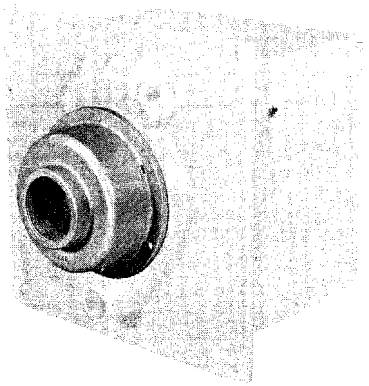
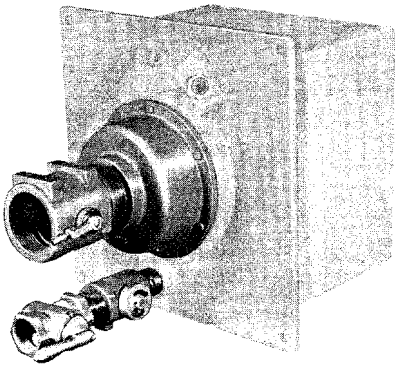
Information Guide 250
07/1986

Eclipse Spiral Flame Burners

Series DSF



Basic Burner



Complete Burner

WARNING

The burners covered in this Guide are designed to mix fuel with air and burn the resulting mixture. All fuel burning devices are capable of producing explosions and fires when improperly applied, installed, adjusted, controlled, or maintained. This Guide will provide information for using these burners for their limited design purpose. Do not deviate from any instructions or application limits in this Guide without written advice from the Engineering Department at the Eclipse factory in Rockford, Illinois. Read this entire Guide before attempting to light burners. If you do not understand any part of the information in this Guide, contact your local Eclipse representative or the Eclipse Engineering Department before proceeding further.

IMPORTANT NOTICES RELATING TO SAFE BURNER OPERATION

1. Store the burner inside. Exposure to the elements can damage the burner.

2. Adjustment, maintenance, and troubleshooting of the mechanical parts of this unit should be done by people with good mechanical aptitude and experience with combustion equipment.

3. Order replacement parts from Eclipse only. Any customer supplied valves, or switches, should carry UL, FM and/or CGA approval where applicable.

4. The best safety precaution is an alert and competent operator. New operators must be thoroughly instructed and demonstrate an adequate understanding of the equipment and its operation. Regular retraining must be scheduled to maintain a high degree of proficiency. The operator must have easy access to this Information Guide at all times.

1.0 APPLICATIONS

The Eclipse Spiral Flame Burner is a heavy-duty, nozzle-mixing, radiant gas burner designed for use on forging and heat treat furnaces, galvanizing tanks, cover annealing furnaces, pot furnaces, salt bath furnaces, ladle heaters, direct fired heat exchangers and other applications requiring high heat uniformity and lack of flame impingement.

The burner flame follows the contour of the combustion block, producing a thin, disc-shaped fire with no forward velocity. This permits the burner to be placed close to the workload without producing flame impingement or localized hot spots. It also permits placing the load closer to the burner, yielding more usable furnace volume.

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2.0 BURNER OPERATING PARAMETERS AND REQUIREMENTS

2.1 Figure 1 lists capacities, air and gas pressures, and flame dimensions for Spiral Flame burners. Do not operate burners outside these limits.

FIGURE 1 - CAPACITIES & SUPPLY PRESSURES
(Using Natural Gas - 0.6 Sp. Gr.)

Burner	Capacities in 1000's Btu/Hr. At Various Air Pressures, " w.c.[1]								Gas Press.[2] " w.c.	Max. Flame Dia.,[4] Inches	Max. Flame Thickness,[4] Inches	Maximum Excess Air	
	.5"	1"	2"	4"	7"	14"	21"	28"				% XS Air	1000's Btu/Hr.
L-52 DSF	6	9.5	14	20	28	45	57	65	1.5[3]	11	2	30	50
H-52 DSF	10	16	25	35	48	68	84	100	1.9[3]	12	2	35	74
83 DSF	35	50	70	105	135	195	240	280	3.6[3]	48	2	40	200
84 DSF	55	75	110	165	220	320	390	460	2.9[3]	50	3	30	350
104 DSF-A	84	120	178	235	355	485	609	710	1.7	42	3	60	440
125 DSF	95	145	215	325	450	715	885	1040	2.1	60	4	40	740
166 DSF	295	385	525	735	985	1435	1775	2075	3.8	60	6	30	1600
248 DSF	400	575	840	1150	1575	2310	2920	3190	3.8	84	6	30	2450
3212 DSF	630	890	1260	2040	2460	3410	4140	4750	3.1	96	7	30	3650

[1] Combustion air pressures measured at tap "A".
[2] High fire gas pressure measured at tap "B" except as noted. See Step 2.2.
[3] Burner does not have gas pressure tap. Measure pressure in gas line immediately ahead of burner connection.
[4] Approximate. See "Minimum Burner Spacing", Figure 5.

