Heat Wise, Inc.

Manual for:

SU-3 199,000 BTU/H to 400,000 BTU/H
SU-4 300,000 BTU/H to 550,000 BTU/H

The burner shall be used only with NATURAL GAS or PROPANE .

Warning: If the following instructions are not followed exactly, a fire or explosion may result, causing property damage, personal injury or death.

- **Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.**

- WHAT TO DO IF YOU SMELL GAS? –

- Do not try to light any appliance.
- Do not touch any electrical appliance.
- Do not use any telephone in your building.
- Immediately call your gas supplier from an outside phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

- **A qualified installer, service agency or the gas supplier must perform installation and service.**
- **At least once per year, a qualified service agency needs to contracted for other than routine maintenance.**

- All installations must be made in accordance with all state and local codes, which may differ from instructions in this manual.
- The installer should inform and demonstrate to the user the correct operation and maintenance of the appliance.
- The installer shall also inform the user of hazards of flammable liquids and vapors and shall remove such liquids and vapors from the vicinity of the burner.

- The installation adjustment data trap (or label) supplied shall be filled in and affixed to the burner or the covered appliance.

These instructions should be affixed to the burner or adjacent to the heating appliance.

NY City MEA 363-99-E

Massachusetts Plumbing Board
G3-0904-16

Manufactured by Heat Wise, Inc.
28 Industrial Blvd. Unit I
Medford, NY 11763

The SU-3 and SU-4 comes in many distinct model numbers, which reflect the listing agency, OEM standard, the fuel, BTU range of the gas train and type of safety control originally supplied with the burner. Check the model number on the label located on the cover of the control box for the specifications of the burner.

Note: Gas trains supplied with the SU-3 and SU-4 are for specific firing ranges, as covered by various codes and listing agencies. Firing this burner above the allowed firing rate will void the warranty, and may result in a fire or explosion, causing property damage, personal injury or death.

Table 1: SU-3 & SU-4 Models and Specifications

Model	Range (MBH)	Fuel	Listing	Gas Train	Gas Conn.
SU-3 U.S. and Canada	199 to 400	Natural Gas And LP		VR 8305	¾”
SU-4AN Canada	300 to 500	Natural Gas Only		VR 8305M	¾”
SU-4N (H or F)* Canada	300 to 550	Natural Gas Only		Two VR 8305M valves in parallel	1”
SU-4P (H or F)* Canada	300 to 550	LP Only		VR 8305M	¾”
SU-4N (H or F)* U.S.	300 to 400	Natural Gas Only		VR8305M ANSI Z 21.17 compliant	¾”
SU-4P (H or F)* U.S.	300 to 400	LP Only		VR8305M ANSI Z 21.17 compliant	¾”
SU-4N (H or F)* U.S.	300 to 550	Natural Gas Only		U.L. 795** w/ low and high gas pressure switches	¾”
SU-4P (H or F)* U.S.	300 to 550	LP Only		U.L. 795** w/ low and high gas pressure switches	¾”

* H=Honeywell control F= Fenwal control

** Also conforms to NFPA-86

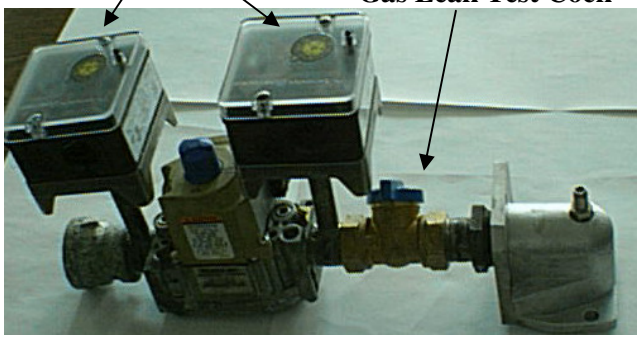
Table 2: SU-3 & SU-4 Electrical Specifications

Primary Electric Input	Secondary Electric Input	Total Watts	Total Amps
120 Volt 60 Hz 1 Ph	24 Volts	150 Max	3 or less

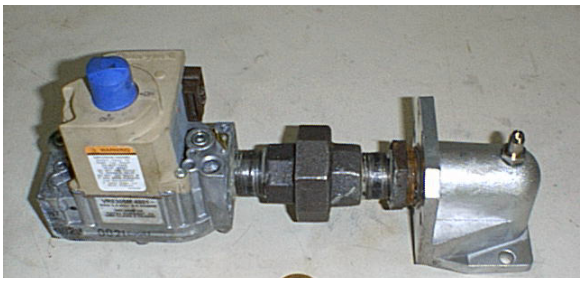
- **Fuel:** The SU-3 and SU-4 Burners will fire natural gas or LP. The maximum inlet pressure at test port is 10" W.C. for both natural and LP gas.
- **Length of Flame Tube:** 5 ¼" or 14" (special order)
- **Firing System:** The burner operates as ON – OFF with a fixed air inlet shutter and proportional head setting. (See the charts for approximate firing rates. In the field they may vary)
- **Blower Motor:** 120 Volt/ 60 Hz/1 Ph, 1/6 HP PSC motor
- **Burner Ignition**: A separate external high voltage ignition transformer provides interrupted ignition with 4 second safety timing to establish the flame.
- **Air Flow Safety Switch**: Diaphragm switch closes when the burner blower develops adequate air pressure. Loss of air pressure causes the fuel valves to close immediately.
- **Pre-Purge**: Minimum 30 seconds is standard on burners.
- **Gas Train**: Below 400,000 BTU low and high gas pressure switches are optional. Above 400,000 BTU they are standard with gas leak shut off valve. (See the setting pressures from the table given) Dual gas valves in the form of a combination valve or separate with built in pressure regulator or separate with shut off valves are all part of the factory-assembled system. When pressure switches are used, the power (120V) passes through each as a part of the limits; they will trip power to the burner as soon as pressure increases or decreases to the system. See the pictures below for common configurations of SU-3 and SU-4 gas trains. **The same gas valve is used for both natural gas and propane without any conversion kit.**

