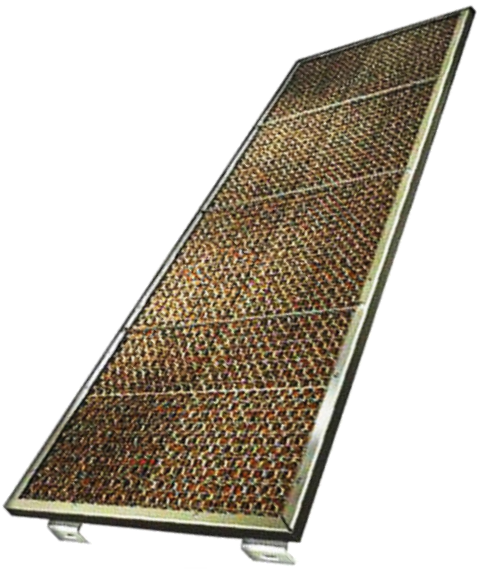
VULCAN™ IR SYSTEMS

INFRARED SYSTEMS • COMPONENTS • SERVICE

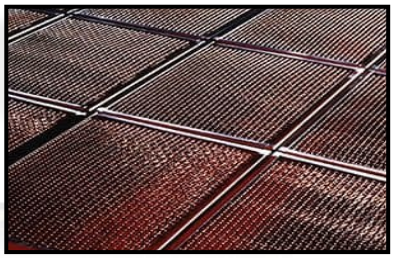
HEATER PANEL MANUAL

INSTALLATION, OPERATION AND MAINTENANCE

FLAMELESS GAS CATALYTIC INFRARED HEATERS



CONTENTS



Engineered systems that are designed and/or supplied by VULCAN™ IR Systems, Inc. include **FM Approved** Catalytic Heater Panels, **UL Listed** Control Cabinet, Valve Train and Zone Controls. Additionally included, are specifications, installation instructions, plumbing and wiring directions which are to be used in conjunction with this Heater Manual.

This Document is provided as a reference tool, for the installation and operations of the Catalytic Heaters. All Country, Federal, State, and Local codes must be considered, taking precedent over these recommendations. The oven assembly, complete with controls and gas management must comply, at a minimum, with NFPA-86, and current NEC.

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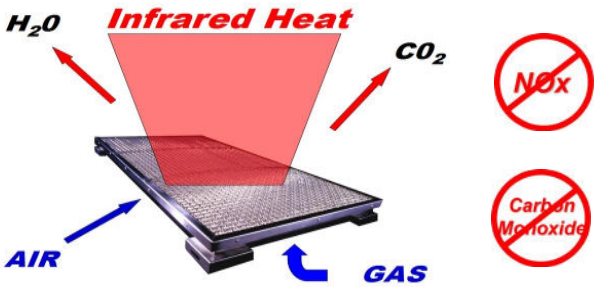
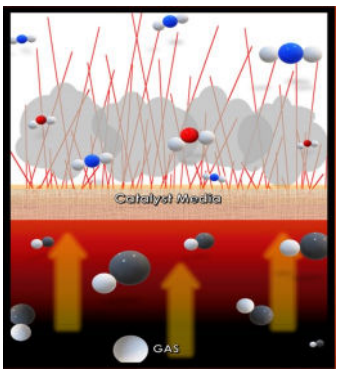
TECHNICAL INTRODUCTION

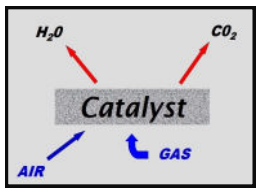
CATALYTIC REACTION

VULCAN™ catalytic panels are a diffusion heater that safely operate utilizing a chemical oxidation reduction process. There is no forced air or oxygen supplied for the chemical reaction. Air that is required for the reaction is diffused through the heater surface and into the reaction sites at the platinum/gas interface.



VULCAN™ IR heaters use a specialized platinum catalyst to break down the components of natural gas or propane to water and carbon dioxide, releasing heat in the process. This flameless reaction occurs within a temperature range of 350-1000°F/175-540°C with such efficiency, neither NOx or CO is exhausted. The heat produced from this reaction is easily controlled by the regulation of gas flow at very low pressure.