2.2 Gas pressures listed in Figure 1 are strictly for the purpose of sizing gas supply trains. **Do not use these pressures for burner setup** — they are too low for setting gas/air ratios accurately. Use metering orifices (Bulletin P-15) or flue gas analysis.

2.3 All operating limits in this guide must be strictly observed.

3.0 BURNER ENVIRONMENT

3.1 The minimum and maximum ambient temperature limits will be dictated by the customer supplied monitoring and control equipment such as ultraviolet (UV) scanners, automatic fuel shut-off valves, and electrical wiring for this equipment.

3.2 Burners should be protected from outdoor elements.

3.3 Combustion air should be free of contaminants which might corrode or plug the burner's internal passages. Eclipse strongly recommends the use of a combustion air filter suitable for the operating conditions.

3.4 Room openings to the outdoors for the purpose of admitting fresh air for use as combustion air must be at least 1 sq. inch for each 4,000 Btu/hr. of burner firing rate.

3.5 Access for inspection and maintenance should be provided.

4.0 IGNITION

4.1 Figure 2 lists recommended pilots for DSF Burners.

4.2 The pilots listed in Figure 2 will light DSF Burners at any stable firing rate; however, low fire lightoff is strongly recommended.

4.3 Eclipse strongly recommends interrupted pilot operation (pilot gas is turned off after main flame is established).

FIGURE 2 - PILOTS FOR DSF BURNERS

Burner Cat. No.	Spark Ignited Pilot	Torch Ignition of Main Flame
L-52 DSF	3B-RAFI-1-3/4	OK*
H-52 DSF	3B-RAFI-1-3/4	OK*
83 DSF	3B-RAFI-1-3/4	OK*
84 DSF	3B-RAFI-1-3/4	OK*
104 DSF	3B-RAFI-1-3/4	OK*
125 DSF	3B-RAFI-1-3/4	OK*
166 DSF	4B-RAFI-2	No
248 DSF	4B-RAFI-2	No
3212 DSF	4B-RAFI-2	No

*Torch ignition of main flame can be carried out only with a strong air-fuel or oxy-fuel torch. Raw gas torches are not acceptable.

FIGURE 3 - FLAME RODS FOR DSF BURNERS

Electrode Burner Size	Length
L-52 & H-52	7"
83	7-5/16"
84 & 104	11-1/4"
125	7"
166	8"
248 & 3212	11"

The flame rod part number for all DSF burners is #14265-2. This rod is furnished with a 12" electrode which must be cut by the customer to the above length as measured from the bottom of the threads.

5.0 FLAME MONITORING

5.1 Flame monitoring may be by flame rod or ultra-violet flame sensing device (U.V. scanner). Flame sensing equipment should be UL, FM and/or CGA approved.

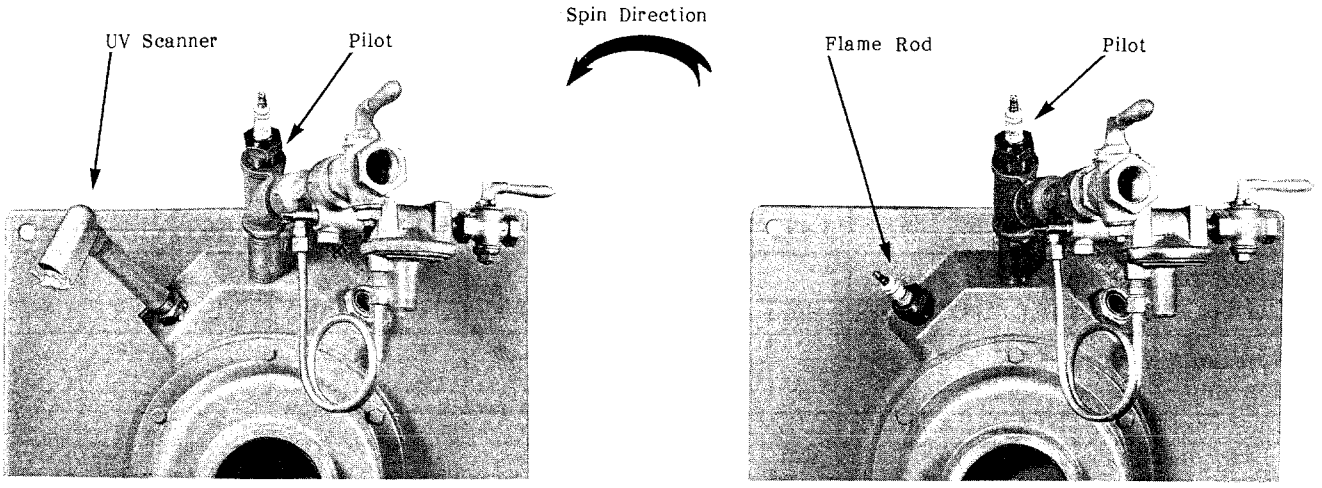
5.2 On L-52 DSF Burners, UV scanners are recommended for use with interrupted pilots. Flame rods may not produce adequate signal strengths at all firing rates on main flame only. On all other sizes of DSF burners, either flame rods or UV scanners will produce acceptable signal strengths on pilot only and on main flame only at all firing rates.

