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IMMERSION TUBE BURNERS

Bulletin 4762

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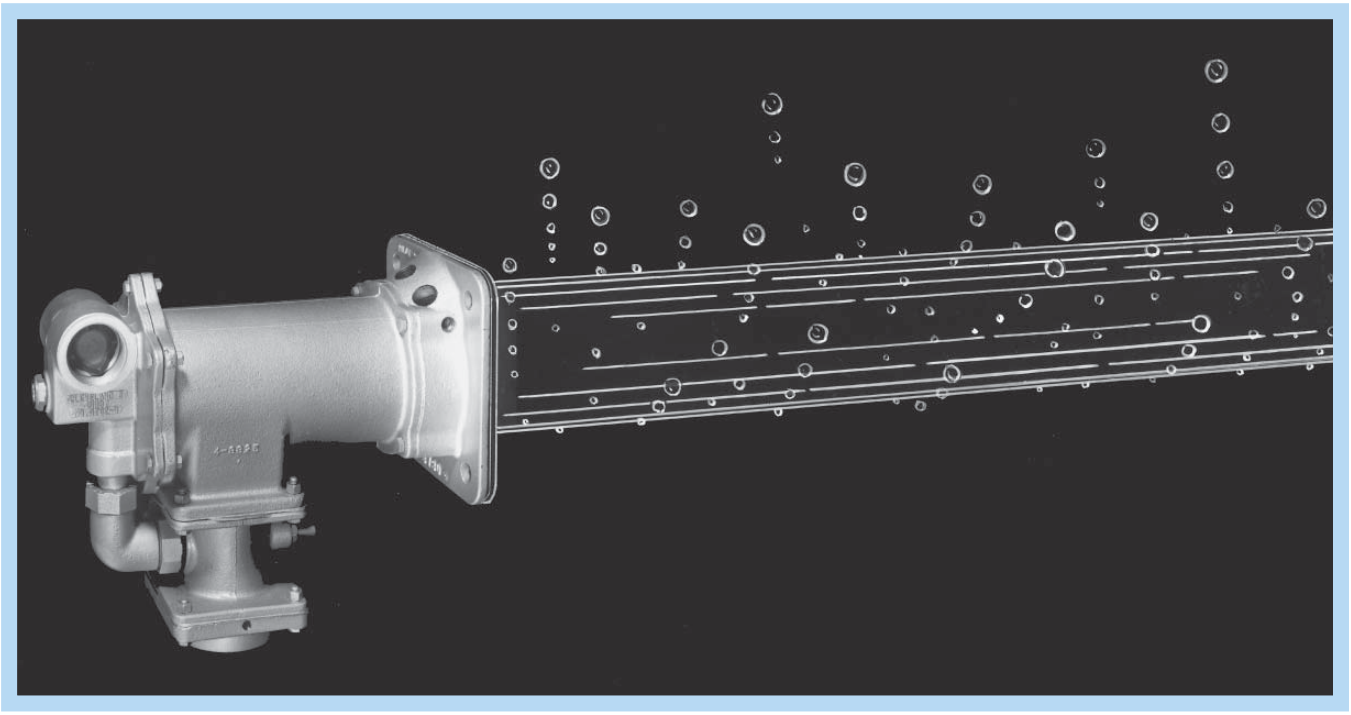


4762 HI-CAPACITY Immersion Tube Gas Burners give unsur-passed performance in applications where liquids are heated by direct-fired tubes. Features:

- ✓**very high heat releases.**
- ✓**quieter, sealed-in operation.**
- ✓**easily lighted flames.**
- ✓**stability over wide ratio ranges.**
- ✓**reliable premix pilot.**
- ✓**provision for optional flame supervision.**
- ✓**observation port.**

Large tanks of liquids are commonly heated by immersion tubes through which burners fire. Flames and flue products scrub inside tube surfaces, rapidly releasing heat to the liquid. This arrangement provides more efficient and economical heating than remote, separately-fired heat sources.

