North American Flame Grid Fume Destructors

Bulletin 4950

FEATURES

4950 Flame Grids are used to incinerate organic vapors from ovens and industrial processes.

Flame Grid burners are inserted into fume-carrying ducts, filling the duct cross section. They release heat uniformly across the duct, using minimum gas to ignite combustible pollutants in the fumes. Incineration is completed in a suitably sized combustion chamber (user built) downstream of the burner.

Flame Grids can be mounted in horizontal or vertical (upflow or downflow) ducts and can be used with recuperators.

Adjustable mixing plates on Flame Grids permit setting of effluent pressure drop across the burner to achieve efficient mixing of fumes and flames.

Flame Grids use combustion air from the effluent stream, so no blower is required. See page 2 for effluent oxygen requirement.

APPLICATION

Flame Grid burners are suitable for the following conditions:

Fume temperature at burner inlet:
1100 F maximum

Temperature at burner outlet:
1200-1600 F. Temperature required depends on nature of fume or smoke being incinerated.

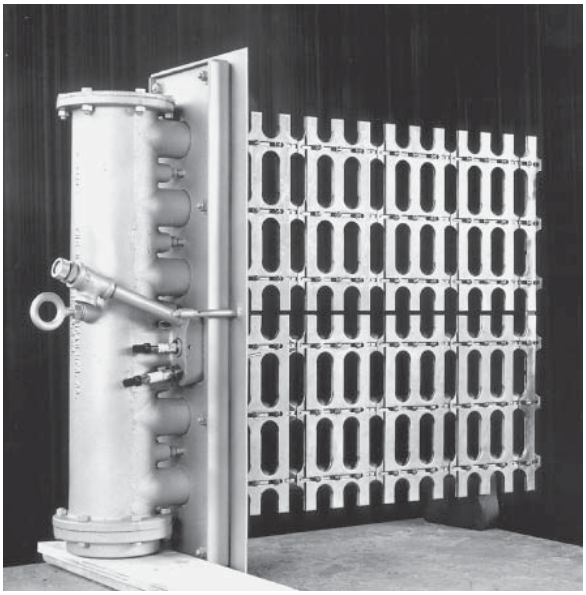
Temperature rise across burner:
200 F minimum
1600 F maximum

Duct pressure upstream of burner:
2.0"wc maximum

Fume stream pressure drop across burner:
0.2"wc minimum
2.0"wc maximum

Minimum oxygen content of fume stream:
See page 2

Flame Grid burners are not suitable for halocarbons.



Fume incinerating flame grids use gas as the auxiliary fuel.

FLAME GRID DUCT SECTIONS

For maximum installation convenience, 4950-0812 through -3648 Burners are available assembled to refractory-lined, cylindrical steel duct sections of short length. These assemblies, designated 4950- -D, can be attached, by welding or compression bands, to upstream and downstream duct sections furnished by the customer. Exterior dimensions of several 4950D sections match commercially available prefabricated stacks and chimneys. See Sheet 4950-4 for details.

CONSTRUCTION

Metal parts are heat-resistant cast iron and steel alloy. Burner mounting is lined with insulation to reduce its outer surface temperature.

Optional hard refractory internal insulation (adds 6" to "A" dimension) is available for use with refractory-lined ducts and 900-1100 F inlet temperatures.

All Flame Grids include spark-ignited pilot assembly, observation port, and provision for flame detection device.

SELECTION. Because the fume stream is the burner's air source, it must contain enough oxygen for complete combustion of all contaminants and auxiliary fuel (gas). Minimum oxygen requirements vary with fume stream temperature--see Figure 1.

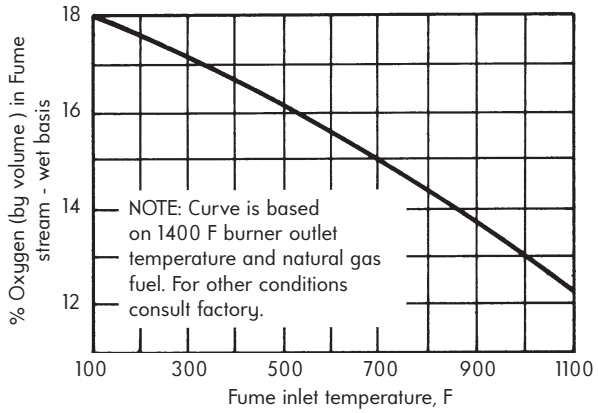


Figure 1. Minimum oxygen content in fume stream.