Picture 1: U.L. 795 gas pressure switches

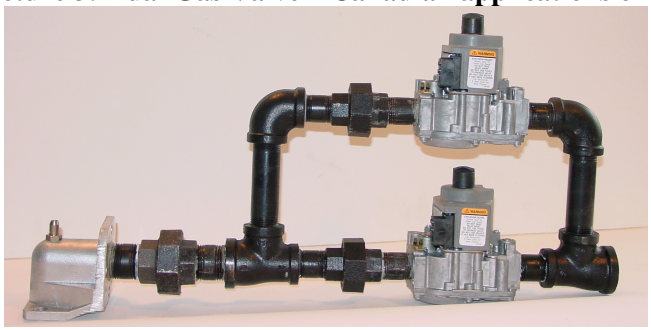
Gas Leak Test Cock



Picture 2: Below 400 MBH Gas Manifold



Picture 3: Dual Gas Valve – Canadian applications only

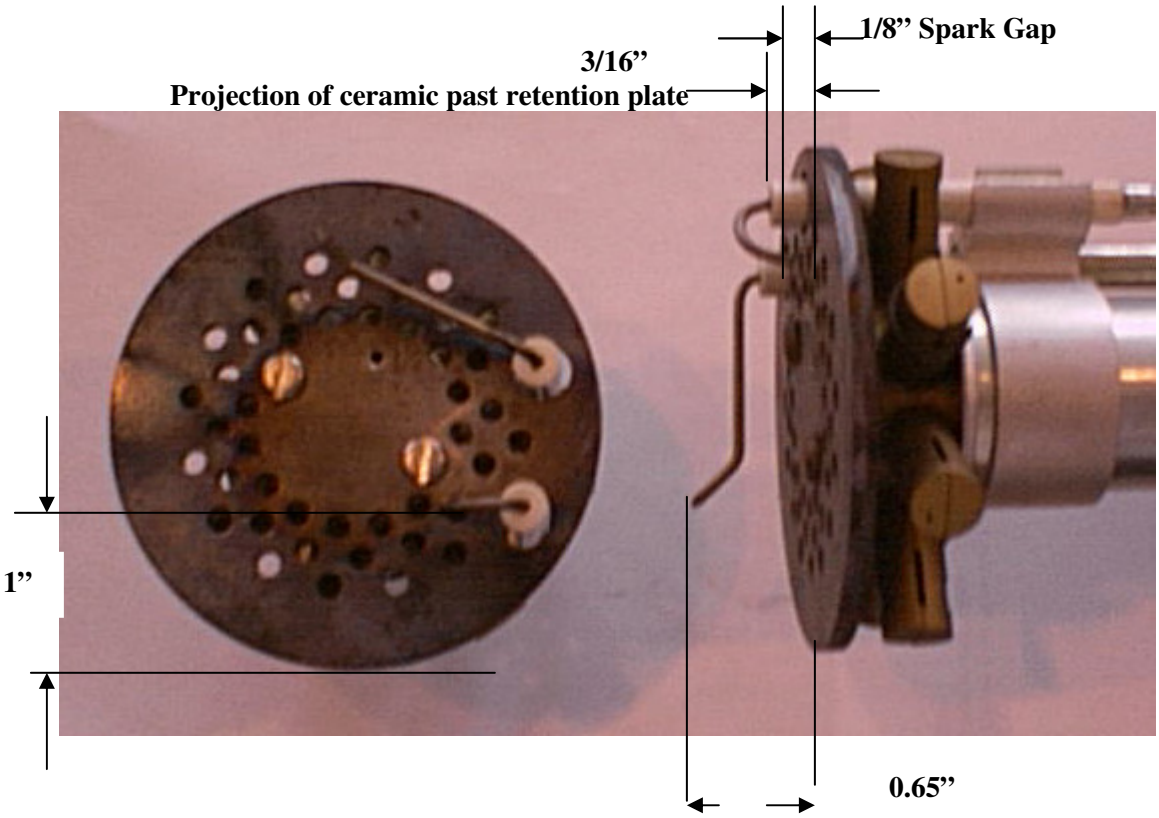


Warning: Should overheating occur, 1) shut off the manual gas shut off valve to control the appliance; 2) DO NOT shut off the control switch to the blower

This power gas burner is designed to convert oil and/or coal fired boilers and furnaces to a gas-burning appliance. The conversion must conform to local codes. In the absence of such codes, the American National Standard Institute (ANSI) for the installation of gas conversion burners, Z21.8A-1990 and the National Fuel Gas Code ANSI 223.1-1992 or current standards should be applied.

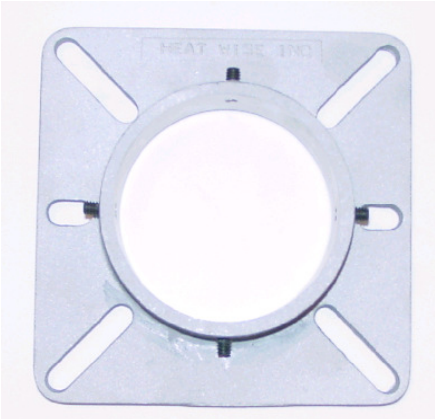
Two electrodes act as a sparker and a flame rod (See Fig. 1). Flame rectification by this flame rod monitors the continued presence of the burner flame.

Fig. 1 Electrode and Flame Sensor Positioning



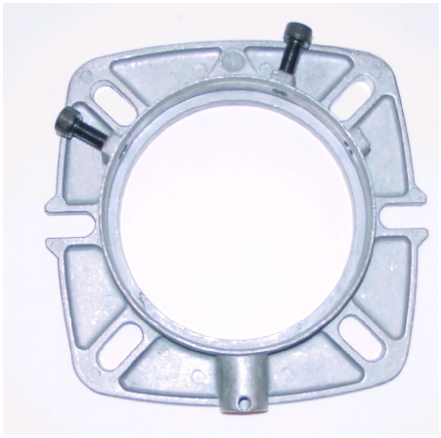
Installing the Burner

If the burner being installed is a conversion burner, use a prefabricated chamber or build a firing chamber that can withstand 2000° F. Measure the boiler or furnace mounting plate to determine the flame tube insertion required. *Deduct ¼" from the total length and tighten the flange on the flame tube with the deducted insertion depth. The ¼" deduction will prevent the tip of the flame tube from burning off.* Install the burner on the unit and then tighten the nuts on the flange so that the burner is permanently secured. Seal off any free openings with high temperature cement.



Picture 4: STANDARD FLANGE:

Measure your insertion depth and mark the blast tube. Deduct ¼" from the total length; the ¼" deduction will prevent the tip of the flame tube from burning off. Remove the blast tube by loosening the two 3 mm allen screws located on the housing near the base of the blast tube. Install the flange and gasket from the rear of the blast tube and tighten the four ¼"-20 setscrews on the flange. Reinstall the blast tube (with flange to the housing). Make sure that the blast tube is firmly fixed to the burner. Mount the burner to the heat exchanger and tighten the bolts. Seal off any free openings with either high temperature cement or high temperature silicone



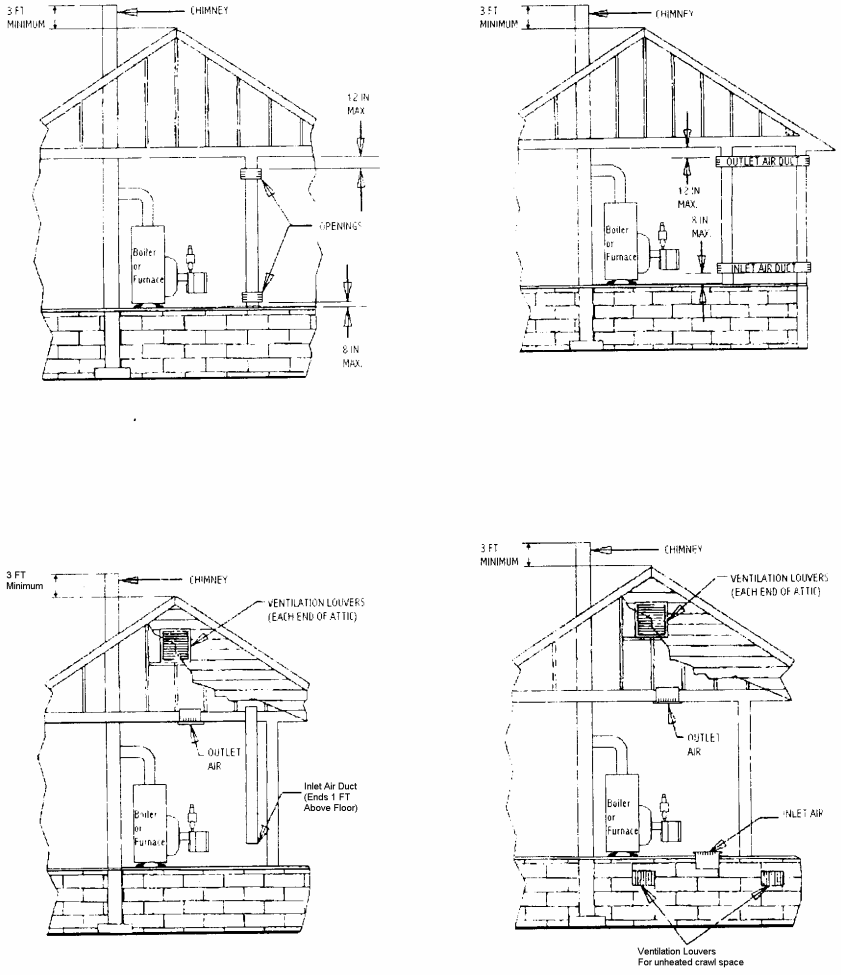
Picture 5: BODY FLANGE:

First, install the gasket and boiler flange to the boiler. For heat exchangers with a diamond stud pattern, one allen screw on the flange should be on the top, slightly to the left of the 12 o'clock stud. The second screw should be on the right (slightly above the 3 o'clock position stud). Tighten all the nuts equally. Make sure that the allen screws are backed out, to allow enough clearance. Then, insert the SU-4 gas burner into the boiler.Once the burner is inserted and pushed all the way forward, tighten the allen screw on the top of the flange. This screw MUST go into the groove that is on the burner housing. Tighten the second allen screw, located on the right side of the flange. This screw should be tight. Seal off any free openings with either high temperature cement or high temperature silicone.

