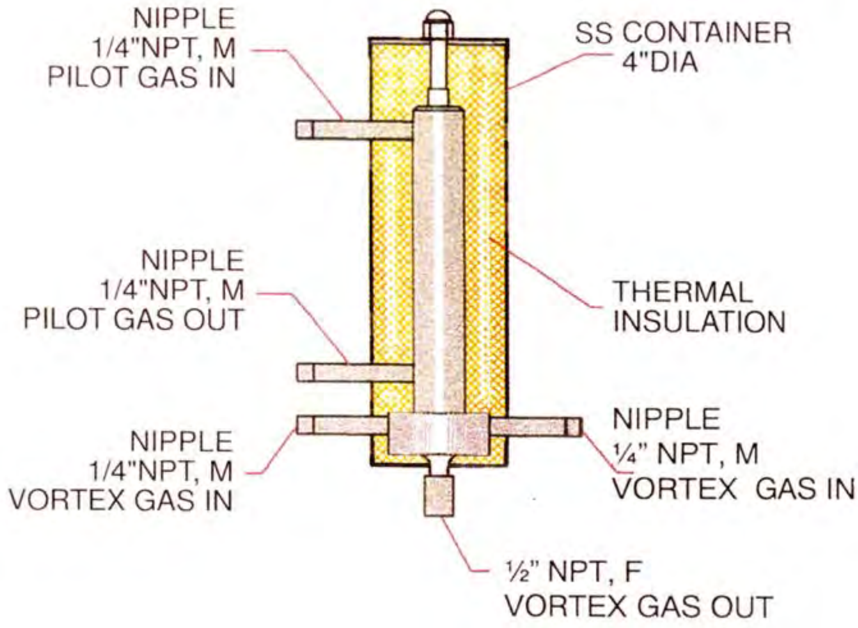
Pic.1

Maintenance

No maintenance is required

Flow Rate

The Vortex Heater's flow rate at the inlet gas pressure of 135 psia and the gas pressure ratio of 2.5 is approx. 45 SCFM. While the gas pressure ratio is 2.5 or higher, the inlet pressure increase results in the proportional increase of the flow rate through the VH. At the lowest gas pressure ratios, the flow rate through the VH decreases gradually to approximately one half of the high pressure ratio's flow.



Vortex Pilot Gas Heater (VPGH)

(as supplied by Universal Vortex, Inc.)

Material Specifications

Material Item List

1 **Vortex Pilot Gas Heater**
2 **Fisher 627M Pilot w/ Orifice no less than 3/8"**
3 **Lockup Valve (optional) 1/2" NPT**
4 **Lockup Valve(optional) 3/8" NPT**
5 **Pilot gas filter**
6 **Recommended Start-up pressure gauge tap connection (3/8" I.D. min.)**

Piping

I **Vortex Supply, 1/2" I.D.**
II **Vortex Outlet, 1/2" I.D.**
III **Pilot Load, 1/4" I.D.**
IV **Control Line (as per 627M)**