4762 Burners allow high heat releases within confined tubes--higher firing rates in smaller diameter tubes than previously possible, resulting in lower tube costs and smaller tanks. They are sealed-in for full control of air/gas ratio and to permit firing into high backpressure. No refractory tile is used.

Flames are extremely stable and quiet burning, operating over a wide range of air/gas ratios. Burners include a primary air adjustment to correct for unusual tube conditions, and an observation port for easy viewing of pilot and main flame. 4762-4 and -6 Burners have a built-in gas adjustment. A separate 1807 Limiting Orifice Gas Valve is used with -7-A, -7-B, and -8 sizes.

OPERATION

Accurate air/gas ratio can be obtained by using metering orifices in air and fuel lines, or by analysis of flue products.

Although 4762 Burners have wide turndown with normal air/gas ratios, additional turndown is possible by using excess air at low fire.

Control: High-low, high-low-off, modulating or modulating-off (not on-off) control can be used. Easy lighting and smooth operation give safe operation with minimum attention.

Pressure Drop in Tubes. High heat releases in small diameter tubes require careful calculation of pressure drops within the tubes to ensure satisfactory operation. Adequate air and gas pressures must be available. Engineering and application information are presented in Tables I, II, III, and IV, together with a sample calculation to illustrate equipment selection. For special conditions, consult North American.

PILOTS/FLAME SUPERVISION

A 4021-12 Pilot Tip and 4031 Mixer should be used. A manually lit pilot is not recommended. Pilot regulator must be cross-connected to pilot air line.

Flame Supervision: Use flame rod or UV detector. Flame rod should extend 4" beyond outer surface of mounting boss.

SAMPLE SELECTION PROCEDURE

Information Required to Select Equipment:

Heat transfer rate to liquid, load and losses*--for example, 550 000 Btu/hr.
Available tank space--for example, enough for 25' of tube with 4 mitered elbows.
Fuel--for example, natural gas.

Step 1--Effective Tube Length for Heat Transfer. Each elbow or return bend adds 1.1' of effective heat transfer length to the total centerline length (including bends); so

Total Effective Length = 25' + (4 × 1.1')
= 25' + 4.4' = 29.4'

Step 2--Firing Rate. At 550 000 Btu/hr in Table I, the next smallest tube length is 28'.

This tube length and heat transfer rate result in a required firing rate of 786 000 Btu/hr and 70% tube efficiency.③ (From Table I.)

Then only 28' – 4.4' = 23.6' of tube is needed.

Step 3--Burner Size, Tube Diameter. Remembering that the blower will have to supply some extra pressure to overcome tube back pressure, use Table II and the square root law of flow to select a burner with 786 000 Btu/hr or more capacity, such as:

4762-4 Burner with 12.7 osi air pressure drop across the burner.

From Table II, this burner requires a 4" tube.

Step 4--Equivalent Tube Length for Pressure Drop. From Table III, find that each 4" mitered elbow produces a pressure drop equivalent to 20' of straight 4" pipe.

Equivalent length of tube =
23.6' + (4 elbows × 20') = 23.6 + 80 = 103.6'

Step 5--Air Pressure. From Table IV, at 70% efficiency (from Step 2), read an air pressure factor of 0.017.

Tube back pressure =
0.017 × 12.7 osi × 103.6/10 = 2.28 osi.①

The required air pressure at the burner is then:

Burner air pressure = 12.7 + 2.28 = 14.98 osi.

Step 6--Gas Pressure. From Table IV, read a natural gas pressure factor of 0.19. The gas pressure drop across the burner is then:

Gas pressure drop = 0.19 × 12.7 = 2.42 osi.

Adding the tube backpressure,
Burner gas pressure = 2.42 + 2.28 = 4.70 osi.

*Losses from vats may be substantial. See pages 125-126, Volume I of the North American Combustion Handbook.