Chimney Requirements

The chimney should extend **at least 3'** above a flat roof or the highest roof ridge (see Fig. 2) and be free in a **radius of 30'** of objects such as tree limbs, other buildings, etc, which may cause a down draft. The chimney should be lined as required by the local Gas utility or local codes. Some utilities require new chimney liners for all gas installations. Use a corrosion resistant chimney liner (approved for gas service) of the same size as the vent pipe.

Fig. 2 Chimney and Fresh Air Dimensions



Gas Service and Pipe Capacity

Before connecting the burner to the gas supply, insure that the gas pipes and service meter are large enough to permit the additional load of the gas burner (see Table 3).

Table 3: Pipe Capacity Table*(x 1,000 BTU's)

	Nominal diameter of pipe in inches			
Pipe Length**	**1"**	**1 ¼"**	**1 ½"**	**2"**
15'	345	750		
30'	241	535	850	
45'	199	435	700	
60'	173	380	610	
75'	155	345	545	
90'	141	310	490	
105'	131	285	450	920
120'	120	270	380	850
150'	109	242	300	780
180'	100	225	225	720

***** *Using 0.6 Specific Gravity Gas and a Pressure Drop of 0.3" of Water Colum*n

*** Each 90^0 elbow counts as 3' for the purpose of these calculations*

Example 1:

There is 75 feet of 1 ¼" pipe from the meter to the burner and there are 5 elbows.
(5 elbows X 3') + 75' pipe = 15' + 75' = 90' of effective pipe length
The maximum BTU that can be fired is 310,000 BTU (see Table 3)

Gas Piping to the Burner

It is advisable to run a separate gas line from the meter to the gas burner to avoid pressure drops. Refer to the above Pipe Capacity table for the correct sizes. ***ALL PIPING MUST CONFORM WITH LOCAL CODES.*** Use black steel pipe and malleable fittings (**do not use cast iron parts**) with a suitable pipe dope which is resistant to liquefied petroleum gases.

Piping should consist of:

1. A shut off valve approximately 6' away from the unit.
2. A 1/8" plugged NPT tapping for gas pressure measurement preferably on the manual shut off valve (as shown or anywhere between the gas valve and the shut off value).
   Note: The manual shut off valve and tapping are NOT part of the SU-4 Gas Burner. Please make sure you conform to local and state codes.
3. A gas union.
4. A drip pipe.
   Caution: The gas valve should not be subjected to more than ½" PSIG. Therefore, the burner should be isolated during high-pressure gas leak tests. The appliance and its individual shut off valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of ½ psig. The appliance must be isolated from the gas supply piping by closing its individual manual shut off valve during any pressure testing of the gas supply piping system at test pressures equal to or less than ½ psig.

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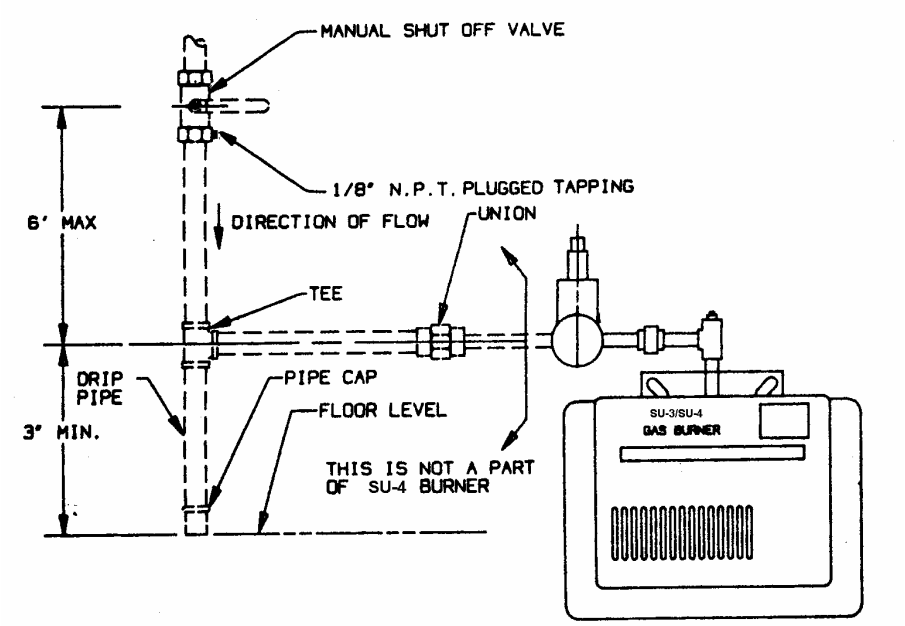
Fig. 3 Gas Burner Piping*

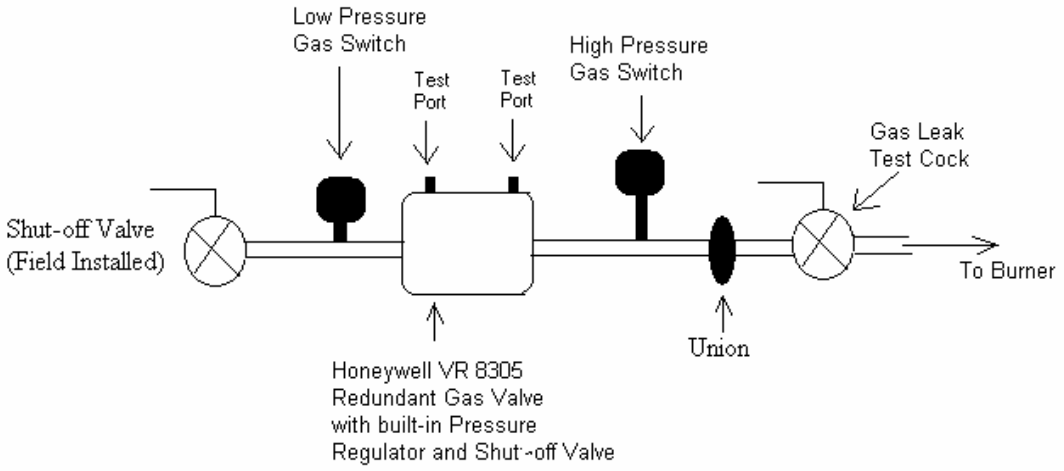


***The dotted lines represent field installation.**

Adjusting the Pressure Switches

Figure 4 demonstrates the possible positioning of pressure switches on the SU-4 gas train. Use the figures in Table 4 to approximate the settings.

Fig. 4 Sample Gas Train #1



The high and low gas pressure switches must be set during installation (refer to Table 3 and Table 4). To determine the setting of the low pressure gas switch (LPS), measure the manifold pressure (MP), inlet pressure (IP) and the pressure between the valve (BV):

Initial setting of the High Gas Pressure Switch:

After the firing rate is determined, refer to the charts Table 3 or Table 4 on page 12 of this manual. Multiply the manifold pressure necessary by 1.5 and set the High Gas Pressure Switch to reflect that calculation.