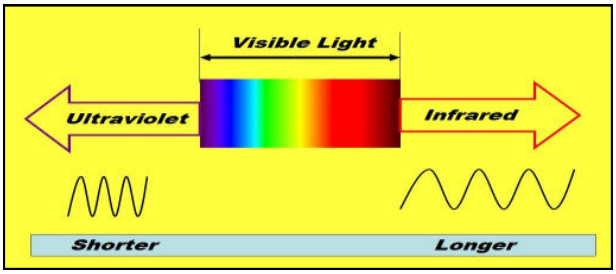




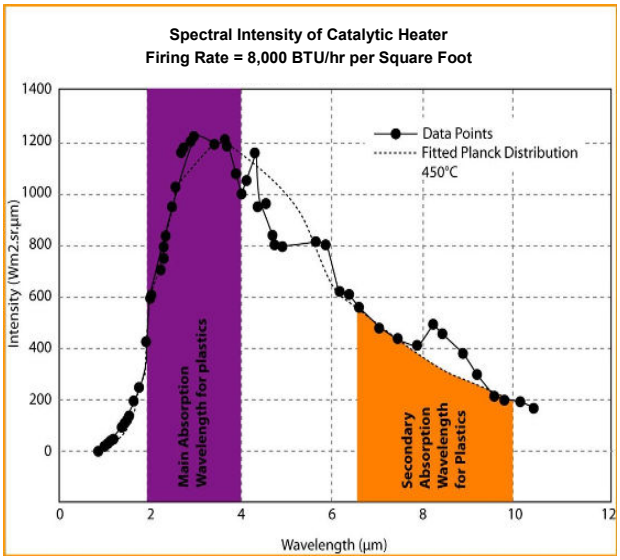
Long to medium wave catalytic heaters are a lower cost alternative to electric resistance heaters. Catalytic heaters also offer several process improvements over combustion/flame burners by more evenly dispersing energy or radiant heat. When compared to convection heating, many types of infrared are a faster and more efficient way to transfer energy.

INFRARED ENERGY

Recognized as radiant heat, electromagnetic radiation are wavelengths found just below the visible light spectrum. Just as visible light is made up of a variety of different wavelengths seen in a spectrum of color, so too infrared is made up a wide range of wavelengths. All objects emit infrared radiation, but the amount and range of wavelengths change depending on the temperature of the matter emitting it.



A catalytic heater operating at 900° F (482° C) converts 80% of the incoming gas into infrared energy that is in the 3.5 micron wavelength, it is at this wave length that all organic materials efficiently absorb infrared energy, rapidly raising their temperature. It is for this reason that catalytic heating is proving to be the most cost effective way of heating and curing coated surfaces such as liquid and powder coatings as well as an ideal method of heating plastics in thermoforming and drying of water for many surface types and substrates.



SPECIFICATIONS

HEATER PANEL: STANDARD DIMENSIONS

MODEL	*Length - in*	*Width - in*	*Length - mm*	*Width - mm*	*Area - in²*	*Area - m²*
P1620C	16 in	20 in	406 mm	508 mm	320 in²	0.206 m²
P1640C	16 in	40 in	406 mm	1016 mm	640 in²	0.413 m²
P1651C	16 in	51 in	406 mm	1295 mm	816 in²	0.526 m²
P1660C	16 in	60 in	406 mm	1524 mm	960 in²	0.619 m²

**Custom sizes available.*

HEATER: ENERGY SPECIFICATIONS - 8k BTU/sf @ 100% OUTPUT

MODEL	*MAX OUTPUT*		*ELECTRIC PREHEAT Amperage Draw by Element Voltage*						*GAS FLOW/hr (High Fire)*			
#	*BTUhr*	*kWhr*	*120V*	*208V*	*220V*	*240V*	*380V*	*480V*	*Natural Gas ft³*	*m³*	*Propane lbs.*	*kgs.*
P1620C	17,760	5.20	4.3	2.5	2.4	2.2	1.4	1.1	17.7	0.50	0.82	0.37
P1640C	35,520	10.41	8.7	5.0	4.7	4.3	2.7	2.2	35.4	1.00	1.64	0.74
P1651C	45,360	13.29	11.1	7.3	6.0	5.5	3.5	2.8	45.3	1.28	2.10	0.95
P1660C	53,360	15.64	13.0	7.5	7.1	6.5	4.1	3.3	51.5	1.46	2.48	1.12

ALL heater panels include the following:

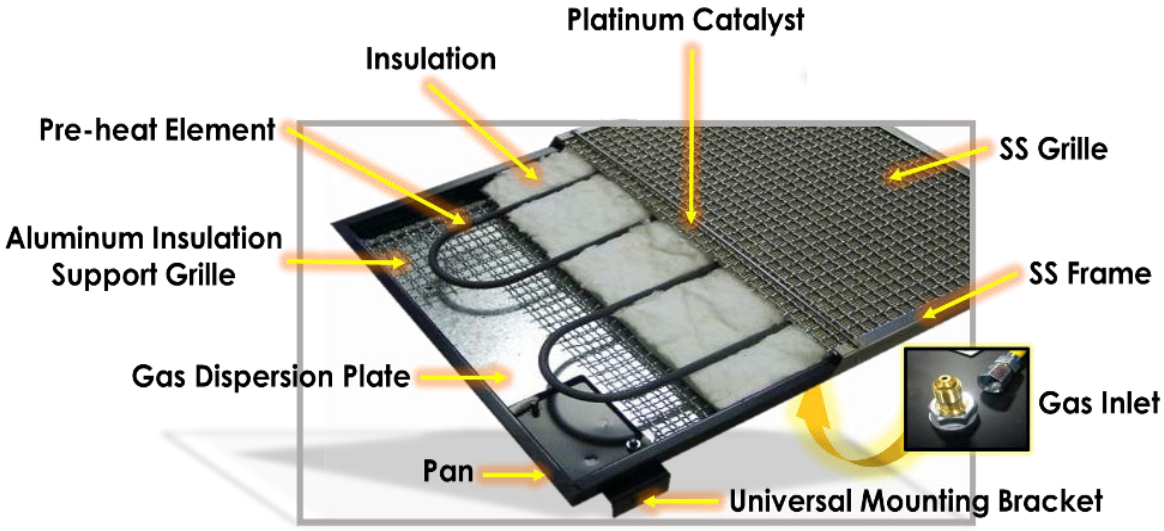
- Choice of voltage: 120V | 208V | 220V | 240V | 380V | 480V
- 3/8" NPT gas inlet connection
- Choice of either NG or LPG fuel gas *
- **NG** operational ranges:
  - 0.5"WC (1.3 mb) / Low Fire to 4.0"WC (10 mb) / High Fire
- **LPG** operational ranges:
  - 1.0"WC (2.5 mb) / Low Fire to 11"WC (27.4mb) / High Fire