Table I. Effective Tube Lengths and Firing Rates When Heating 180 F Water

(Note: "Effective" Tube Lengths relate to heat transfer; "Equivalent" Lengths--Table III--apply to pressure drop.)

Heat Transfer, 1000's Btu/hr	60% Effective Tube Length	60% Firing Rate, 1000's Btu/hr	65% Effective Tube Length	65% Firing Rate, 1000's Btu/hr	70% Effective Tube Length	70% Firing Rate, 1000's Btu/hr	75% Effective Tube Length	75% Firing Rate, 1000's Btu/hr	80% Effective Tube Length	80% Firing Rate, 1000's Btu/hr
300	13'	500	16'	461	21'	428	–	–	–	–
350	14'	583	18'	538	22'	500	29'	466	37'	437
400	15'	666	19'	615	24'	571	31'	533	40'	500
450	16'	750	20'	692	25'	642	33'	600	42'	562
500	17'	833	21'	769	27'	715	35'	667	45'	625
550	18'	916	22'	846	28'	786	36'	733	47'	688
600	19'	1000	23'	922	29'	856	38'	800	49'	750
700	20'	1170	25'	1080	32'	1000	41'	934	53'	875
800	21'	1330	26'	1230	34'	1140	43'	1070	56'	1000
900	22'	1500	28'	1380	36'	1290	46'	1200	60'	1120
1000	23'	1670	30'	1540	38'	1430	49'	1330	63'	1250
1200	25'	2000	32'	1850	42'	1725	53'	1600	69'	1500
1400	27'	2330	35'	2150	45'	2000	58'	1870	75'	1750
1600	29'	2670	37'	2460	48'	2280	62'	2130	80'	2000
1800	31'	3000	40'	2770	51'	2570	65'	2400	85'	2250
2000	33'	3330	42'	3070	54'	2960	69'	2660	89'	2500
2200	34'	3670	44'	3380	56'	3140	72'	2940	93'	2750
2400	36'	4000	46'	3690	59'	3430	76'	3200	98'	3000
2600	–	–	48'	4000	61'	3710	79'	3460	102'	3250
2800	–	–	–	–	63'	4000	82'	3730	105'	3500
3000	–	–	–	–	65'	4280	85'	4000	108'	3750
3200	–	–	–	–	–	–	–	–	112'	4000
3400	–	–	–	–	–	–	–	–	116'	4250
	60% EFFICIENCY③		65% EFFICIENCY③		70% EFFICIENCY③		75% EFFICIENCY③		80% EFFICIENCY③	

① Multiply air pressure factor by burner air pressure to obtain pressure drop in each 10 feet equivalent length of tube.

② Multiply natural gas factor by burner air pressure drop to obtain gas pressure drop across burner. Add tube backpressure to get required gas pressure. Consult North American for other gases. These factors are based on the primary air setting as shipped. They will be proportionally higher if the percent primary air is increased.

③ "% tube efficiency" is really % available heat, which is the best possible fuel efficiency (with no wall or surface losses).

Table II. Burner Capacities, in scfh air Multiply by 100 to obtain Btu/hr

Burner No.	Air pressure drop across burner, osi 1	5	6	8	12	16	Tube Size
4762-4	2 120	4 750	5 210	6 240	7 640	8 500	4"
4762-6	4 570	10 200	11 200	12 700	15 500	18 300	6"
4762-7-A	5 250	11 700	12 800	14 800	18 200	21 000	8"
4762-7-B	8 000	17 900	19 600	22 600	27 700	32 000	8"
4762-8	10 500	23 500	25 700	29 700	36 300	42 000	8"

Table III. Equivalent Lengths of Fittings (welded), for pressure drop calculations④

Pipe Size	Mitered 90° Elbow	Mitered 180° Bend	Short Sweep 90° Elbow	Short Sweep 180° Bend	Long Sweep 90° Elbow	Long Sweep 180° Bend
4"	20'	35'	5'	8'	4'	6'
6"	30'	50'	8'	12'	6'	8'
8"	40'	60'	11'	14'	8'	10'