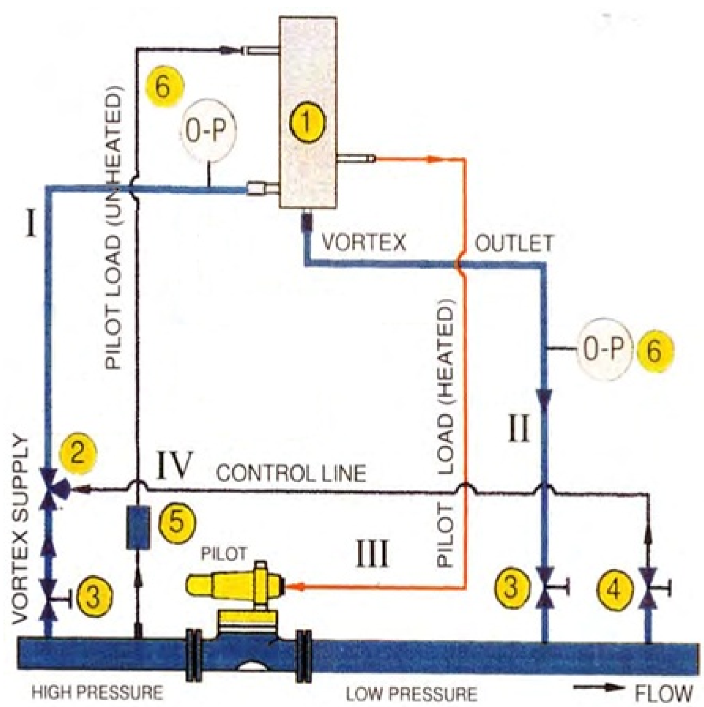


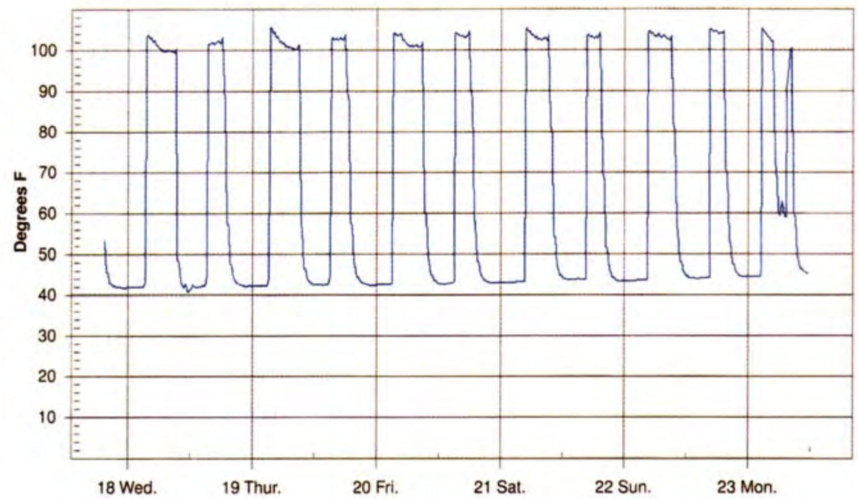
Figure 2

Vortex Pilot Gas Heater Installation Schematic

Performance

A typical graph of the VPGH performance is shown to the right. The data was monitored in winter during VPGH operations at a gas pressure regulation station.

The flat upper part of the graph demonstrates the actual pilot gas temperature (some 100° F) while the station is in operation. When the stations' flow is zero (flat bottom parts of the graph) the pilot gas temperature is about 40° F, e.g. equal to the ground temperature. Thus, the net increment of the pilot gas temperature is about 60° F.



VPGH Characteristics

VPGH overall dimensions:	***4" DIA x 10" Long***
Weight :	***5.3 Lbs.***
External Connections:	***1/4" Standard NPT***
Material of Construction:	***304SS***

It is designed for an operating pressure of 1000PSIG. Each unit is certified by a Hydrostatic Test of 1500 PSIG.

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Dual Path Vortex Pilot Gas Heater

A **Dual Path Vortex Pilot Gas Heater (VPGH-DP)** performs on the same principles as the VPGH. It has a larger heating capacity and can efficiently heat pilot gas flow twice as much as the VPGH's pilot gas flow. The **VPGH-DP**'s heat exchanger is set up on the Vortex Heater's walls. The heat exchanger consists of two separate chambers, each of them designed to heat a separate pilot gas flow. Therefore, the **VPGH-DP** can operate two pilots at once and independently of each other.