5.3 Figure 3 lists proper flame rod lengths for DSF Burners.

5.4 Because of the direction of spin of the air and gas in DSF Burners, the flame detector must be installed counterclockwise from the pilot as viewed from the rear of the burner (Figure 4). Otherwise, the spin will push the pilot flame away from the detector, causing nuisance outages.

5.5 Because a positive pressure exists at the flame detector mounting connection, UV scanners should be installed with heat block seals (See Bulletin P-30-1).

FIGURE 4 - PILOT & FLAME DETECTOR POSITIONS



Flame detector must be CCW from pilot when viewed as shown above.

5.6 The spark of the pilot ignition plug may energize a U.V. scanner system even when no pilot flame is present. To prevent this, control sequencing must turn off the spark before main gas shut-off valves are energized.

5.6 CAUTION: Failure to use suitable flame sensing devices and automatic fuel shut-off valves can cause violent explosions.

6.0 Limit Controls And Safety Equipment

6.1 Installation of limit controls and safety equipment should comply with current NFPA Standard 86 and all applicable local codes and standards. See Step 8.6 for the NFPA's address.

7.0 Burner Installation

7.1 A thorough inspection should be made when uncrating and before installing the burner. If any parts appear broken, bent, or damaged, contact your Eclipse, Inc. representative or the Eclipse factory before installing the burner.

7.2 Burners may be installed as suggested in Eclipse publication P-5 Installation Suggestions.

7.3 Spiral flame blocks must be installed with their hot face flush with the inner furnace wall. Recessing the block face below the wall face will create a step that will deflect the flame forward, possibly leading to flame impingement on the furnace load.

7.4 Burners must be bolted to the furnace shell by means of the holes provided in the mounting flange. A suitable ceramic fiber gasket should be installed between the flange and the furnace shell.

7.5 The burner mounting flange will support only the weight of the burner body and components supplied by Eclipse as a part of the burner assembly. Burner supply piping must be adequately and independently supported.

7.6 Burners should be installed to place the ignition and flame monitor ports above the centerline. Otherwise, condensation may collect in these ports and cause ignition or flame monitoring malfunction.

7.7 On multiple burner installations, burner center-to-center distance will be dictated by the heat input required and the number of burners required to supply that input. Closely spaced burners will produce high heat inputs and uniform furnace wall temperatures, so uniform heat transfer will result, even with close burner-to-load spacing. Widely spaced burners tend to create less uniform wall heating, so burner-to-load distances should be increased to assure uniform radiation transfer to the load.

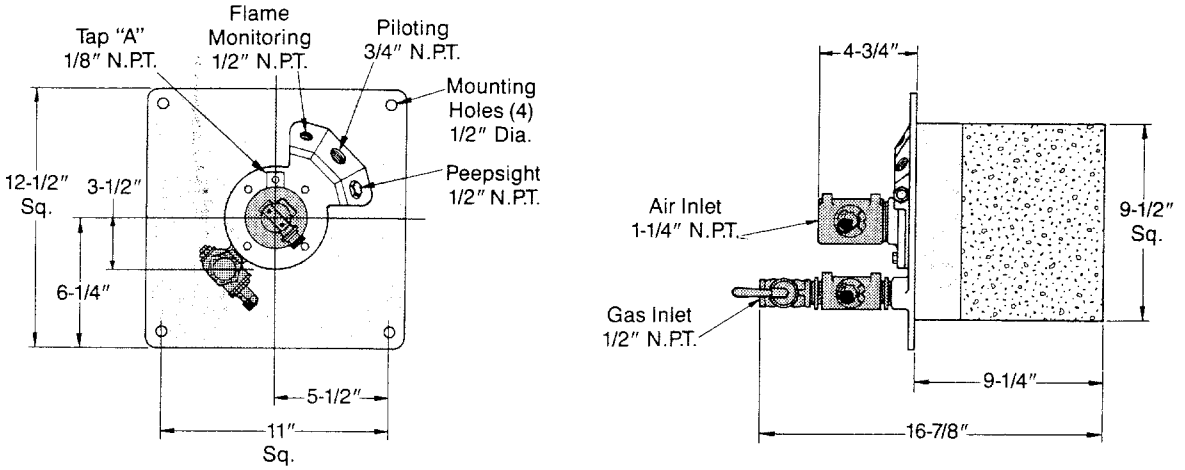
Burners should not be placed so closely together that their flames overlap. Otherwise, turbulence may direct the edges of the flames forward, causing impingement on the work load. Figure 5 lists minimum burner-to-burner and burner-to-load spacings.