Minimum oxygen content is shown on a wet basis; i.e., as a percentage of total gases, including water vapor. Most oxygen analyzers report oxygen on a dry basis, so their readings must be corrected for water vapor content.

If a potential application does not satisfy the requirements listed above, an alternate method of incineration may be necessary using furnace burners with an external source of combustion air. Check with your Fives field engineer.

If fume stream contains sufficient oxygen, a Flame Grid can be selected by the following procedure, which assumes combustible contaminants make a negligible contribution to heat required to raise fume stream to incineration temperature. It also assumes 1400 F is adequate for incineration of all combustible contaminants.

Basic selection information required:

1. Maximum flow rate of fumes, acfm
2. Fume temperature at burner inlet
3. Fume stream pressure drop available across burner.

Table 1. Effects of inlet temperature

Inlet temperature	Grid air capacity correction factors (60 F basis)	Gross input (Btu/hr) per scfm air heated to 1400 F
60 F	1.00	1810
200	1.13	1640
300	1.21	1510
400	1.29	1390
500	1.36	1260
600	1.43	1130
700	1.49	1000
800	1.56	870
900	1.62	730
1000	1.68	590
1100	1.73	440
1200	1.79	290

EXAMPLE

Given: 9900 acfm fume-laden air at 400 F. Available pressure drop 1.2"wc.

Selection procedure:

1. **Convert acfm to scfm**, using ratio of absolute temperatures:

$$9900 \text{ acfm} \times \left(\frac{460 + 60}{460 + 400}\right) = 5990 \text{ scfm.}$$

2. **Temperature correction**
   Multiply scfm by Table 1 air capacity factor:

$$5990 \times 1.29 \text{ (for 400 F)} = 7727$$

3. **Pressure correction**
   Multiply corrected air capacity by Table 2 factor:

$$7727 \times 0.65 \text{ (for 1.2"wc)} = 5020 \text{ (equiv. scfm air at 60 F inlet and 0.5"wc pressure drop)*}$$

4. **Select Flame Grid from Table 3:**
   5020 scfm falls between wide open and minimum settings of 4950-3624 Burner, which is the proper selection.

5. **Fuel input requirement from Table 1:**
   5990 scfm × 1390 Btu/hr per scfm (at 400 F inlet)
   = 8,330,000 Btu (approx. 8330 cfh natural gas)

Table 2. Pressure drop correction factors

Pressure drop, "wc	Air Factor (0.5"wc base)	Pressure drop, "wc	Air Factor (0.5"wc base)
0.2	1.59	0.9	0.75
0.3	1.28	1.0	0.71
0.4	1.12	1.2	0.65
0.5	1.00	1.4	0.60
0.6	0.92	1.6	0.56
0.7	0.85	1.8	0.53
0.8	0.79	2.0	0.50

Table 3. Grid air capacities

Flame Grid designation	scfm air (corrected to 60 F inlet and 0.5"wc pressure drop) Shutter wide open	Shutter at min. setting
4950-0812	710	440
4950-1212	1 060	660
4950-1412	1 240	770
4950-2012	1 800	1 100
4950-1424	2 500	1 500
4950-2024	3 550	2 200
4950-2624	4 600	2 850
4950-3624	6 400	3 900
4950-2648	9 200	5 700
4950-3648	12 700	7 900
4950-5248	18 400	11 400
4950-7248	25 400	15 800

* See "Fluid Flow" chapter in North American COMBUSTION HANDBOOK for explanation of correction procedure.

GAS PRESSURE REQUIREMENT. Available pressure to Flame Grid must overcome pressure drops through the burner and its gas train. Table 4 shows natural gas capacities at 1"wc pressure drop (with standard gas port drilling).

To determine gas pressure drop across the 4950-3624 Burner selected above, apply the flow square root law:

$$1\text{"wc} \times \left(\frac{8330 \text{ cfh}}{2380 \text{ cfh}}\right)^2 = 12.3\text{"wc } \Delta P.$$

Supply pressure must equal this **plus** duct pressure at the burner plus pressure drops through the gas train.