④ **Do not use this table for heat transfer calculations.**

Table IV. Air and Gas Pressure Factors

Burner No.	Tube Size	Air Pressure Factors① Tube Efficiency 60%	65%	70%	75%	80%	Natl. Gas Pressure Factors②
4762-4	4"	0.022	0.020	0.017	0.015	0.013	0.19
4762-6	6"	0.012	0.011	0.010	0.008	0.007	0.15
4762-7-A	8"	0.004	0.004	0.004	0.003	0.003	0.08
4762-7-B	8"	0.010	0.008	0.008	0.007	0.006	0.11
4762-8	8"	0.013	0.012	0.011	0.008	0.008	0.20

INSTALLATION

1. Bolt the burner flange to a matching flange welded to the immersion tube. Bolt these together tightly to prevent flue gas leakage. Leakage can cause instability and excessive noise under some conditions. (An optional mounting gasket is offered--see Parts List & Instr. 4762-1.) The burner should be as close as possible to the tank, because heat is released very close to the burner. Tank insulation, if any, should be removed to provide clearance around the tube to prevent overheating.

2. Connect the main gas regulator and valves, the pilot accessories, and a spark-ignited pilot as shown in the typical piping diagram below. A separate regulator must be used for each burner. For 4762-7-A, -7-B, and -8 Burners, add an 1807 Limiting Orifice Valve in the gas line as close as possible to the burner.

3. If the gas pressure does not exceed air pressure by at least 2 osi, use an 8654 Bleeder, piping the "M" connection to the hole provided for that purpose in the burner mounting plate. (Subtract the tube backpressure from both the gas and air pressure before figuring the % bleed.)

4. It is often difficult to set the air/fuel ratio by sight or sound; so use of a metering orifice or flue gas analyzer is strongly recommended.

Fig. 1. Typical Piping Arrangement–Plan View (Safety equipment not shown)