The gas inlet location and orifice size differs for each model based upon fuel gas. These components are critical for control of the chemical reaction, ensuring proper flow rate and a homogeneous distribution of gas throughout the catalytic heater panel.

The fuel gas must be specified when ordering heater panels - they are NOT interchangeable

CONSTRUCTION

The VULCAN™ IR catalytic heater is a multi-layer device with each component serving an important function. Gas is introduced at very low pressures and evenly dispersed throughout the entire heater panel via a dispersion plate mounted within the pan. An electrical preheat element is used to start the catalytic reaction by preheating the catalyst layer. Installed on top of the insulation, the elements are then covered by a layered catalytic composite- the workhorse of this heater. To contain the light heater contents, a layer of basalt scrim is placed directly on top he catalytic pad. Next, a SS grill is held in place using an exterior frame secured with SS pop rivets. Further aspects of the heater panel construction are covered under patents issued within the United States, Canada and United Kingdom.

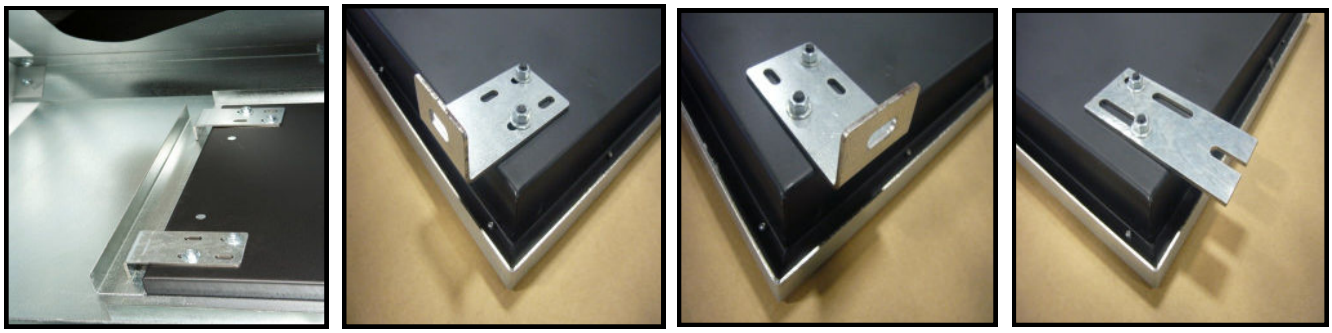


MOUNTING

UNIVERSAL MOUNTING BRACKETS

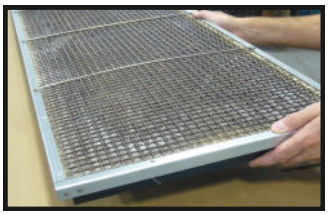
VULCAN™ IR catalytic heaters are designed for simple installation using multi-purpose brackets that are attached in one of three ways. The first two methods allows for connecting along either of the 2 sides, with the 3rd for use when attaching into a sheet metal aperture. In this case the heater is securely attached while allowing for the expansion and contraction of the heater and the surrounding oven.

NOTE: When attaching brackets to the heater, do not over tighten nuts. Hand tighten nuts, then turn an additional 1/4 turn rotation with wrench.



INSPECTION

INSPECT EACH HEATER



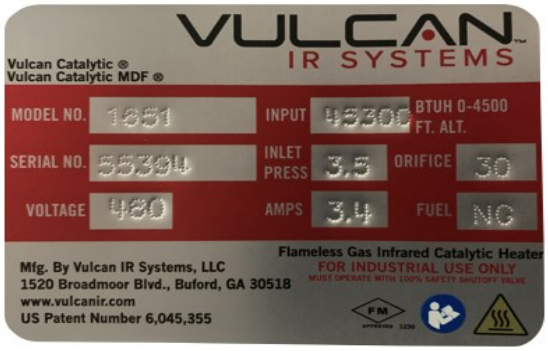
Remove the heaters from their shipping cartons. Always place the heaters on a flat surface with the SS screen side up. To avoid damage to the underlying catalyst material surface, DO NOT place anything on top of the panel. Inspect each panel for any obvious damage.