Warning: Minimum gas pressure drop across the burner is 0.7"wc. Lower drops may cause uneven gas distribution in the burner. Maximum drop with good flame stability is 3 psi.

PILOTS, FLAME SUPERVISION. Options available:

Option 1 — raw gas pilot/flame rod

Option 2 — raw gas pilot/UV

Option 3 — premix pilot/flame rod

Option 4 — premix pilot/UV

If UV is specified, an adapter nipple is furnished, but detector must be purchased separately. Flame rods are furnished when Option 1 or 3 is specified.

Raw gas pilots require combustion air from the fume stream. A spark electrode ignites gas and air as they mix. Gas pressure at the pilot inlet must exceed duct pressure by at least 3"wc. Raw gas pilots should be ignited with normal air. After the main burner flame is ignited, the fume-laden reduced-oxygen air can be introduced into the duct.

If dirty effluent might foul the raw gas pilot igniter, a premix pilot is recommended. This pilot requires at least 4 osi combustion air from an external source (blower or compressed air reducer).

If effluent is "clean," either a flame rod or UV detector is suitable. High particulate loads may foul a flame rod. Dense smoke may blind a UV detector. Choose flame supervision based on specific conditions.

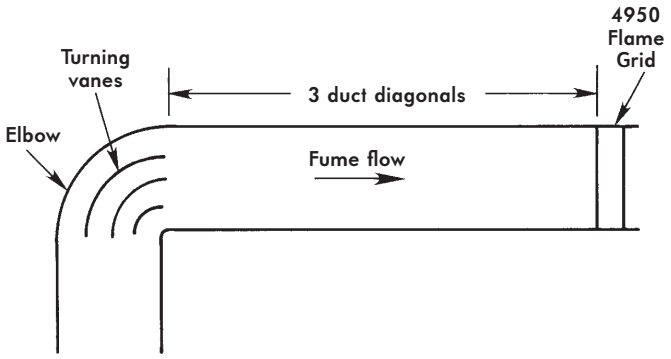
An interrupted pilot must be used. A constant pilot is a safety hazard and causes uneven heating of the burner. When spark igniting raw gas pilots, flame detection system must interrupt spark. Spark can dissociate raw gas into carbon compounds that over time could ground the spark plug.

Table 4. Natural gas capacities

Burner designation	Capacity scfh @ 1"wc ΔP	Burner designation	Capacity scfh @ 1"wc ΔP
4950-0812	270	**4950-2624**	1730
4950-1212	390	**4950-3624**	2380
4950-1412	480	**4950-2648**	3470
4950-2012	670	**4950-3648**	4760
4950-1424	940	**4950-5248**	6940
4950-2024	1340	**4950-7248**	9500

INSTALLATION. Flame Grids are inserted through duct wall cutouts (see page 4 for cutout dimensions).

Fume flow pattern to the burner must be as uniform as possible to assure complete incineration. Therefore, locate Flame Grids at least 3 duct diagonals downstream from any elbow or fan; turning vanes are recommended in elbows.



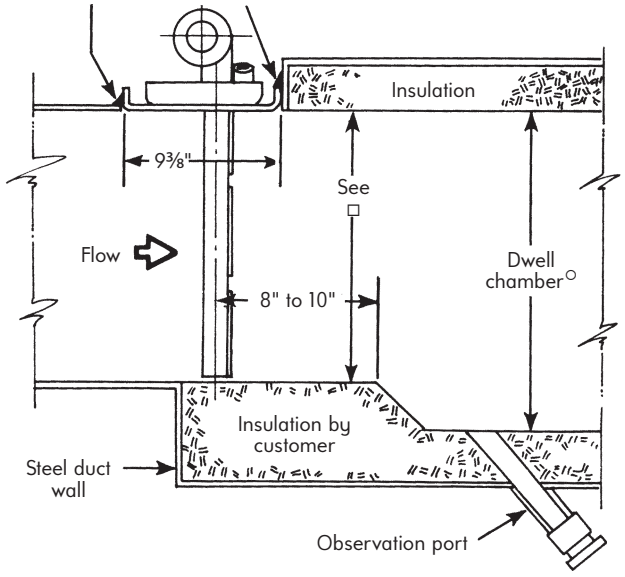
Duct downstream of burner must be enlarged and refractory-lined. See Figure 2. Always install one or more observation ports (e.g., North American 8792) downstream of the burner for observation of the complete grid surface.