Initial setting of the Low Gas Pressure Switch:

Divide the manifold pressure by 2 and add the pressure drop across the valve.

Example: Natural Gas at 340 MBH
Required Manifold Pressure= 2.7”

Pressure drop across Honeywell valve=1.0”

HPS = 1.5*2.7”=4.0”
LPS = (2.7”/2) + 1.0”=2.35”

For other valves, refer to the manual for that specific valve for the pressure drop.

Warning: After the burner has been adjusted so that the burner is operating properly, the pressure switches must be readjusted.

- Using a monometer, measure the manifold pressure that was necessary to achieve the exact firing rate necessary. Multiply the manifold pressure by 1.5. With the burner firing, use an analyzer and slowly increase the gas pressure up to the new calculated high pressure cutoff point. If the CO level reaches 400 ppm **before the newly calculated setting**, then at the point just before 400 ppm CO is reached is where the high gas pressure switch must be set.

- Reset the manifold pressure back to the correct setting.

- After the High Gas Pressure Switch is set, the recalculate the low gas pressure switch setting by dividing the actual manifold pressure by 2 and adding the pressure drop across the valve. With the burner firing use an analyzer and slowly decrease the gas pressure **into the valve** to the new calculated low pressure cutoff point. If the CO reaches 400 ppm before the newly calculated setting, then at the point just before 400 ppm CO is reached is where the low gas pressure switch must be set.

- Reset the incoming pressure back to the correct setting.

If the combustion does not reach the 400 ppm mark at the set points, the burner can be left at those settings. IMPORTANT: Any switch can be adjusted, as long as it meets both sets of criteria: Not greater than 400 ppm CO and meets the appropriate calculation for the switch.

Table 4: Sample Pressure Switch Settings

Gas	Firing Rate MBH	Flame Tube	Inlet Press. T_P	Manifold Press. T_M	$T_M > 50\% T_M + \Delta P^*$ LPS	$<1.5 \times T_M$ HPS
Nat.	300	5 ¼”	6.9”	3.3”	1.6+1=2.6”	3.3x1.5=4.9”
Nat	550	5 ¼”	5.5”	4”	2+1=3”	4x1.5=6”
Nat.	300	14”	6.9”	3.3”	1.6+1=2.6”	3.2x1.5=4”
Nat.	550	14”	5.5”	4”	3”	4”
LP	300	5 ¼”	8.6”	3.7”	1.85+1=2.85”	5.6”
LP	550	14”	9.2”	2.3”	2.2”	3.4”

* ΔP= Pressure drop. For this gas valve, ΔP= 1”. Refer to the literature for the gas valve for more information on pressure drops.

Chimney Liner, Draft Regulator And Vent Pipe

Some utilities require new chimney liners for all gas installations. Use a corrosion resistant chimney liner (approved for gas service) of the same size as the vent pipe. Use a double swing draft regulator, listed by CSA or U.L. When the burner is used as a conversion burner, draft over fire should be maintained between –0.02 and +0.01 "W.C. by adjusting the regulator when the burner is fired. The installer should follow the barometric draft regulator manufacturer's instructions for complete details for installations and adjustments. The vent pipe should extend only to (but not beyond) the inside wall of the chimney.

Adjusting the Firing Rate

See Fig. 6 below. Position D_1 represents the burner head all the way forward. By rotating the burner head adjustment screw ***clockwise***, the head can be moved back 0.5" (to position D_3). Similarly, if the head adjustment screw is turned ***counter-clockwise***, the head is moved forward. At head position D_3, the SU-4 gas burner fires at 300,000 BTU when the gas manifold pressure is 3.5" W.C. Adjust the air shutter and use a combustion analyzer to set the burner to between 8% and 9.5% CO_2 for natural gas or between 10.0% and 11.5% for LP gas. (See page 13 & 14 of this manual for further details on burner operation).

By adjusting the manifold pressure, it is possible to adjust the firing rate. Refer to Tables 5 and 6.

Note: The pressure and head setting may vary for OEM packaged units.

Fig. 5 Top View Of Gas Valve

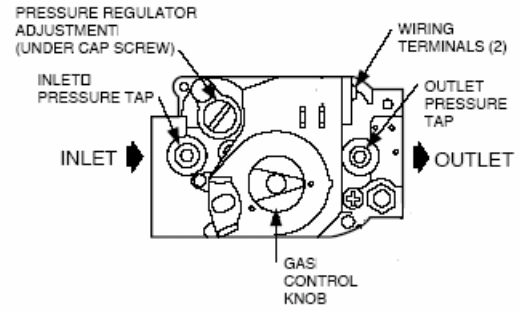
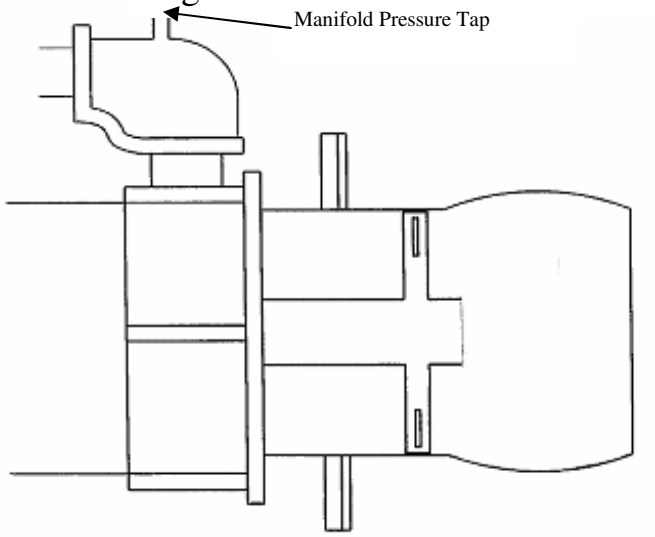


Fig. 6 Adjusting the Firing Rate



When commissioning the burner, make sure the gas control knob is in the "ON" position. Install monometers at the inlet pressure tap and manifold pressure tap on the burner. Record the static incoming gas pressure. When the burner lights off, record the running incoming gas pressure; ***the running incoming gas pressure should never be below 5".*** Note: this pressure drop should not be greater than 1". Check the manifold pressure from the outlet pressure tap. ***Note: When checking manifold pressure, do not subtract burner housing pressure during valve-on delay.*** Refer to Charts 5, 6, 7 and 8 on pages 10 and 11 to make sure the gas pressure is set for the appropriate fuel and pressure. If adjustments need to be made, remove the cap screw and adjust the pressure regulator. Screwing the regulator clockwise will increase the manifold pressure and counter-clockwise will decrease the manifold pressure.