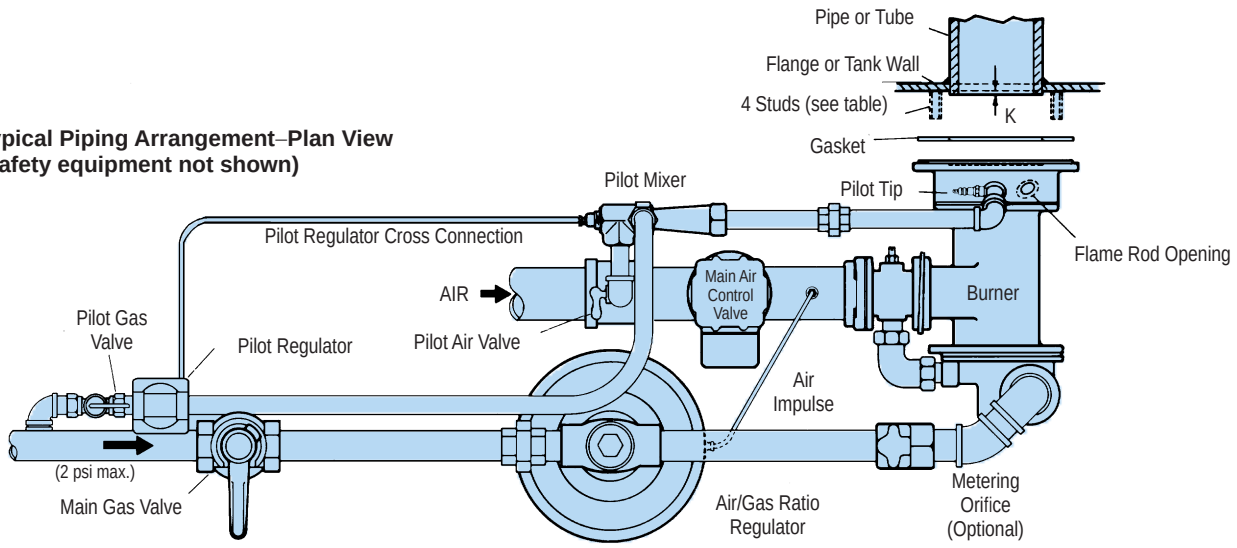


Table V. Installation Dimensions

Burner Designation	Tube Size	Stud Diameter	Stud Length	K
4762-4	4"	5/8"	1 1/2"	1/8"
4762-6	6"	5/8"	1 1/2"	1/8"
4762-7-A, -7-B, -8	8"	3/4"	1 3/4"	1/4"

START-UP and ADJUSTMENT

WARNING: Startup and adjustment of combustion equipment should only be done by trained personnel familiar with combustion technology, combustion equipment, and with the particular burner system, equipment, and controls.

1. Purge the gas supply line.

2. Close all gas valves.

3. Set the main air control valve for about 2 osi pressure at the burner or about 1/4 open.

4. Open the pilot air valve. Energize the ignition transformer and open the pilot gas valve. The pilot should light in a few seconds. (See Pilot Bulletin.)

5. Remove the protective cap, and open the limiting orifice gas valve (built into the back of 4762-4 and -6 Burners, separate on larger sizes) a few turns counterclockwise from the closed position. Open the main gas valve. If no main flame appears in 10 seconds, close the main gas valve and allow a few minutes for purging before trying again.

6. The flame should not start in the burner gas tube at any time. If this occurs at the low firing rate, turn the regulator's spring adjusting plug clockwise until the flame moves out of the gas tube. (See Regulator Bulletin.)

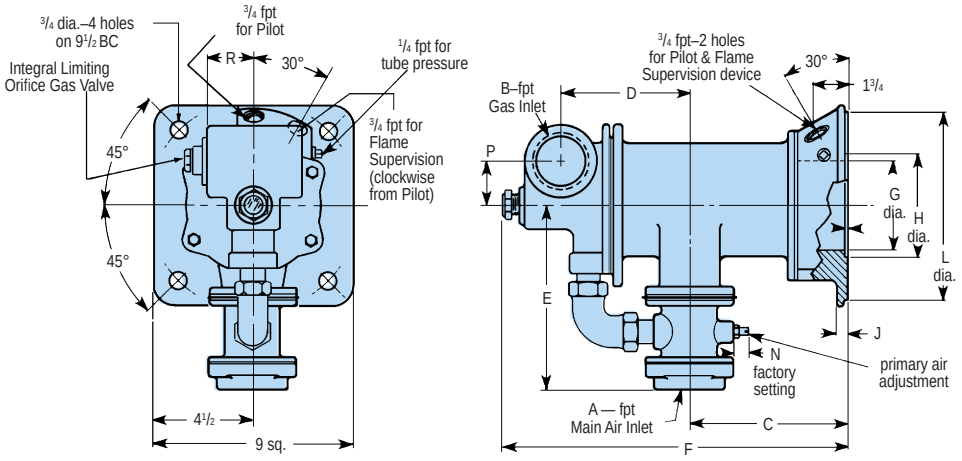
7. Ignition should always take place at low firing rate (2 osi or less). High fire lighting or extinguishing may accidentally put out the pilot.

8. Adjust the high and low fire linkage settings (firing ratios) as desired. These can range from 1/2 osi (1"wc) to 16 osi.