FIGURE 5 - MINIMUM BURNER SPACINGS

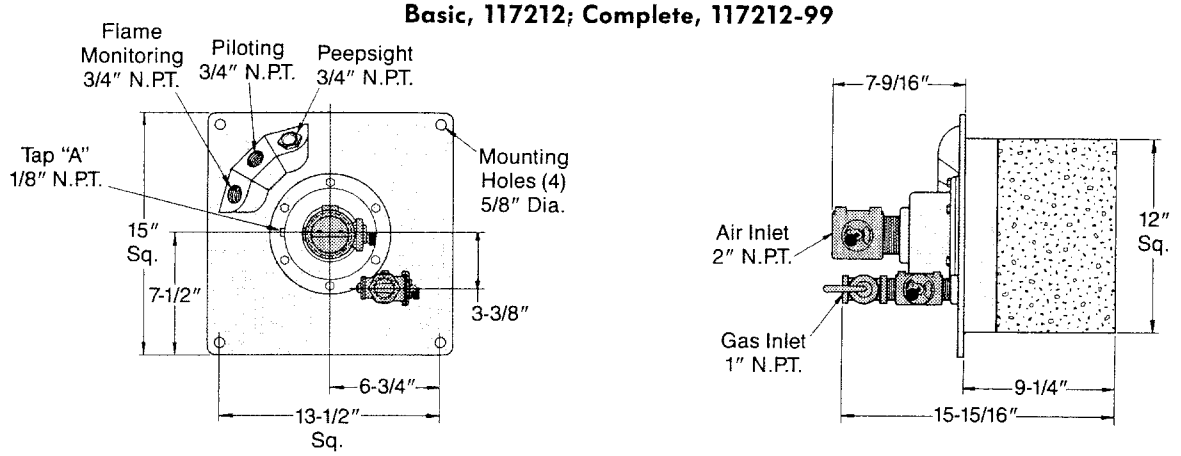
Burner	L-52	H-52	83	84	104	125	166	248	3212
Minimum Burner-to-Burner Centerline Spacing, Inches	12	12	48	50	42	60	60	84	96
Minimum Burner-to-Load Spacing, Inches	7	7	7	8	8	8	10	10	11

FIGURE 6 - DIMENSIONS & SUPPLY LOCATIONS

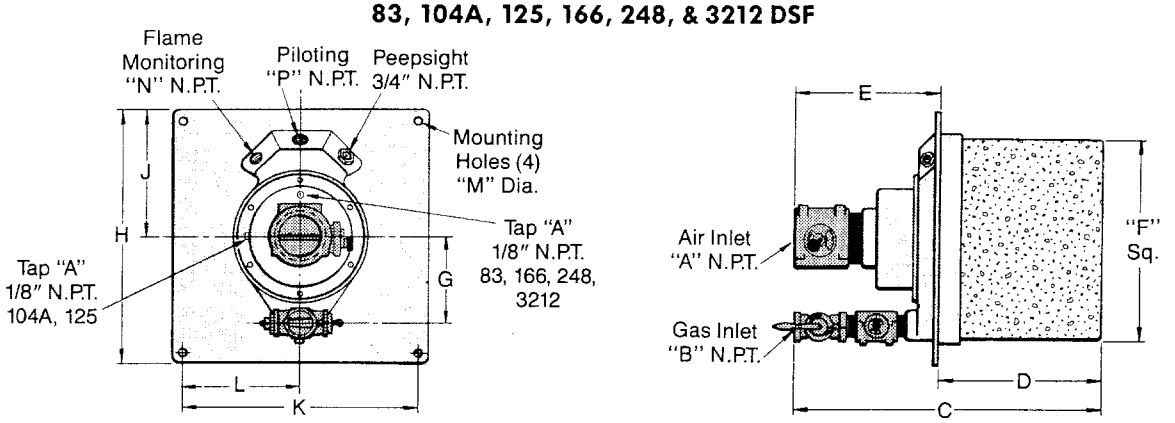
L-52 & H-52 DSF
L-52: Basic, 117207; Complete, 117207-99
H-52: Basic, 117252; Complete, 117252-99



84 DSF
Basic, 117212; Complete, 117212-99



83, 104A, 125, 166, 248, & 3212 DSF



Basic Burner. Although the block and holder assembly is illustrated as part of the basic burner, it must be ordered as a separate item. See page 3.

Additional items included with Complete Burner.