Table 5: Firing Rates at Various Settings, Natural Gas for SU-3

Manifold Pressure = 1.0”			Manifold Pressure = 1.7”			Manifold Pressure = 2.7”		
Head Setting #	Air Shutter #	MBH	Head Setting #	Air Shutter #	MBH	Head Setting #	Air Shutter #	MBH
1	0.18	224	1	3.13	272	1	9.62	340
2	0.25	225	2	3.24	272	2	9.79	339
3	0.32	227	3	3.35	274	3	9.97	342
4	0.39	230	4	3.47	278	4	10.14	348
5	0.46	234	5	3.58	284	5	10.32	355
6	0.53	238	6	3.69	290	6	10.49	363
7	0.60	242	7	3.81	296	7	10.67	372
8	0.67	247	8	3.92	302	8	10.84	380
9	0.74	251	9	4.03	307	9	11.02	388
10	0.81	254	10	4.15	312	10	11.19	394
11	0.88	258	11	4.26	316	11	11.37	400
12	0.95	260	12	4.37	320			
13	1.02	263	13	4.49	322			
14	1.09	265	14	4.60	324			

Table 6: Firing Rates at Various Settings, Propane (LP) for SU-3

Manifold Pressure = 1.0”			Manifold Pressure = 1.75”			Manifold Pressure = 2.1”		
Head Setting #	Air Shutter #	MBH	Head Setting #	Air Shutter#	MBH	Head Setting #	Air Shutter #	MBH
1	1.04	229	1	4.60	274	1	8.88	328
2	1.25	234	2	4.90	279	2	9.27	333
3	1.45	239	3	5.19	284	3	9.67	339
4	1.66	244	4	5.48	290	4	10.07	345
5	1.87	248	5	5.77	295	5	10.47	351
6	2.07	253	6	6.07	301	6	10.86	358
7	2.28	258	7	6.36	307	7	11.26	365
8	2.49	263	8	6.65	313	8	11.66	373
9	2.69	267	9	6.95	318	9	12.05	380
10	2.90	272	10	7.24	324	10	12.45	388
11	3.11	276	11	7.53	330	11	12.85	396

Table 7: Firing Rates at Various Head Settings, Natural Gas for SU-4

Manifold Pressure = 2.2” W.C.			**Manifold Pressure = 2.75” W.C.**			**Manifold Pressure = 3.5” W.C.**		
Head Setting #	Air Shutter #	MBH	Head Setting #	Air Shutter #	MBH	Head Setting #	Air Shutter #	MBH
1	6.04	306	1	10.01	344	1	10.01	395
2	6.18	306	2	10.19	343	2	10.19	393
3	6.32	308	3	10.37	346	3	10.37	396
4	6.47	313	4	10.55	351	4	10.55	403
5	6.61	319	5	10.72	359	5	10.72	412
6	6.76	326	6	10.90	367	6	10.90	422
7	6.90	334	7	11.08	376	7	11.08	433
8	7.04	341	8	11.26	384	8	11.26	443
9	7.19	347	9	11.44	392	9	11.44	452
10	7.33	353	10	11.61	399	10	11.61	460
11	7.48	358	11	11.79	404	11	11.79	467
12	7.62	362	12	11.97	408	12	11.97	471
13	7.76	365	13	12.15	411	13	12.15	475
14	7.91	367	14	12.32	413	14	12.32	477
15	8.05	368	15	12.50	415	15	12.50	478
16	8.20	370	16	12.68	416	16	12.68	479
17	8.34	372	17	12.86	418	17	12.86	480
18	8.48	375	18	13.03	421	18	13.03	484
19	8.63	379	19	13.21	426	19	13.21	489
20	8.77	386	20	13.39	434	20	13.39	499
21	8.92	397	21	13.57	447	21	13.57	514
22	9.06	412	22	13.75	465	22	13.75	537

Table 8 Firing Rates at Various Head Settings, Propane (LP) for SU-4								
Manifold Pressure = 1.8" W.C			**Manifold Pressure = 2.5" W.C**			**Manifold Pressure = 3.0" W.C**		
Head Setting #	Air Shutter #	MBH	Head Setting #	Air Shutter #	MBH	Head Setting #	Air Shutter #	MBH
1	6.74	301	1	11.73	364	1	15.29	409
2	7.09	306	2	12.19	369	2	15.84	414
3	7.43	312	3	12.66	375	3	16.40	420
4	7.78	317	4	13.13	382	4	16.95	428
5	8.12	323	5	13.59	389	5	17.50	435
6	8.46	329	6	14.06	396	6	18.05	444
7	8.81	336	7	14.52	404	7	18.61	453
8	9.15	343	8	14.99	413	8	19.16	463
9	9.50	349	9	15.46	421	9	19.71	472
10	9.84	356	10	15.92	430	10	20.26	483
11	10.19	363	11	16.39	439	11	20.81	493
12	10.53	370	12	16.85	448	12	21.37	504
13	10.88	377	13	17.32	457	13	21.92	515
14	11.22	384	14	17.79	467	14	22.47	526
15	11.57	391	15	18.25	476	15	23.02	536
16	11.91	398	16	18.72	485	16	23.58	547
17	12.26	405	17	19.18	494			
18	12.60	411	18	19.65	502			
19	12.95	417	19	20.11	511			
20	13.29	424	20	20.58	519			
21	13.64	430	21	21.05	526			
22	13.98	435	22	21.51	533			

Electric Wiring

These gas burners are manufactured for use with 120 volt, 60 cycle, single-phase electric current. The installation must comply and be grounded in accordance with the National Board of Fire Underwriters and National Electric Code ANSI/NFPA No. 70-1987 (or the latest addition). All applicable local codes should be followed as well.

Installation wiring should be wired through each limit control or interlock; follow the wiring diagram for the control for details. Do not use the 24 Volt transformer found on the burner to power other items in the heating system, such as thermostats, spill switches, etc. See the sample wiring diagrams provided below:

Wiring Diagrams

Below are several wiring diagrams. Depending on the control system of the burner, the wiring and sequence of operations will differ (see Fig. 6 and 7). Also included are some common wiring diagrams for field wiring (Fig. 8 and 9). Wire the burner accordingly in compliance with all applicable codes. For special controls, a separate control manual will be provided. Please refer to these diagrams for further information.

Fig. 6 Honeywell S89F control

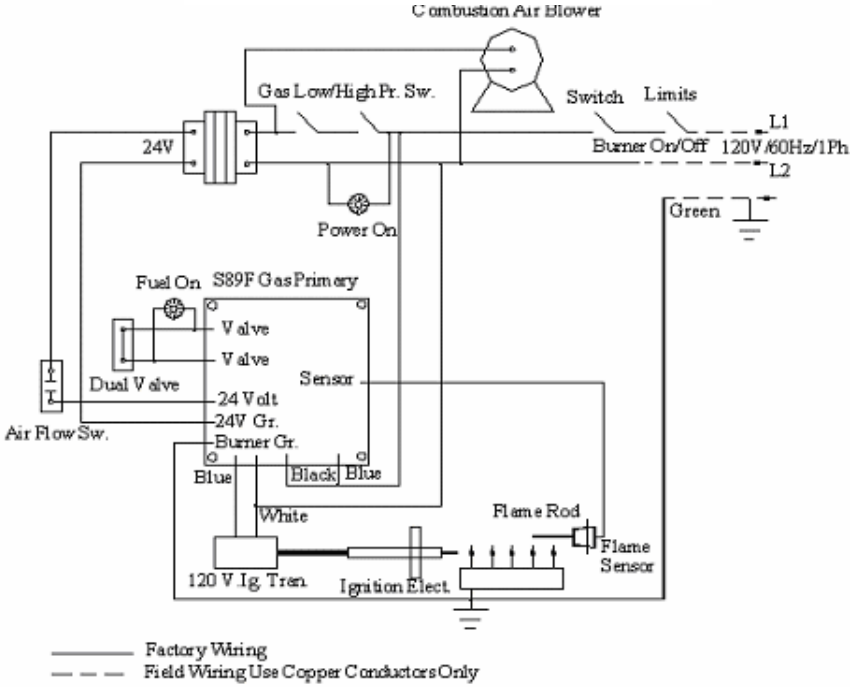
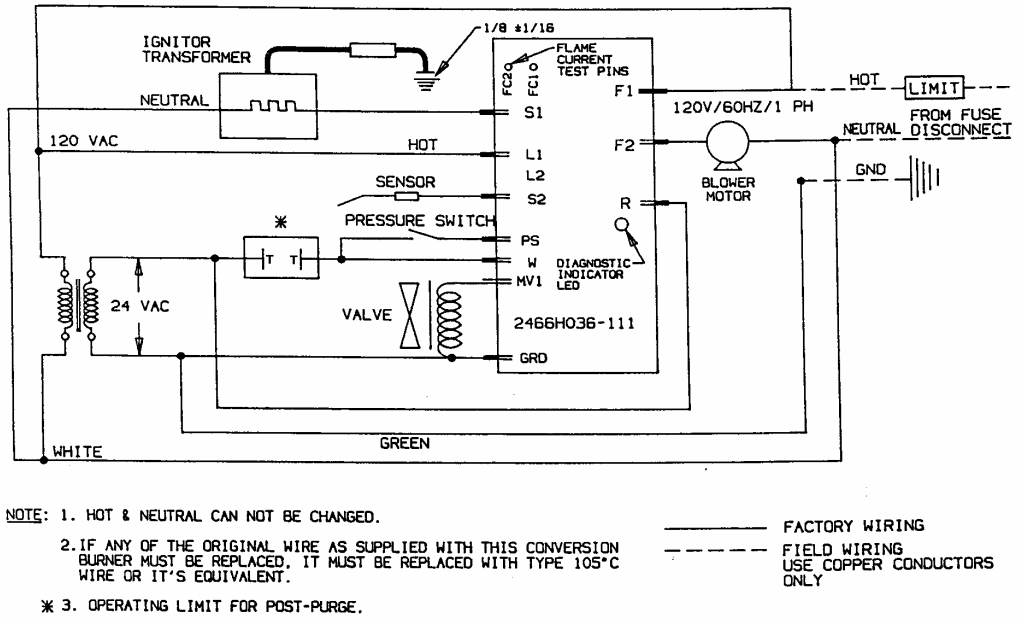