MANUFACTURERS LABELING

Locate the manufactures label on the back of the heater panel. Ensure that all specified information matches, including fuel type and voltage. If you find a label that does not correctly match, contact VULCAN™ IR Systems Technical Services immediately and verify information, prior to placing **ANY** heater into

READING THE MANUFACTURERS LABEL

EXAMPLE: Each affixed label includes a model number (outer pan dims), unique serial number, orifice size and operating parameters. Using natural gas (NG) as a fuel, the example (right) demonstrates a heater which operates with 3.5" WC (8.72 mb) at full fire. The size 30 orifice is installed to specifically regulate proper amounts of natural gas for it to achieve 45,300 BTU/hr. output during full fire. Only energized during a pre-heat cycle, the electric elements require 480V and draw 3.4A.



INSTALLATION: HEATER PANELS

NOTE: *It is suggested that heater panel installations are completed by a two person team to safeguard against accidental drops and/or avoid personal injury due to larger heater panels weights that may exceed 40lb or 18kg.*

LOCATION

Heaters should be mounted in a location that will protect the panel from water spray, air turbulence and excessive exposure to dust and dirt. Heaters can be mounted in any orientation.

ORIENTATION

It is critical to install heater panels with the information labels in an upright, readily readable position to ensure proper NG vs LPG orientation. ***Improper installation could result in damage and/or injury.***

INSTALLATION: ELECTRICAL

NOTE: *All local, state and national electrical codes should be followed and take precedence over the instructions provided. Contact* **VULCAN™ IR Systems** *for specific wiring instructions which are dependent on the number of heaters and application type. To avoid bodily injury, prior to performing* ***ANY*** *installation work, confirm main power is off and locked out accordingly.*

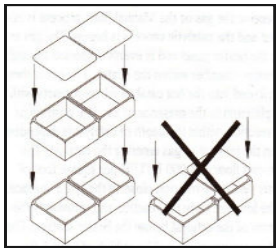
- WARNING -

Electrical wiring must withstand temperatures of up to 400° F (205° C)
TGGT High Temperature Wire that is rated for to 482°F (250 °C) and 600V

JUNCTION BOXES

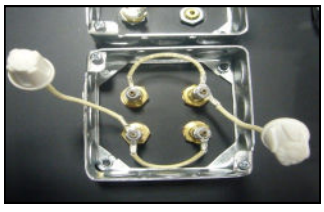
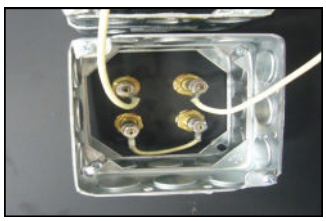
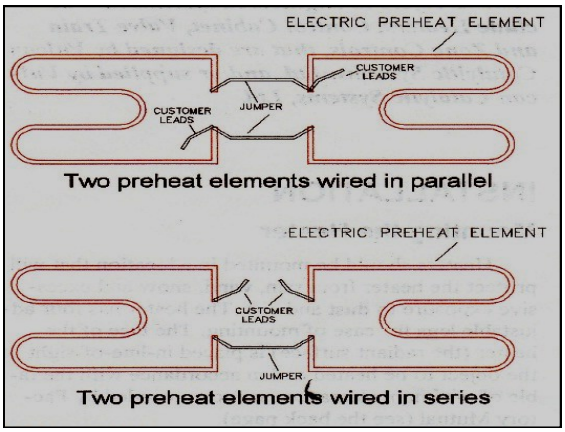
Both the thermo-switch and the electrical pre-heater connections first receive a base electrical box ring, followed by a second ring into which the conduits are connected. A double box ring is essential to ensure necessary clearance above the preheat terminals in the junction box.



ELECTRIC PREHEAT ELEMENTS

Being a flameless chemical reaction, catalytic heaters **DO NOT** have gas-pilot lights. Instead, electrical preheat elements are utilized to initiate the catalyzation process. Heater panels with two terminal leads are single element heaters while four terminal leads indicates a paired set of elements. These can be clearly identified by removing the "Preheat Connections" junction box cover located on the rear of the heater panel. Specific to load requirements all elements are wired in either series or parallel as seen below.

DO NOT remove or reposition jumpers when connecting power to preheat elements. If jumpers are missing or have been removed, call **VULCAN™** for assistance prior to placing heater into service.

INSTALLATION: LOW-VOLT ELECTRICAL

THERMO-SWITCHES

The thermo-switch is part of the limits circuitry and safety system for a catalytic oven. It is a normally opened switch that closes once it senses preheat temperature is achieved by the electric preheat element.