Burner	Assembly No.		Dimensions In Inches													
	Basic	Complete	A	B	C	D	E	F	G	H	J	K	L	M	N	P
83 DSF	117196-00	117196-99	2	3/4	16-1/4	9-1/4	5-5/8	11-1/2	3-7/8	14-1/2	7-1/4	13	6-1/2	5/8	3/4	3/4
104 DSF-A	117253-00	117253-99	2-1/2	1	19-5/8	11-3/8	10-1/8	14-1/2	6	17-1/2	8-3/4	16	8	9/16	3/4	3/4
125 DSF	117254-00	117254-99	3	1-1/4	21-1/4	11-3/8	10-1/8	14-1/2	6	17-1/2	8-3/4	16	8	9/16	3/4	3/4
166 DSF	117258-00	117258-99	4	1-1/2	21-3/8	11-3/8	11-1/2	16	6-7/8	19	9-1/2	17-1/2	8-3/4	5/8	3/4	1
248 DSF	117259-00	117259-99	6	2	24-5/8	13-3/4	17-1/4	18	8	21	10-1/2	19-1/2	9-3/4	5/8	3/4	1
3212 DSF	117255-00	117255-99	8	3	29-3/8	13-3/4	21-1/4	21-1/2	9-5/8	24	12	22-1/2	11-1/4	3/4	3/4	1

8.0 SYSTEM INSTALLATION

8.1 Figure 6 shows locations for connecting air and gas pipes, flame monitoring device, and ignition device to the burner.

8.2 The internal area of the customer supplied piping must be at least as large as the internal area of the inlet piping of the burner. For optimum results, size combustion air piping for 40 ft/second velocity and natural gas piping for 50 ft/second velocity at maximum flow.

8.3 All valves must be installed so that the arrow on the side of the valve body points in the direction of gas or air flow through the valve. If the handle of a manual plug type gas cock is removable, be sure that the handle is properly installed. When the valve is in the "off" position, the handle must be 90° or at a right angle to the valve body.

8.4 Gas balancing valves should be located as close to the burner as possible.

8.5 Gas piping must comply with American National Standard entitled "National Fuel Gas Code"* (NFPA No. 54 or ANSI Z223.1), or must be acceptable to the authority having jurisdiction.

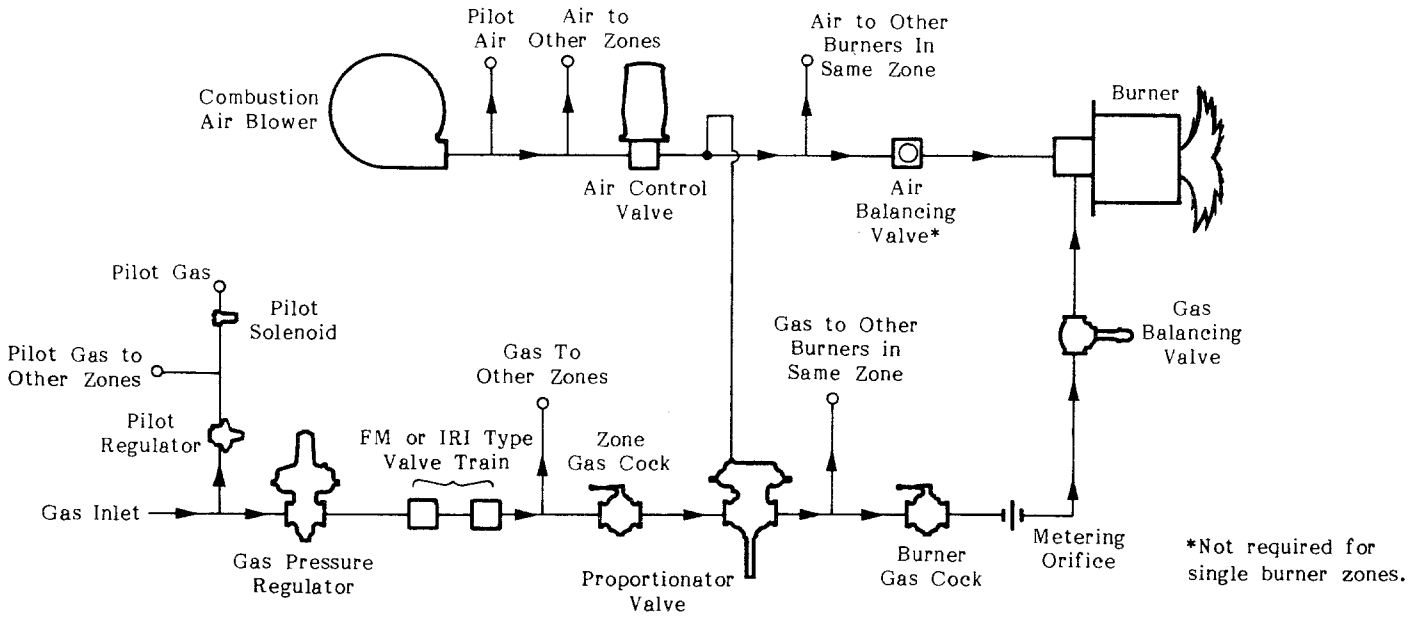
8.6 Electrical wiring must comply with the National Electric Code*, (NFPA Std. 70 or ANSI CI 1981), or must be acceptable to the authority having jurisdiction.