Flame Grids can be installed in horizontal or vertical ducts. If fume stream contains particulate matter, burner duct should be horizontal to prevent particulate accumulation on the grid. Excessive buildup can require frequent cleaning.

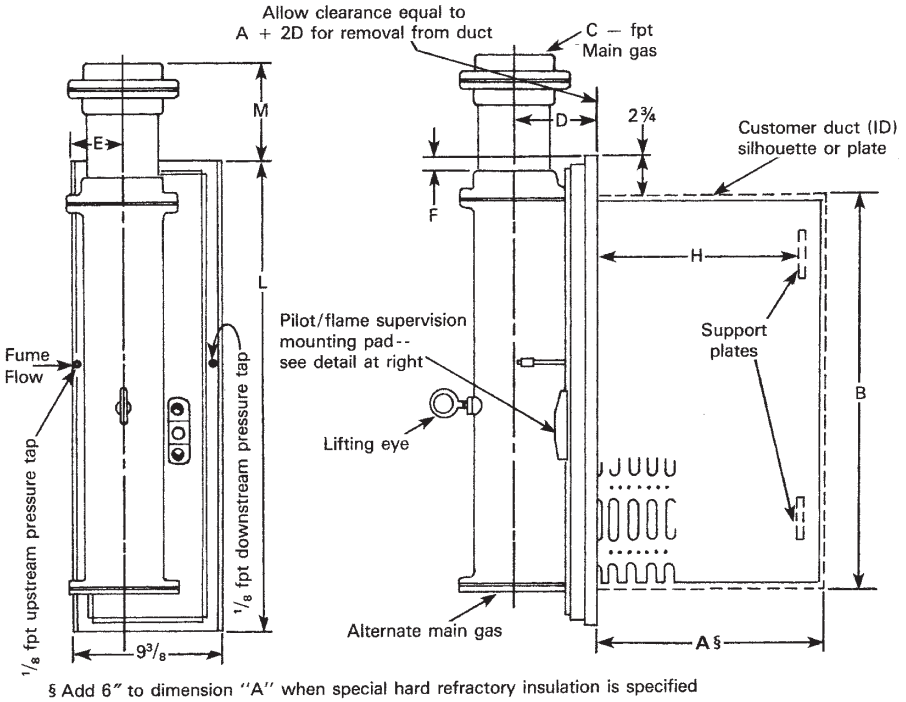
4950 Burners with "A" dimension 20" or greater have support plates near the free end of the grid. These plates should be attached to duct wall or suitable structural members to support free end.

Figure 2. Typical Flame Grid installation.

Continuous weld this mounting plate to duct, centered and square with ⅛" clearance between grid and duct wall or silhouette plate. Burner has provision for removing from mounting plate if necessary.

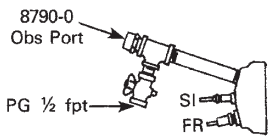


□ Inside duct dimensions for first 8-10" downstream of Flame Grid must conform to burner dimensions A and B (e.g., 14" × 12" for 4950-1412).
○ Dwell chamber cross sectional area must be at least **twice** nominal burner area (dimension A × dimension B).

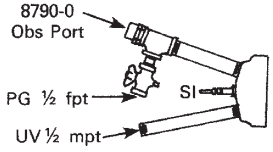


§ Add 6″ to dimension ″A″ when special hard refractory insulation is specified (for higher flame temperatures).