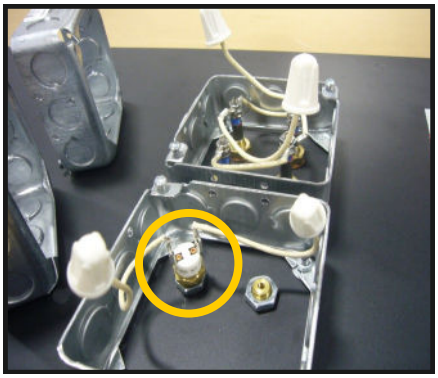
Wiring used for the thermo-switch should be rated for a minimum of 400°F (205°C).

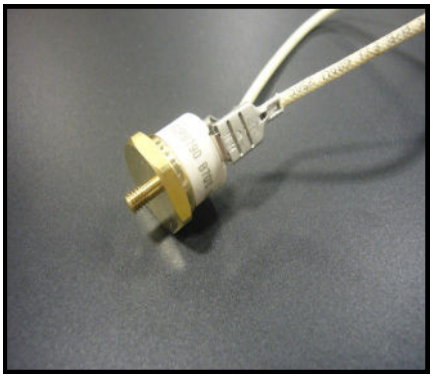
The factory installed thermo-switch will be screwed into the back of the heater panel w/leads provided. Ceramic wire nuts are also provided for use as high temperature fasteners. Any conduit or conduit fittings in the areas of the heaters should also be rated for higher temperatures. Consult the VULCAN IR™ in the event of questions or problems.

The thermo-switch is part of the limits circuitry and safety system for a catalytic oven. It is a normally opened switch that closes once it senses preheat temperatures are achieved by the electric preheat element.

TEMPERATURE READING

Integrated in the back of each heater panel, they are a safeguard against heater panels that may be experiencing issues and do not maintain the minimally required operating temperature.





INSTALLATION: GAS PLUMBING

All gas plumbing and connection types should conform with state and local codes, adherent to NFGC/ NFPA 54 codes within the US. All gas catalytic systems are designed based on the number of heaters, specific build and application type. For further specific technical questions or instructions, please contact VULCAN™ IR Systems via information at the bottom of this page.

ORIFICE INLET

Every heater includes a threaded, 3/8" NPT gas fuel inlet on the back of the panel. Ensuring proper gas flow is critical to output and controllability. Each orifice is specifically sized and preinstalled into the gas inlet.

Each orifice is sized for a particular heater output allowing for varied sized heaters requiring 6k, 7k and 8k BTU/HR per square foot. As fuel weights vary between NG vs LPG, orifices are fuel specific.

-NG vs LPG GAS ORIFICES ARE NOT UNIVERSAL -

The serial number label on the back of each heater specifies the required orifice for safe, proper operation.

Gas Inlet with Orifice Insert

GAS CONNECTION

Note that a flexible gas lines are utilized to simply alignment of connections from hard piping. These connections require minimal sealant to avoid blocking orifice.

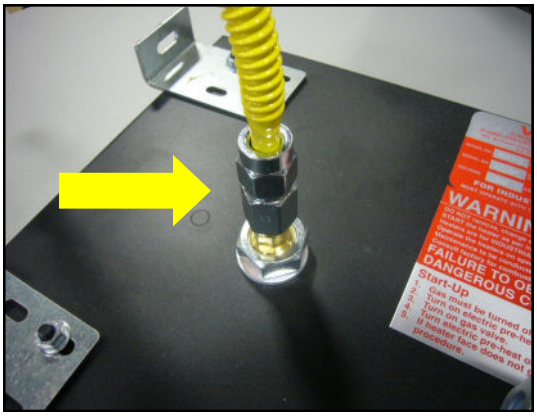
FLEXIBLE PIPING

Properly sized, NFPA approved flexible gas lines are supplied when heaters are pre-mounted into a VULCAN™ modular system however, component or replacement heaters require a separate gas lines be purchased. Flexible gas lines are commonly utilized when connecting from hard plumbing to the back of the heater panel, with lengths ranging 12"-36" (305-914 mm) having DIAs of 1/4"-3/4".

Flexible gas lines allow for assisting with final alignment and connections. When possible, use a smooth interior line. For safety and optimal flow, utilized only approved flex lines and minimize lengths. Maintain compliance to all times by adhering to applicable state and local codes.