Fig. 7 Fenwal 2466H



SEQUENCE OF OPERATIONS
Honeywell S89F

1. Limits close.
2. Blower motor starts as the 24 Volt transformer powers the airflow switch.
3. Power from the airflow switch to the S89F control initiates 34 second pre-purge.
4. At the end of the pre-purge, the spark is energized for 4 seconds. At the same time, the 24 Volt transformer powers the gas valve, allowing the fuel to flow.
5. Within 4 seconds, the flame should be established and proved. The spark will shut off and the control will hold power to the gas valve until the limits open and the burner stops firing.
6. If the flame is not established, the blower motor continuously runs.

To restart, power should be interrupted for five minutes. Then turn on the power to start this sequence again.

Optional Valve-on Delay/Motor-off Delay control
Below 400,000 BTU ONLY

Not recommended for Propane (LP) applications

SEQUENCE OF OPERATIONS: Fenwal 2466H 036-111

1. All limits are closed and 120-volt power is on for the burner.
2. T-T terminals are closed (24-volt power carrying lines; do not power this.) Sometimes, T-T terminals are jumped with a wire nut for burners ***not*** set for motor-off delay.
3. Burner motor starts and pre-purge begins
4. Burner housing pressurizes and proves air flow - contacts closed. {Note: if the contacts are closed before the motor starts, blower motor runs continuously. Diagnostic light flashes once every 3 seconds.}
5. At the end of pre-purge, ignition spark starts (audible sound) and the redundant gas valve opens for 4 seconds. (Trial for ignition)
6. Within 4 seconds, gas flame is established and the flame rod carries current to prove the flame {Note: a minimum of 0.7 micro amps are required; 5 micro amps is not uncommon.}
7. Flame remains till operating limit is open. If T-T is used to fire the burner (field wired for post-purge), the burner will go into post-purge once the thermostat is satisfied (T-T open). These burners have 60 seconds post purge.
8. If the flame is not established, the control will attempt ignition two more times before locking out for 60 minutes. The control will then attempt to re-establish the flame every 60 minutes. To reset the control, interrupt power for five minutes to start the sequence again.

Fig. 8 Wiring the SU-3/SU-4 with a switching relay

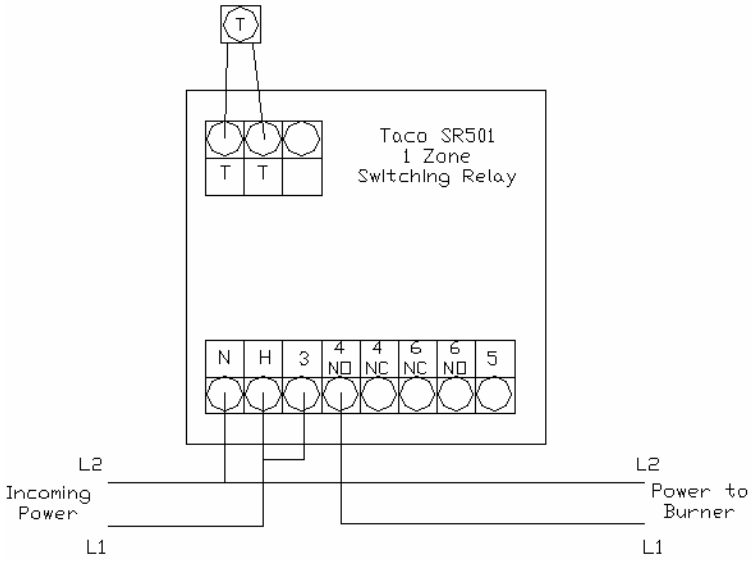
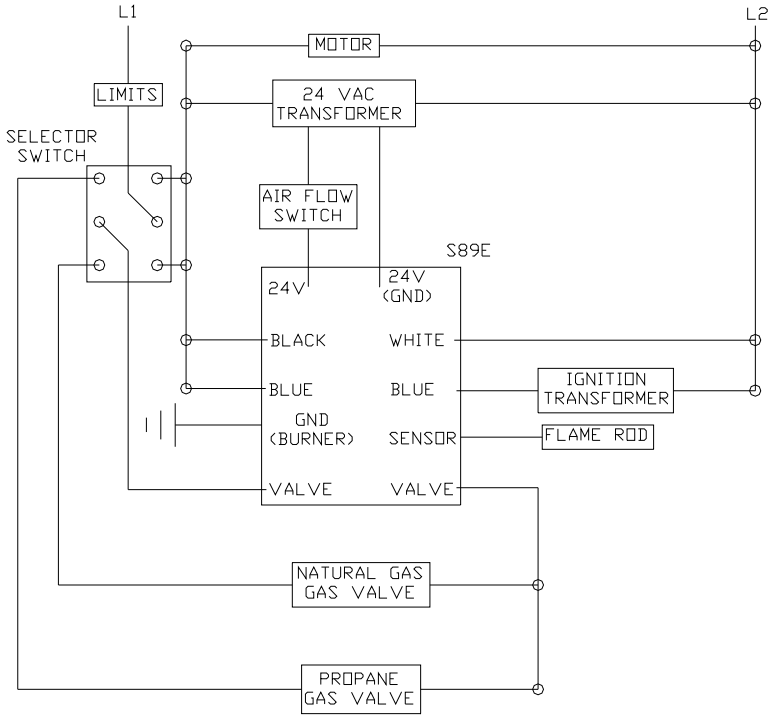


Fig. 9 Wiring the SU-3/SU4 as a two-fuel burner (Natural Gas and LP) with two separate gas trains



The manual shut-off valve downstream of the fuel not being used must always be closed. When switching fuels, the burner should be shut-off by putting the selector switch in the center position. The manual valves should then be moved so that the fuel that is not being used is closed and the fuel that is being used is opened. ***The burner shall not switch fuels while firing. Failure to follow this procedure could cause property damage personal injury or death.***