*Available from:

National Fire Protection Association
Batterymarch Park
Quincy, Massachusetts 02269

American National Standard Institute
1430 Broadway
New York, New York 10018

FIGURE 7 - PROPORTIONING SYSTEM



9.0 CONTROL METHODS

9.1 Figure 7 shows the most commonly used control system for DSF Burners.

9.2 Complete burners are furnished with air balancing valves, gas balancing valves, and burner gas cocks. For basic burner assemblies, the customer must provide suitably sized valves. Air balancing valves can be omitted on single burner zones.

9.3 DSF Burners will operate at combustion air pressures up to 28" w.c. The higher the combustion air pressure at the burner, the wider its turndown range.

9.4 Minimum combustion air pressure at the burner (low fire) is 0.5" w.c.

9.5 Gas pressure required at the burner for proper operation is listed in Figure 1. Gas piping and accessories must be sized to insure this pressure at the burner at high fire.

10.0 AIR & GAS FLOW MEASUREMENT

10.1 Air flow through the burner can be determined by measuring the static pressure at Tap "A", Figure 6. The graphs in Figure 8 relate measured pressure to air flow.

10.2 Gas pressure at the burner is too low to provide an accurate indication of flow. Use metering orifices (Bulletin P-15) in the gas lines to each burner for accurate measurement of gas flows. When installing metering orifices, provide a straight pipe run of at least ten pipe diameters upstream and five pipe diameters downstream of each orifice. **Failure to comply will cause inaccurate meter readings.**