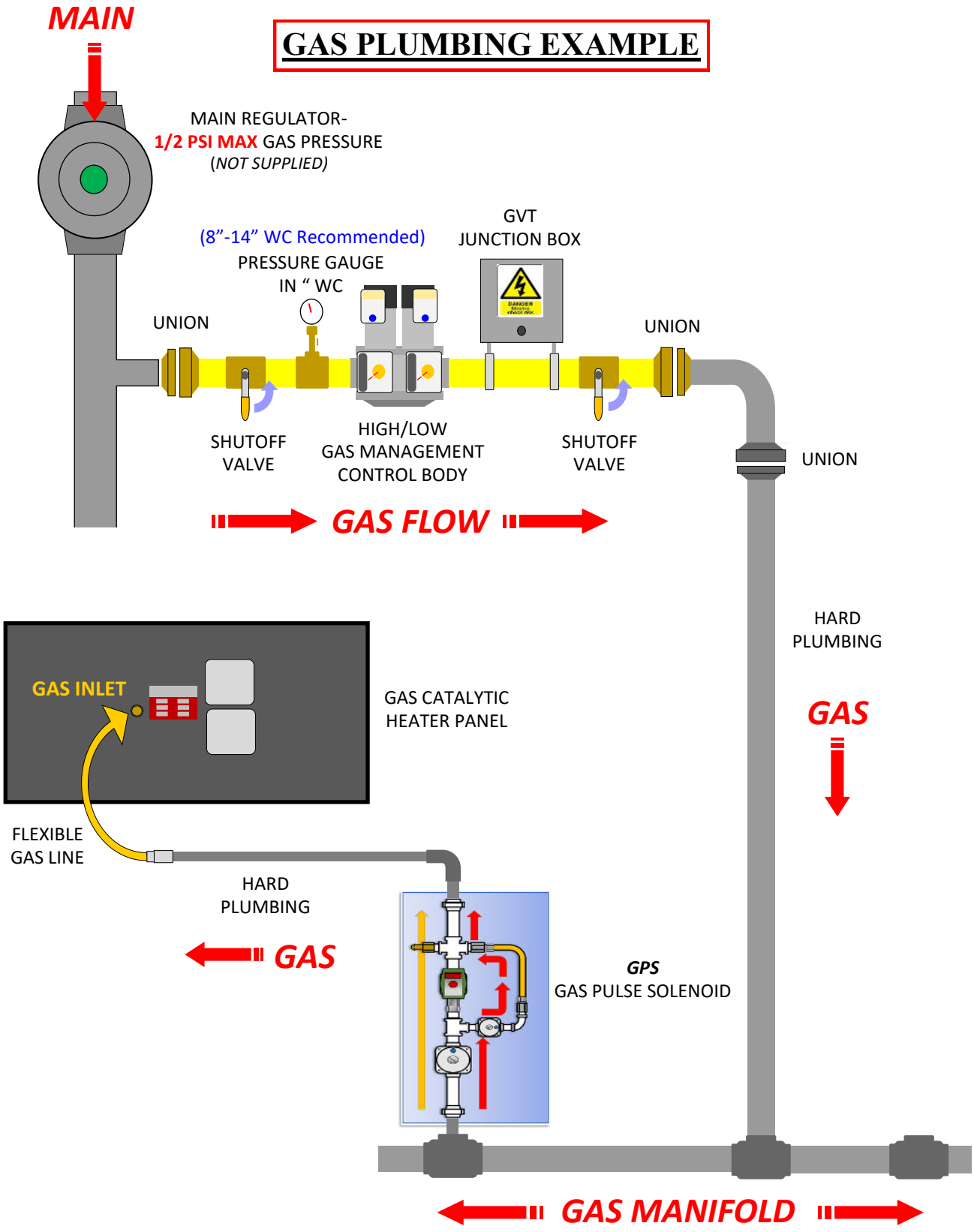
Refer to NFPA guidelines when confirming:

- **Fuel Type**
- **BTU Load**
- **Temperature Rating**
- **Pressure**



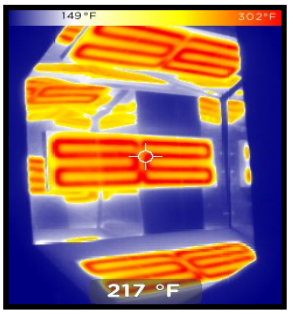
Flexible Gas Line with 3/8" NPT female connection to Gas Inlet shown. Sizes may vary.

GAS PLUMBING EXAMPLE



OPERATIONS DEFINED

This section will cover the start up procedure and operation of the Vulcan catalytic heater. Heater outputs are incorporated into the system for total control and monitoring.



- NOTE -

The visible radiant glow seen during this period should not be relied upon to determine heater temperature. Said glow is highly subject to work space lighting and **NOT** an accurate indicator of heater surface output temperature. Surface temperatures should be read using a quality infrared temperature reader and only by qualified persons.

FIRST STAGE PREHEAT: POWER ON

The catalytic reaction requires that the catalyst be at a minimum temperature of 300°F (149°C). To achieve this, electrical preheat elements (***not pilot lights***) are utilized to slowly heat the catalyst media which begins the chemical reaction. These elements will slowly heat up with temperatures read by an integrated thermoswitch. (see TEMPERATURE CHECK below)

To initiate the catalyst preheat process, use the supplied **HMI** and navigate to the **OPERATIONS** screen. Sequentially press: ***EXHAUST*** then, ***PREHEAT***.