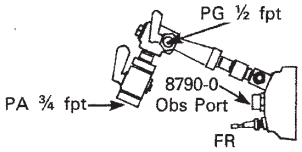
Pilot/Flame Supervision Options



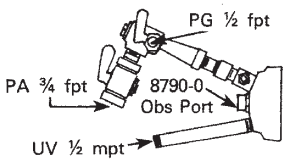
Option 1 — Raw Gas Pilot/ Flame Rod



Option 2 — Raw Gas Pilot/UV



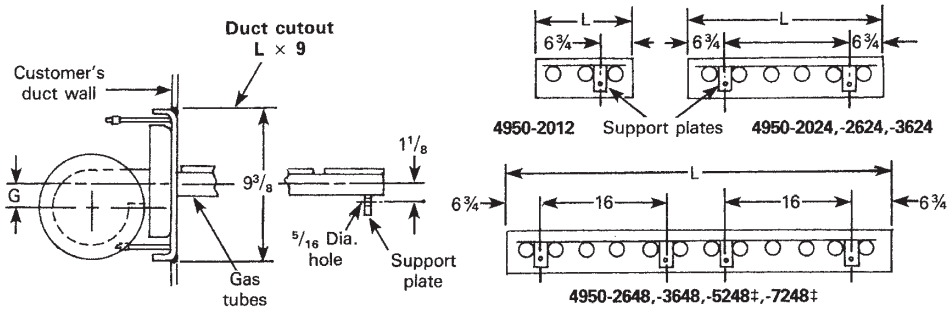
Option 3 — Premix Pilot/ Flame Rod



Option 4 — Premix Pilot/UV

Explanation of Abbreviations Above

FR — Flame Rod
Obs — Observation Port
PA — Pilot Air Connection
PG — Pilot Gas Connection
SI — Spark Igniter
UV — UV Adapter Tube



U. S. Patent No. 3,524,632

Burner designation	dimensions in inches A	B	C	D	E	F	G	H	L	M	Wt, lb
4950-0812	8	12	2	4½	4 3/16	2¾	½	–	17½	3⅞	65
4950-1212	12	12	2	4½	4 3/16	2¾	½	–	17½	3⅞	75
4950-1412	14	12	2	4½	4 3/16	2¾	½	–	17½	3⅞	80
4950-2012	20	12	2	4½	4 3/16	2¾	½	13⅛	17½	3⅞	90
4950-1424	14	24	4	5¼	3 5/16	1 3/16	⅜	–	29½	4⅛	150
4950-2024	20	24	4	5¼	3 5/16	1 3/16	⅜	18⅞	29½	4⅛	170
4950-2624	26	24	4	5¼	3 5/16	1 3/16	⅜	18⅞	29½	4⅛	200
4950-3624	36	24	4	5¼	3 5/16	1 3/16	⅜	16⅞	29½	4⅛	240
4950-2648	26	48	4	5¼	3 5/16	1 3/16	⅜	18⅞	53½	4 3/16	370
4950-3648	36	48	4	5¼	3 5/16	1 3/16	⅜	16⅞	53½	4 3/16	450
4950-5248†	52	48	4	5¼	3 5/16	1 3/16	⅜	18⅞‡	53½	4 3/16	740
4950-7248†	72	48	4	5¼	3 5/16	1 3/16	⅜	16⅞‡	53½	4 3/16	900

† 4950-5248 and -7248 each consist, respectively, of two 4950-2648 and -3648 Burners inserted into opposite sides of the duct so the grids abut. These burners are furnished with crossover plates to ensure grid alignment and ignition from one side to the other. Each half of burner has a pilot/flame supervisory mounting pad, but a single pilot and flame detector can serve the entire burner assembly. Both gas manifolds should be connected to a common supply line--6" pipe is recommended.

‡ Support plates are furnished only on one half of 4950-5248 and -7248 Burners

To order, specify: 4950-(size designation)-(flame detector/pilot option).

Example: 4950-0812 Burner Complete w/Option 2 Pilot Assembly.

Option numbers are:
1. Raw Gas Pilot/Flame Rod
2. Raw Gas Pilot/UV Adapter
3. Premix Pilot/Flame Rod
4. Premix Pilot/UV Adapter
5. Any other arrangement--give details when ordering.

Orders must specify minimum oxygen content (wet basis), maximum water vapor content, and temperature of fume stream at burner inlet.

Example: 4950-2012 Burner with Option 2 Pilot Assembly. Fume stream contains 18% oxygen (wet basis) and 11% water vapor at 400 F.

WARNING: Situations dangerous to personnel and property may exist with the operation and maintenance of any combustion equipment. The presence of fuels, oxidants, hot and cold combustion products, hot surfaces, electrical power in control and ignition circuits, etc., are inherent with any combustion application. Parts of this product may exceed 160F in operation and present a contact hazard. Fives North American urges compliance with National Safety Standards and Insurance Underwriters recommendations, and care in operation.

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