FIGURE 8 - AIR FLOW ADJUSTMENT DATA

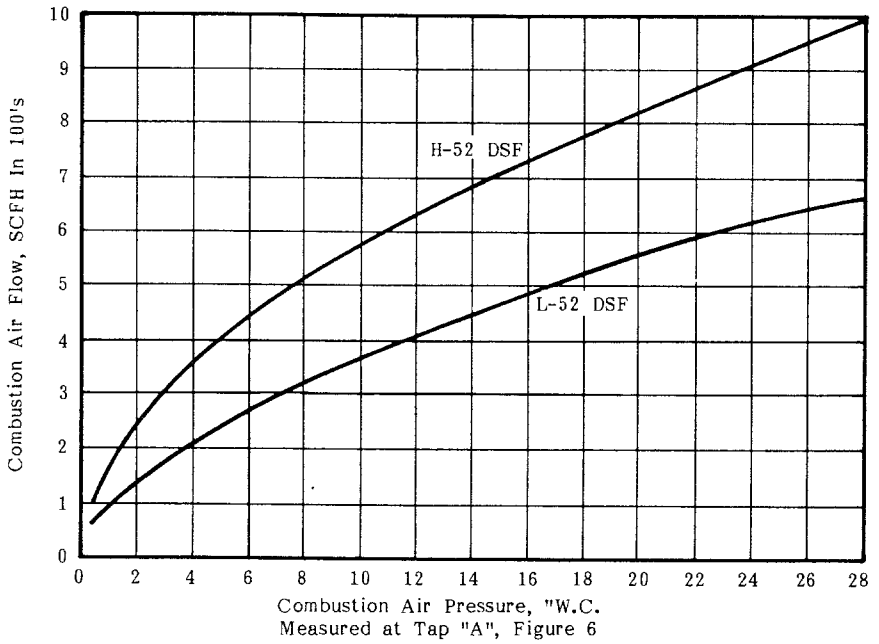
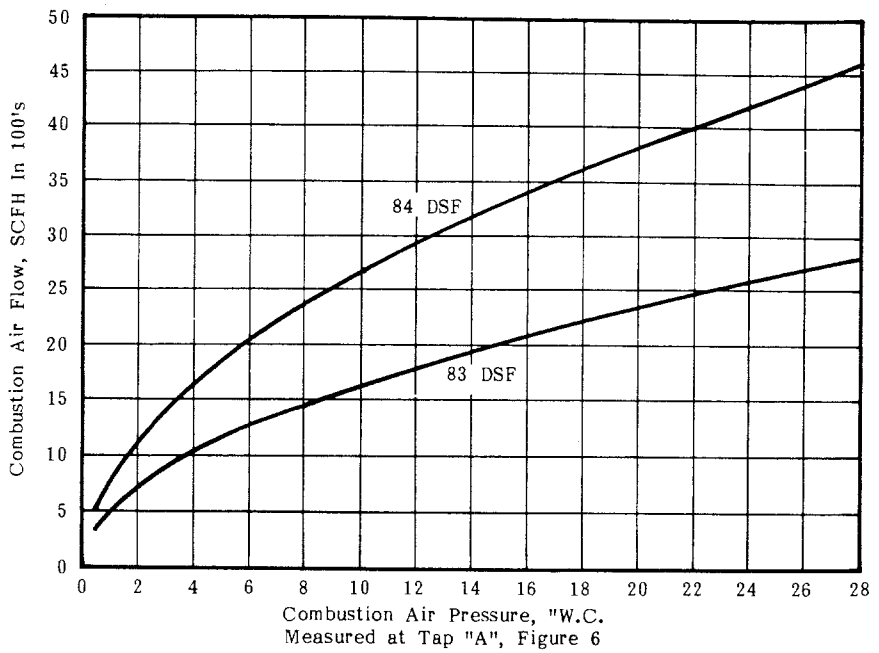
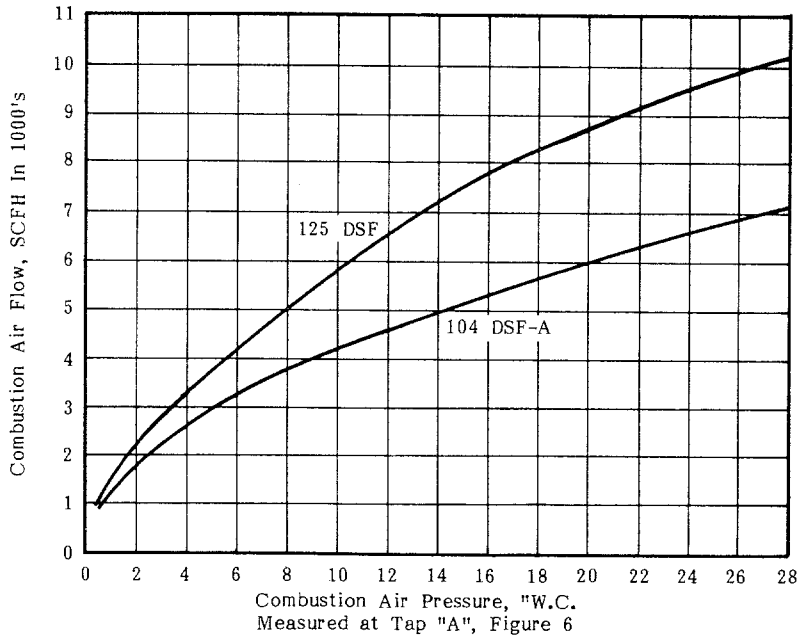
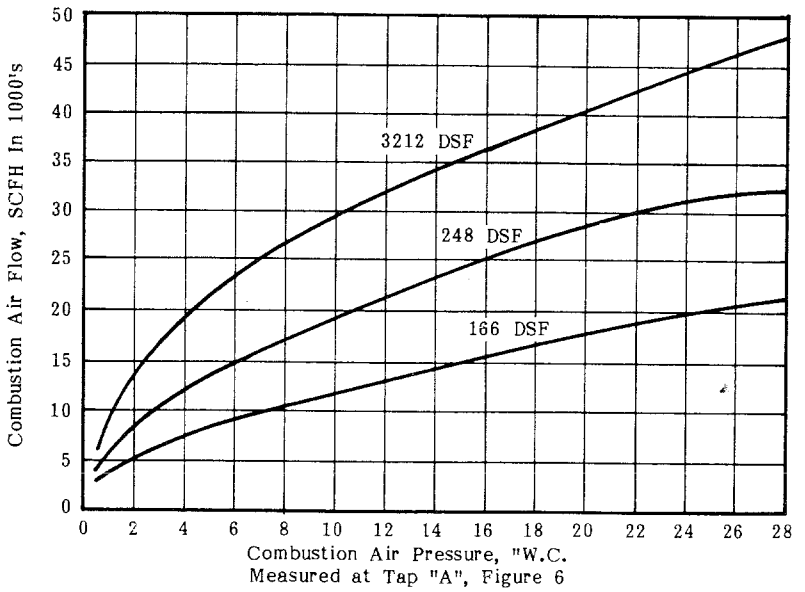


FIGURE 8 - AIR FLOW ADJUSTMENT DATA (Cont'd.)







11.0 INITIAL START-UP & ADJUSTMENT

11.1 Close all manual and automatic gas valves including the gas balancing valves, pilot adjusting valves, and pilot shut-off cocks.

11.2 Adjust the linkage of the air control valve so that the butterfly opens 75% (100% for reduced port butterfly valves) when the operator moves to the high fire limit of its stroke.

11.3 Close the air balancing valves.

11.4 Start the combustion air blower. Visually confirm that the fan or impeller is rotating in the correct direction. If rotation is wrong, have a qualified electrician change the wiring to the blower motor.