NOTE: *To ensure safe operation, exhaust must be activate.*

Activation is noted when the icons toggle ***RIGHT*** and text box turns ***GREEN.***

INTRODUCTION of GAS

Once all element limits are satisfied, return to the OPERATIONS screen. Press the YELLOW text box- 'HOLD FOR GAS'.

Gas introduced to the heater while the pre-heat elements remain on to start the catalytic reaction at the high fire pressure of 4.0"w.c. (10 mb) for Natural Gas or 11"w.c.(27 mb) for Propane.

This begins the POST HEATING Stage.

POST HEATING CYCLE

During this stage, the pre-heat elements remain on and gas valves remain open. Also referred to as "HIGH FIRE MODE", this stage requires 3 minutes to establish a homogeneous catalytic reaction across the face of the entire heater panel. As part of safely operating any system, the required 3 minute time limit is preprogrammed into the PLC and automatically activates when gas is introduced.

OPERATIONS DEFINED (cont.)

POST HEATING CYCLE (cont.)

Once the catalyst media reaches approx 300°F (149°C) the required chemical reaction is both established and homogenous. With preheat elements no longer required, the **PREHEAT ON** (***GREEN***) text box reverts to **PREHEAT OFF** (***RED***) automatically shutting off. The control panel and gas managements components are now ready and operating at 120V.

COMPLETION of POST-HEAT CYCLE

Pre-heat elements turn off and gas control valves revert to previous output % and process settings.

At the end of this timed cycle, the preheat elements are turned off and the heater can then be modulated. If the process requires high fire, the gas control valves will remain in the same position. If the process calls for lower heat output, then the control valves will be activated at this time to lower the output.

OPERATION MODE: Constant Monitoring

Each thermo-switch constantly monitors individual heaters ensuring it is operating above the minimum temperature of 300°F. With these measures, it assures the catalytic reaction remains self sustained and safe operating condition are present. As thermo-switches are normally open (LIMITS NOT met) on initial start up, the switch will close (LIMITS met) once specific temperatures are achieved. In the event where a heater drops below the minimum safe operating temperature, the thermo-switch opens, signaling the control panel to shut down the gas flow to the entire system, heater panel or grouped heater panels. An alarm will sound with a message on the HMI similar to, 'MOD 1A - TS Fault'. This message indicates the approximate location of the heater panel or heater panel grouping where the issue is located.

EXAMPLE: '**MOD 1A - TS Fault**'

MOD = Module or Section of system
1A = Normally the side of system closest to the operator or control panel
1B = Paired opposite side of the abovementioned heated section
TS = Thermo-switch. This does not indicate a failure of thermo-switch

Note: During the operation mode, the heater can be modulated within a pressure range of 0.5"- 4" w.c. (1.2 - 10 mb) for natural gas and 1"- 11" w.c. (2.5 - 27 mb) for propane. By setting specific percentages on HMI, it provides adjustments of 20-100% output of the heater panel in any heated ZONEs.

SHUT DOWN

The heaters / system can be easily turned off by navigating to the OPERATIONS screen, locate the **GREEN** press the **HOLD to STOP GAS** for 5 seconds. This will stop the flow of gas to all heater panels by closing the gas valvetrain and safely turn off the system. Gas catalytic heater panels and gas manifolds DO NOT retain pressures when OFF. As the heater panels are always open by design, the catalytic reaction ceases when either fuel or oxygen is removed.

OPERATIONS DEFINED (cont.)

RESTART

To restart heaters immediately after an accidental shut down (line issue, power outage, etc) the restart sequence will be considerably shortened. Provided all TS limits are still met (see LIMITS screen) it may be possible to restart the heater panels in approximately 5 mins. If the TS limits are no longer met, the full 15 mins START SEQUENCE must be repeated as seen in Step1.

MAINTENANCE

BASICS

There are no moving parts in the catalytic heater so maintenance consists of inspection for cleanliness and damage to ensure optimum operation.

Once the catalytic process begins, it should continue as long as fuel and fresh air are available. The fuel supply is regulated and the fuel orifice must be kept clean to avoid blockages which will reduce the gas input.

The air naturally filters into the heater face so excess build up of dirt or foreign material must be avoided as it will reduce the output and efficiency of the heater.

Located beneath the face screen of the heater, the catalyst should be protected at all times from punctures and tears during installation and maintenance. Damage or disruption of the catalyst surface will reduce the effectiveness of the heater and require rebuilding or replacement of the unit.

CLEANING

Great care must be taken with any cleaning attempt to avoid catalyst surface damage.

DO NOT use water or air to clean heaters. Do not brush or vacuum the front surface of the heater panels as this may disrupt the catalyst surface causing damage to the catalyst media required for proper operation of the unit.