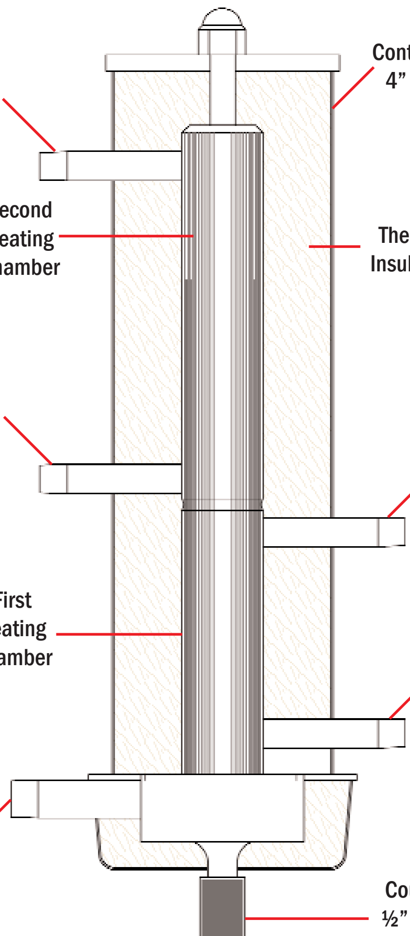
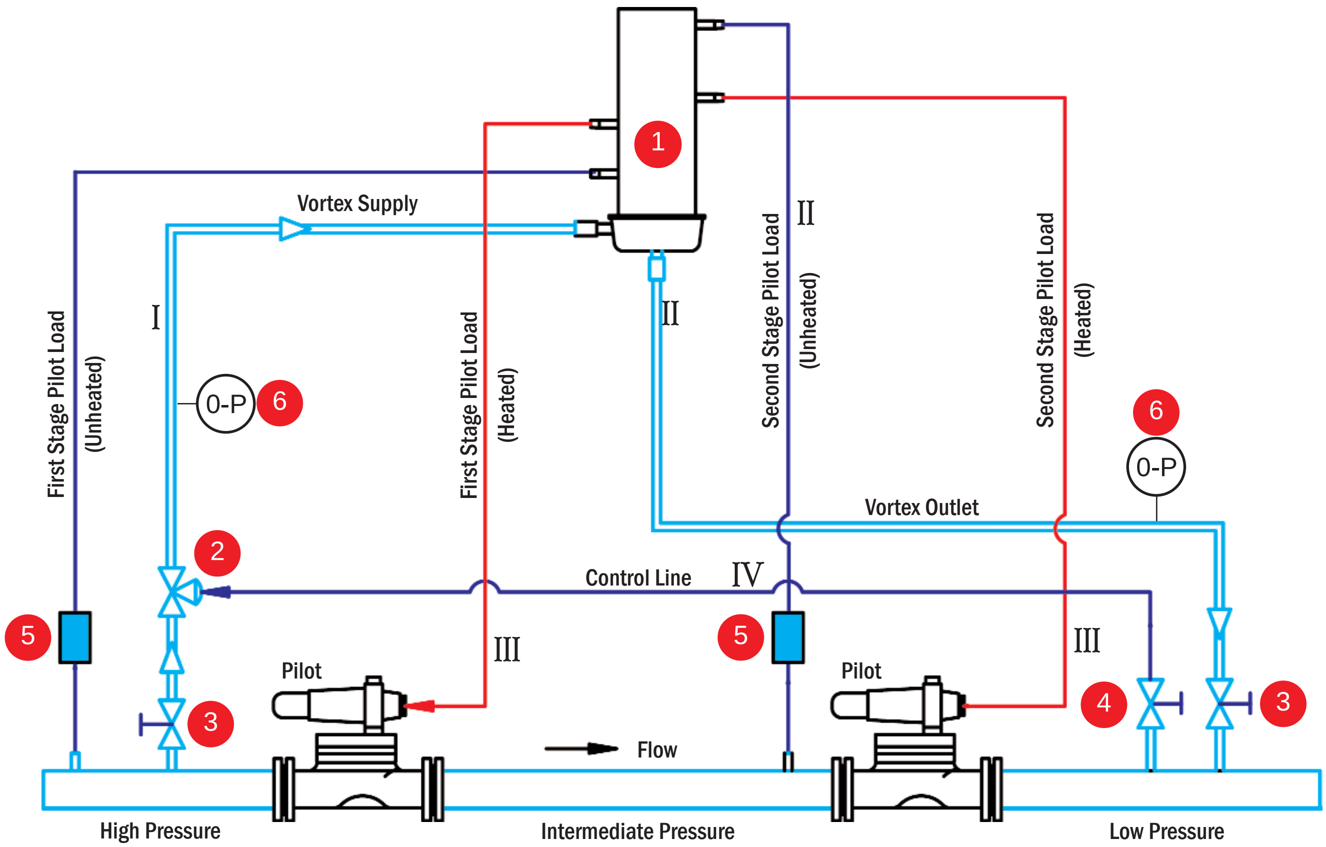