11.5 Drive the air control valve to its high fire position. Measuring air flow as described in section 10.1 of this Guide, gradually open each air balancing valve until the desired high fire air flow is reached. When all balancing valves in a zone have been adjusted, recheck the air flow measurements.

11.6 Adjust the linkage of the air control valve to produce the desired low fire air flow. Cycle the air control valve several times checking high fire and low fire air flow measurements.

11.7 Drive the air control valve to the low fire position.

11.8 Energize the ignition transformer and pilot solenoid.

11.9 Ignite and adjust blast type pilots according to the instructions furnished by the manufacturer.

11.10 Open all gas valves upstream of the gas balancing valves.

11.11 Measuring gas flow as described in section 10.2 of this Guide, gradually open each gas balancing valve until the corresponding burner lights. Do not open the valves past the point required for burner ignition.

11.12 Drive the air control valve to the high fire position. Check to be sure the burners remain lit.

11.13 Adjust the gas balancing valves to provide the desired high fire gas flow.

11.14 Drive the air control valve to low fire and set the gas flow with the adjusting spring in the proportionator valve.

11.15 Cycle the air control valve several times to be sure the burners are properly adjusted at all firing rates.

12.0 SHUTDOWN

When shutting down burners on a hot furnace, allow the combustion air blower to continue to run until the furnace temperature drops below 500°F. The combustion air control valve should be in the low fire position — this will provide sufficient air flow to cool the burner internals without causing thermal shock to the hot burner blocks.

13.0 MAINTENANCE

13.1 Maintenance Program

A sound preventative maintenance program, carried out by qualified individuals, will greatly increase equipment reliability and productivity. Frequency of maintenance checks should reflect the duty cycle of the heating equipment and conditions such as dirt and temperature. Any maintenance program should include at least the following steps:

a) Check burner high and low fire air and gas settings.

b) Examine and, if necessary, clean or replace air and gas filter elements.

c) Check all piping connections for leaks.

d) Check the ability of the flame supervision system to function properly by simulating system failures:

1. Simulate burner flame-out by manually shutting off the gas.

2. Trip out pressure switches and other limit interlocks.

3. Try to light the burner before the purge and other timers have finished their cycles.

If simulated limit or flame failures do not shut down the fuel system within an acceptably short period of time, immediately take the equipment out of service and correct the problem.

e) Leak test automatic and manual reset fuel valves per insurance company procedures.

f) Check all bolts and screws for tightness.

g) Check the area around the burner mounting flange for signs of overheating. Gasket or insulation replacement may be necessary.

14.0 TROUBLE-SHOOTING

Caution: Trouble-shooting of panels and electrical circuits should be done by qualified plant electricians, technicians, or engineers experienced in all facets of this type of combustion equipment.

14.1 Pilot Fails To Light

a) On initial start-up, gas line may be filled with air. Repeat ignition trial several times to purge.

b) No power to ignition transformer or pilot solenoid.

c) Open circuit between ignition transformer and spark plug.

d) Spark plug needs cleaning.

e) Spark plug electrode gap incorrect. Regap or replace plug.

f) Spark plug improperly grounded. Do not use pipe dope on ignition plug threads.

g) Insufficient gas pressure into or out of pilot regulator.

14.2 Pilot Lights, Main Gas Valve Does Not Open:

a) Flame monitoring device may be dirty or improperly installed.

14.3 Main Gas Valve Opens, Burner Fails to Light or Goes Out as Burner Cyles to High Fire.

a) Air in the gas line may prevent the burner(s) from lighting on initial start-up. Several trials for ignition may be necessary before gas line is purged of air.

b) Pilot set too lean, becomes unstable as air increases.

c) Insufficient pressure into or out of main gas regulator.

d) Main gas adjusting valve not open enough.

e) Marginal air pressure switch setting.

14.4 Main Flame Too Large & Yellow on High Fire

a) Gas flow is too high. Gas balancing valve is open too far.

14.5 Main Flame Too Small on High Fire

a) Gas flow is too low. Gas balancing valve is closed too far.

14.6 Low Fire Flame is Long, Soft or Yellow

a) Too much gas flow. Proportionator spring is screwed in too far.

b) Insufficient air flow due to dirty blower filter or impeller.

14.7 Low Fire Flame is Weak or Unstable

a) Insufficient gas flow. Proportionator spring is not screwed in far enough.

14.8 Burner Behaves Erratically, Does Not Respond to Adjustment

a) Burner internals loose, dirty, or burned out. If this appears to be the problem, contact your Eclipse representative or the Eclipse factory for service.

b) Proportionator has broken diaphragm or dirty valve.

14.9 Burner Flame Lacks Spin, Excessive Forward Flame Travel

a) Internal spin chamber ports are dirty, clogged, or corroded. Contact your Eclipse representative or the Eclipse factory for replacement parts or service.

b) Spin chamber internal cover missing. Contact your Eclipse representative or the Eclipse factory for replacement parts or service.