HEATER PANEL INSPECTION

DAILY	MONTHLY
• Ensure heaters are free from obstructions before starting • Visually check for any physical damage. • Visually check for obvious coloration difference in heater panels when comparing to others in the same zone. Notable variations may indicate that troubleshooting steps should be made to ensure heater is operating efficiently.	• Inspect wiring for cracks, frays or damage • Inspect gas hoses & lines for leaks or wear • Ensure heater operating temperatures are within optimal range • NOTE: If temperature fluctuations occur check for correct incoming gas pressures

MAINTENANCE (cont.)

REMOVAL OF ORGANIC MATERIAL (Basic Weekly PM)

Minor amounts of oil (or any hydrocarbon), overspray of paint or powder will self clean in most cases. These materials will oxidize in a flameless combustion process during heater operation. If a small amount of plastic or paint comes in contact with heater surfaces, it is recommended to run heaters at high fire for 30 minutes.

IN CASE OF WATER CONTACT

If the catalyst pad comes in contact with water it will not function until the moisture is dried out. Drying can be accomplished by placing the heater in a convection oven at 250°F (120° C) for approximately 2 hours.

STORAGE

When the heater is not in use, it should be stored where dirt, animals, insects and other contaminants cannot degrade the catalyst surface. Stored heaters should be wrapped in protective plastic or similar material.

BASIC TROUBLE SHOOTING

-ISSUE-	-POTENTIAL CAUSE-	-CHECK-
Preheat not working	*Circuit breaker tripped*	Reset Breaker | Check for shorts
	Improper wiring	Check wiring compared to wiring schematic
	Improper voltage	Voltage at heater junction box
	Damaged pre-heat element	Ohm | Replace if necessary
Thermo-switch not closing	*Minimal safe temp not achieved*	Ensure contactors are pulled in. Inspect control panel for tripped
	Loose wiring	Tug test | Reset | Tighten
Low heater surface temperature	*Insufficient gas pressure*	Check supply @ Gas Valvetrain pressure gauge. Adjust accordingly
		Check for blockage in gas orifice @
		Possible gas leaks- Loose fittings | Damaged Plumbing
	High Fire sequence does not start	Repeat startup procedure ensuring that the high fire start up steps are followed

APPENDIX

MATERIALS OF CONSTRUCTION

Catalyst Media	Platinum Catalyst on Ceramic Substrate
Pan | Housing	Powder Coated Steel
Internal Compartments	Steel | Aluminum
Catalyst Net (Scrim)	Ceramic Composite
Protective Surface Screen	Stainless steel -400 Series
Gas Fitting	Brass

EMISSIONS

Emission Type		Fuel: Natural Gas PPM produced per MIL BTU Consumed	Regulated Gas
Carbon Dioxide	**CO_2**	**128**	**No**
Water	**H_2O**	**105**	**No**
Nitrogen Oxide	**NOx**	**0**	**Yes**
Sulfur Dioxide	**SO_2**	**0**	**Yes**
Particulates	**-**	**0**	**Yes**
Mercury	**Hg**	**0**	**Yes**
Carbon Monoxide	**CO**	**0**	**Yes**

APPENDIX

PRESSURE EQUIVALENTS

Inches Water Column (‘’ W.C.)	Millibar (mbar)
0.75	1.9
1	2.5
1.5	3.7
2	5
2.5	6.2
3	7.5
3.5	8.7
4	10
6	15
8	20
10	25
12	30
14	35

WARRANTY INFORMATION

WARRANTY

All Catalytic heaters manufactured by **VULCAN™ IR Systems** are warranted against defects in material and workman-ship for a period of one (1) year from date of purchase. Repairs within this warranty period will be made without charge if transportation costs are prepaid to the manufacturing facility. An authorized RMA is required prior to receival of materials.

SAFETY PRECAUTIONS

WARNING

Heaters to be installed by QUALIFIED PERSONNEL according to system design and all local, state and federal codes.

DO NOT remove, change or repair the gas orifice, heater surface, warning labels or any other heater component. START the heater as per instructions, DO NOT operate or attempt to start if heater or controls are damaged. Operate the heaters on specified fuel source, inlet pressure, and pre -heat voltage. Maintenance to be conducted after electrical and gas has been turned off. Consult factory for combustible clearances.

FAILURE TO OBSERVE THESE WARNINGS CAN RESULT IN DANGEROUS CONDITIONS

IMPORTANT ELECTRICALSAFETY PRECAUTIONS

Improper connection of the equipment-grounding conductor can result in a risk of electrical shock. All electrical work is to be installed by a qualified electrician or serviceman.

To prevent unnecessary risk of fire, electrical shock or personal injury, all wiring and grounding must be done in accordance with the National Electrical Code ANSI/FNPA, No. 70-Latest Revision and local codes and ordinances. It is the personal responsibility and obligation of the equipment owner to provide electrical service for this equipment.

IMPORTANT HOT SURFACE SAFETY PRECAUTION

DO NOT touch heater face when the heater is on!

Caution is also advised when heater is off as residual heat may be high enough to cause burn injuries.