Commissioning the Burner

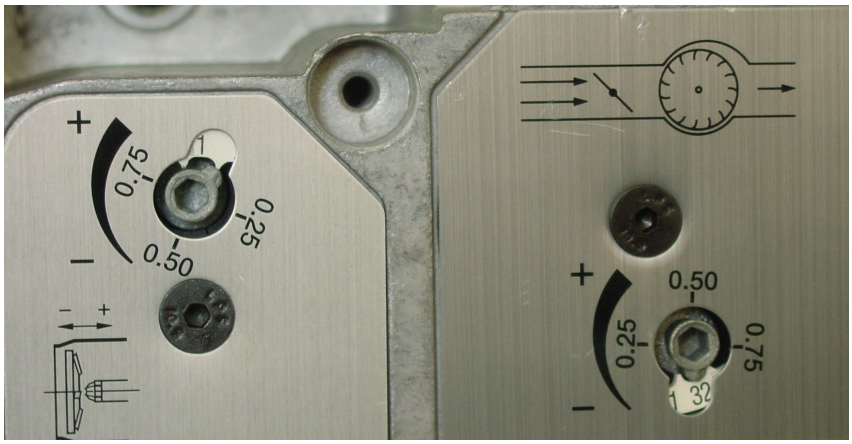
Once installed, a higher or lower firing rate can be achieved by raising or lowering the manifold pressure by +/- 0.3". Pressure changes can only be made when the burner is running. The typical working manifold pressure for natural gas is **2.5 to 3.3 Inches of Water Column ("W.C.),** or **2.0 to 2.5 "W.C.** for propane. ***Note: When checking manifold pressure, do not subtract burner housing pressure during valve-on delay.*** The maximum inlet pressure at the gas valve is **11 "W.C**.; the minimum is **5 "W.C.** Refer to Charts 5, 6, 7 and 8 on pages 9 and 10

Clock the meter to determine the firing rate. The firing rate should be +/- 3% of the heat exchanger manufacturers' specifications. Check the heat exchanger manual for further details.

The head is pre-set at the factory for OEM applications. Check your OEM manual for the proper head setting for that oven. In the case of a conversion or retrofit burner, refer to pages 9, 10 and 11 for further details. Using a combustion analyzer, check the CO_2 (or O_2) and carbon monoxide levels. Adjust the air as necessary (See below :)

Picture 6

Head Adjustment



Air Adjustment

Turning the Air Adjustment dial clockwise opens the air shutter and increases the air; turning the air adjustment dial counter-clockwise closes the air shutter and reduces the air.

Adjusting the Burner

Using a combustion analyzer, check the following readings:
If CO_2 is greater than 9.5% (O_2<3.5%); Open Air Shutter
If CO_2 is less than 8.8% (O_2> 5%); Close Air Shutter
Carbon monoxide levels should be below 400 ppm; 100 ppm or less is ideal. Check local codes for emissions requirements. ***Note: if any adjustments are made, it is important to recheck the firing rate and combustion analysis.***

Lighting Istructions

To light the SU-3/SU-4 Gas Burner

1. Set the thermostat to the lowest temperature
2. The control knob on the gas valve should be in the "OFF" position for at least five minutes.
3. Rotate the control knob counter-clockwise to the "ON" position and set the thermostat to the desired temperature settings

Reset, if Flame Lockout Occurs

1. Turn the thermostat off, or turn the main power off
2. Wait five minutes
3. Turn the main power on

To shut the burner off

1. Rotate the control knob on the gas valve to the "OFF" position
2. Set the thermostat to the lowest temperature

Burner Operation

Before turning the burner on, check for gas supply leaks. Check the wiring diagrams; install manometers before and after the gas valve. Keep the observation port of the boiler or furnace open. Follow the instructions on the nameplate of the burner to turn it on. Follow the sequence of operations for the control (see page 9). Record the readings below.

COMMISSIONING/TROUBLESHOOTING CHECKLIST

There are four factors that are needed to operate the gas burner:

____ 1. Combustion Air ____ 2. Electricity ___ 3. Gas Flow ___ 4. Combustion Analysis

☐ **1. Combustion Air**

Check the air coming into the area where the burner is located.

____ 1. If the burner is in a large area that air can come into freely (i.e. an open basement for home heating systems), then the air supply should be sufficient for the burner.

____ 2. If the burner is in an enclosed area (i.e. small room or closet) then fresh air must be supplied to the burner. The intakes to the area must terminate facing down in order to avoid obstructions. The total open free area must be 1 in^2 per 10,000 BTU input

Example

350,000 Btu/hr firing Rate

$$(350{,}000 BTU/hr) * \frac{(1 in^2)}{10{,}000 BTU/hr} = 35 in^2$$

☐ **2. Electricity**

Check burner wiring

____ 1. Check that 120VAC is coming into the burner

____ 2. Check that the burner is properly grounded using a ground wire

____ 3. Check the polarity to the burner is correct.

(To check polarity: Set a multimeter to VAC. Touch L1 to one of the probe tips and ground to the other. If a voltage between 110 and 125 is shown then it has the correct polarity; if any other reading is shown, then check the L2 wire. If the L2 wire shows a voltage between 110 and 125 is shown then the polarity to the burner is reversed.)

☐ **3. Gas Flow**

____ 1. Check that the capacity of the meter can meet the demand of the burner and all other appliances running off the meter.

____ 2. Check that the burner is on a direct pipe from the meter.

____ 3. Measure the total length of all the pipe and count the number of elbows (1 90^o elbow=3 ft. of pipe). Compare the total feet of pipe and the BTU demand using the chart on Page 5 to determine the size of the pipe required.

____ 4. Check that the proper orifice is installed if needed.

____ 5. Check the gas pressure at the gas valve (line pressure). This pressure should be between 5" wc and 10" wc when the burner is not firing. ***Note: When checking manifold pressure, do not subtract burner housing pressure during valve-on delay.***

____ 6. With the burner firing the pressure drop on the supply side should not exceed 2" wc. If the pressure drops and then surges back up, double check the piping because it means the pipes are undersized.

☐ **4. Commissioning the Burner**

____ 1. Check the head and air settings and start the burner.

____ 2. **Use a combustion analyzer** to check CO_2 and CO. CO_2 should be between 9% and 9.8% and CO must be less than 400 ppm but we suggest less than 100ppm. If the CO_2 is greater than 9.8% then the air should be opened to reduce the CO_2; if the CO_2 is below 8%, then the air should be closed to increase CO_2.

____ 3. Check the manifold pressure to verify that it is at the specified pressure. ***Note: When checking manifold pressure, do not subtract burner housing pressure during valve-on delay.***

____ 4. Clock the gas meter and check that the correct firing rate is achieved. If the firing rate is low, the gas pressure should be increased slightly. If the firing rate is too high then the gas pressure should be decreased. (Usually if the stack temperature is below 300F the firing rate is too low. If the stack temperature is over 600F then the firing rate is usually too high or on rare occasions the heat exchanger is blocked up)

Gas Input to Burner in ft^3/hr *

Seconds	1/2 ft^3	1 ft^3	2 ft^3	Seconds	2 ft^3	5 ft^3
10	180	360	720	50	144	360
12	150	300	600	55	131	327
14	129	257	514	60	120	300
16	113	225	450	65	111	277
18	100	200	400	70	103	257
20		180	360	75		240
22		164	327	80		225
24		150	300	90		200
26		138	277	100		180
30		120	240	110		164
35		103	206	120		150
40			180	130		138
45			160			