Figure I
Dual Path Votex Pilot Gas Heater (VPGH-DP)
[as supplied by Universal Vortex]

Field Installation Photos of the **VPGH-DP**

Only one VPGH-DP is needed to serve pressure regulation run with either **standby monitor** or with **working monitor in two-stage sequences.**



Material Specification

MATERIAL - ITEM LIST:

1. Dual Path Vortex Pilot Gas Heater
2. Fisher 627M Pilot w/orifice no less than $^3/_8$"
3. Lockup Valve (optional) $^1/_2$" NPT
4. Lockup Valve (optional) $^1/_4$" NPT
5. Pilot Gas Filter
6. Recommended Start-Up Pressure Gauge

Installation and Start-Up

The VPGH-DP installation, overpressure protection, start-up and insulation requirements are the same as for the VPGH. The VPGH-DP installation schematic for two-stage pressure regulation with monitor is shown in Figure II. It is recommended to direct the first-stage pilot gas to the VPGH-DP's first chamber, and the second-stage pilot gas to the second chamber. In the case of a standby monitor sequence, heated pilot gas from the first chamber goes to the worker and the heated pilot gas from the second chamber goes to the monitor.

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Pilot Gas temperature increment in the Vortex Pilot Gas Heater

The pilot gas temperature increase in the VPGH is a result of heat transfer from the heat generating part of the VPGH.
The heat generated in the VPGH is, roughly, proportional to the unit inlet to outlet pressure ratio, which is a ratio of the Pressure Regulating Station upstream to downstream pressures. Joule-Thomson temperature drop in the VPGH pressure reducing nozzles equal to the PRS upstream and downstream pressure differential reduces the vortex heat flux transferred to pilot gas.

Calculated values of the pilot gas temperature increment at different gas pressure ratios and gas pressure differentials are in the chart

Inlet Gas Pressure, psi	Outlet Gas Pressure, psi	Pilot Gas Temperature Net Increment, ºF
1500	150	50-55
1030	150	72-76
730	150	83-90
440	150	72-76
260	150	45-55

Measured values of the Pilot gas temperature increment are reduced by the heat losses to piping and ambient. Pipe insulation decreases but not eliminates these loses.

In the chart below are the values of the Pilot gas temperature increase in the VPGH measured in the field with an Infrared thermal gauge.

Inlet Gas Pressure, psi	Outlet Gas Pressure, psi	Pilot Gas Temperature Net Increment, ºF
980	60	80-90
690	60	90-100
365	60	85-95
700	350	30-40
850	350	40-50

Maximal Flow Rates - The maximal flow rate takes place when the VPGH inlet pressure is 2.2 and more times greater than its outlet pressure.

Gas inlet pressure, psig	Flow Rate, VPGH-DP Approx 34 X PSIG	Flow Rate, VPGH-SP Approx 20 X PSIG
300	170 SCFM (10,200 SCFH)	100 SCFM (6000 SCFH)
500	280 SCFM (16,800 SCFH)	165 SCFM (9,900 SCFH)
700	390 SCFM (23,400 SCFH)	230 SCFM (13,800 SCFH)
900	510 SCFM (30,600 SCFH)	300 SCFM (18,000 SCFH)
1100	600 SCFM (36,000 SCFH)	353 SCFM (21,180 SCFH)
1300	710 SCFM (42,600 SCFH)	417 SCFM (25,020 SCFH)
1500	820 SCFM (49,200 SCFH)	482 SCFM (28,920 SCFH)