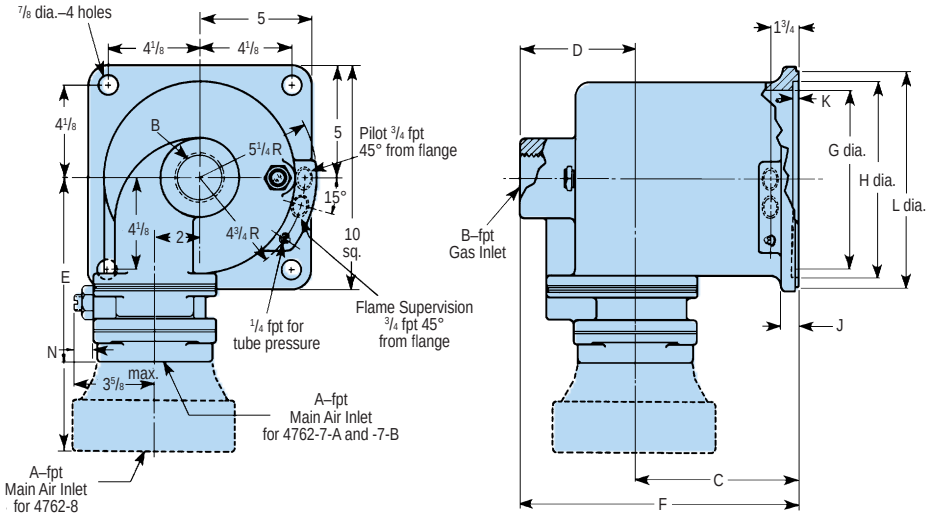
WARNING: Situations dangerous to personnel and property may exist with the operation and maintenance of any combustion equipment.The presence of fuels, oxidants, hot and cold combustion products, hot surfaces, electrical power in control and ignition circuits, etc.,are inherent with any combustion application. 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.

DIMENSIONS

in inches



4762-4 and -6

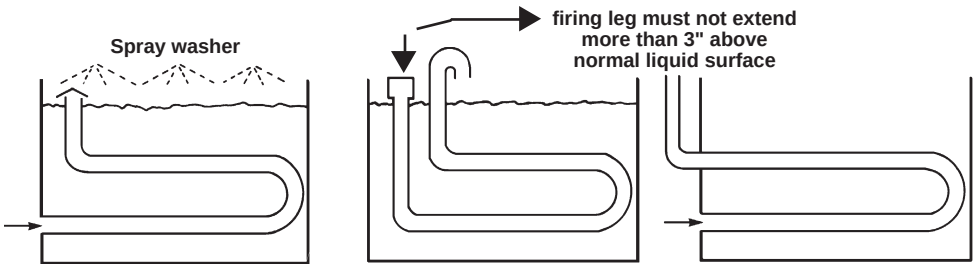


4762-7-A, -7-B, and -8

DIMENSIONS SHOWN ARE SUBJECT TO CHANGE. PLEASE OBTAIN CERTIFIED PRINTS FROM FIVES NORTH AMERICAN COMBUSTION, INC.
IF SPACE LIMITATIONS OR OTHER CONSIDERATIONS MAKE EXACT DIMENSION(S) CRITICAL.

Burner designation	dimensions in inches														recommended Pilot Tip	wt, lb
	A	B	C	D	E	F	G	H	J	K	L	N	P	R		
4762-4	2	1 1/4	7 1/16	5 1/4	8 1/4	14 1/16	4	4 5/8	1/2	1/8	8 1/8	1 1/16	1 1/2	1 5/8	4021-12	46
4762-6	3	2	9 1/2	5 1/2	9 15/16	17 1/8	5 7/8	6 3/4	1/2	1/8	8 1/2	1 3/16	1 7/8	2	4021-12	46
4762-7-A	4	2	7 1/4	5 1/4	8 3/8	12 1/2	8	8 3/4	3/4	1/4	9 5/8	Closed	—	—	4021-12	54
4762-7-B	4	2	7 1/4	5 1/4	8 3/8	12 1/2	8	8 3/4	3/4	1/4	9 5/8	15/16	—	—	4021-12	54
4762-8	6	2	7 1/4	5 1/4	12	12 1/2	8	8 3/4	3/4	1/4	9 5/8	1 3/8	—	—	4021-12	67 1/4

If used, flame rod length should be 4" from outer surface of mounting boss.



common immersion tube arrangements

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