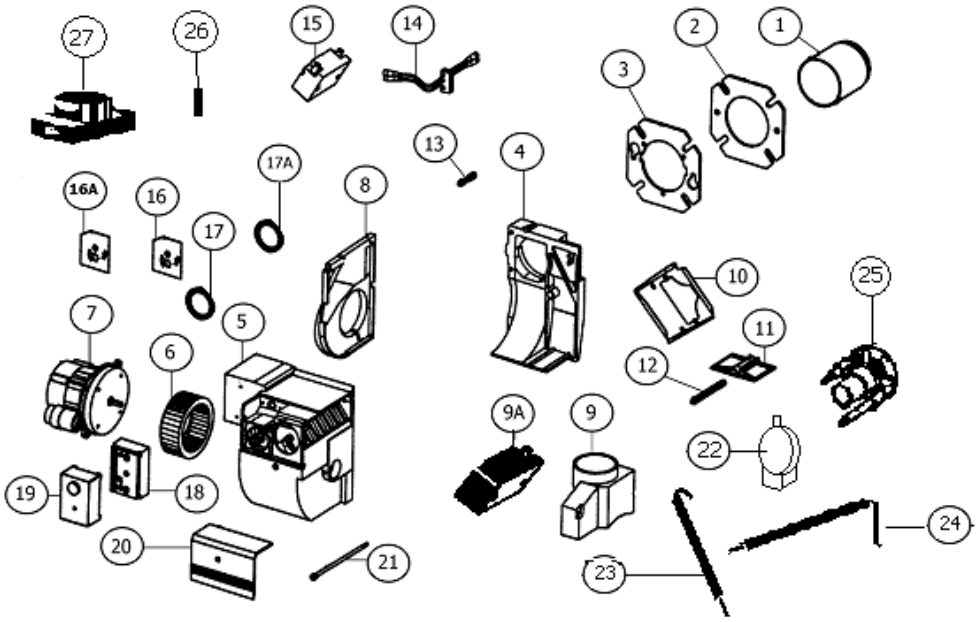
* For BTU/hr Natural gas multiply by 1000 BTU/hr;
for Propane multiply by 2500

____ 5. If the firing manifold has been readjusted,
redo steps 2 and 4

____ 6.Check that the draft over-fire is positive

BURNER OPERATION: Record the Readings at Steady State		
Draft over fire at steady state (should be –0.02 "W.C. to +0.50 "W.C.)		
Draft in the Breech at steady state (refer to heat exchanger manual for details)		
Natural Gas CO_2 % = (9% to 9.8%) or O_2 % = (5.0% to 3.5%)		
LP Gas CO_2 % = (10.5% to 11.5%) or O_2 % = (5.0% to 3.5%)		
Stack Temperature – Gross ^oF (300^o F minimum, 550^oF maximum)		
Room Temperature ^oF		
Carbon Monoxide (CO) in PPM		
NOx in PPM (If necessary)		
Incoming Gas/LP pressure = "W.C. (minimum 5")		
Natural Gas manifold gas pressure = "W.C. minimum 2.2", max 4.0"*		
LP Gas manifold gas pressure = "W.C. minimum 1.8" max 4.0"*		
Carbon Monoxide in flue (less than 100 PPM ideal; should not exceed 400PPM)		
High Gas Pressure Switch Setting		
Low Gas Pressure Switch Setting		
Head Setting		
Air Shutter Setting		
Running Motor Amps and Volts		
Water Temp. ^oF / Steam Pressure		

**** This may vary for OEM application. Refer to heat exchanger manual for further instructions.***



ITEM		PART #	ITEM	PART	PART #
1	Blast Tube	1175-1701	17A	Scale - Air Regulation	1188-7801
2	Adjustable Flange Gasket	10195-1	18	24 Volt Transformer	2440VA
	Fixed Flange Gasket	1173-9801			
3	Adjustable Flange	10195	19	Safety Control	2466H or S89F
	Fixed Flange	1190-4001			
4	Front piece - Housing		20	Plastic Cover Plate	11850001
5	Rear piece – Housing		21	Screw (Long Special)	1175-0702
6	Fan Wheel - 146 mm	1187-2601	22	Airflow Switch	6041A
7	1/6 HP PSC Blower motor	D82132	23	Ignition Electrode	1153-4704
8	Shielding Plate Housing		24	Flame Rod	1153-4703
9	Outside Air Boot (optional)	83296	25	Retention head	1193-8501
9A	Silencer (optional)	11909-60105	26	Union	113-9101
10	Air Regulation Plate	1186-7401	27	Gas Valve	VR 8305
11	Air Damper	1186-7501		Power On light	115-2001
12	Air Regulation Adjustment screw	1184-8401		Fuel On Light	124-2001
13	Adjustment Screw – Nozzle Line	1191-2901		Air light	124-2001
14	Ionization Cable	1186-5805		Adjustable Flange Ring	11726701
15	Ignition Transformer	2260-TWO		Low Pressure Gas Switch	(**C6097B *or*** GML- A4-4-4
	Ignition Cable for 2260-TWO	2260-GTO			
16	Cover Plate - Air Regulation	1188-7401		High Pressure Gas Switch	**C6097A** or **GMH-A4-4-4**
16A	Cover Plate - Nozzle Line	1188-7302			
17	Scale - Nozzle Line	1188-8501		Adjustable ring for fixed flange	1172-6701

Trouble shooting:

There are three factors to operate the gas burner properly:

1. Electricity {(main Power 120V/60 Hz /1 Ph) (secondary 24V)}
2. Gas flow (Incoming pressure should be 10" w.c. with proper gas line without pressure drop during burner operation).
3. Combustion air.

Check these three items properly before proceeding in detail for other problems.

Condition	Solutions
1. Burner motor runs and:	
No flame after pre-purge & no fuel indicator (where applicable)	Check 24V feed to airflow switch & after airflow switch to control. Fix or replace the airflow switch. If there is no secondary power, then replace the 24Vtransformer.
No flame, fuel indicator on (where applicable), faulty ignition transformer or spark separately	Check ignition transformer, electrode, cracked electrode or gap. Fix or replace.
Fenwal control defective after above tests.	Replace
Burner locks out after 4 seconds	
	First, check ionization electrode, ionization cable (for cracks) and boot. Fix as needed.
Polarity reversed	Check power feed for broken polarity
Bad earth grounding	Fix the ground wire
Gas pressure is too low	Check the gas pressure and adjust to proper pressure
2. Pulsation at start	
	First, check the burner head location with respect to the end of the flame tube. Adjust as necessary.
Gas pressure is too high.	Use manometer and readjust the pressures.
Blocked Flue	Check draft and clear flue of foreign materials.
3. Pulsation during operation	
Burner is not correctly adjusted.	Readjust with combustion analyzer.
The burner is dirty.	Clean the burner.
Defective chimney	Check and change if necessary with liners.
4. Burner locks out	
Ionization current is too low.	Check current. Minimum 0.8 micro amps. Check position of ionization electrode and the condition of the cable.
5. The CO content is too high	
Excess air is too high or too low.	Adjust air shutter.
The gas holes are clogged.	Clean them.
The fresh air intakes are too small.	Check and readjust.
The burner head is out of position.	Check and readjust.
6. Condensation in the heat exchanger	
Firing Rate is too low.	Increase the firing rate so that the stack temperature is 350^{o} F or HIGHER. Insulate the chimney.

<u>Maintenance Instructions</u>: TO BE FIXED/ATTACHED NEAR BURNER

At least once a year, a qualified service agency needs to be contracted for other than routine maintenance.

1. The blower motor is the only moving part. It does not require lubrication, since the ball bearings have been permanently lubricated.
2. The user should do periodic visual checks of the burner and the flame.
3. Laundry lint or dog and/or cat hairs should not go inside the blower. If they are seen, they should be removed after disconnecting the power to the burner and cover parts should be installed before starting the burner.
4. Keep the area around the conversion burner clear and free from combustible materials, gasoline, and other flammable vapors and liquids.

. No obstruction for the flow of combustion and ventilating air.

Flange – SU-3 and SU-4