

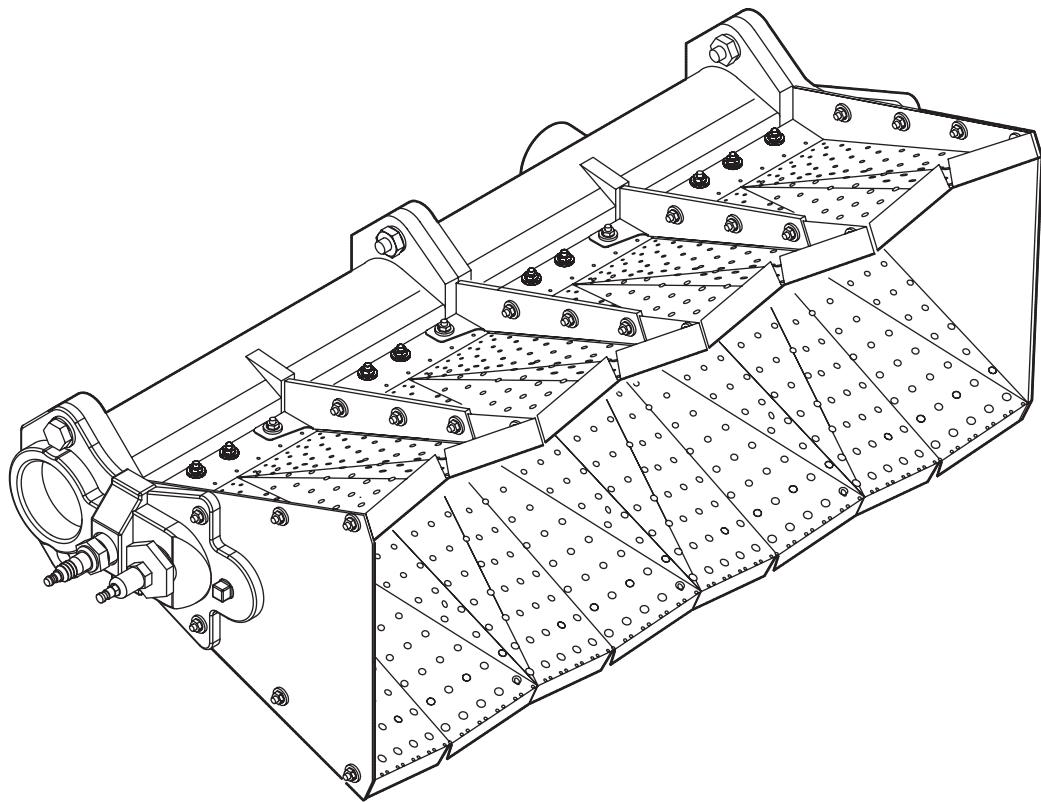
# Eclipse AirHeat Burners

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AH-MA Series

Technical Information Edition 2.15

Version 2



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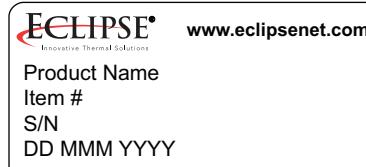
The explanation of these symbols follows below. Please read it thoroughly.

## How To Get Help

If you need help, contact your local Eclipse representative. You can also contact Eclipse at:

1665 Elmwood Rd.  
Rockford, Illinois 61103 U.S.A.  
Phone: 815-877-3031  
Fax: 815-877-3336  
<http://www.eclipsenet.com>

Please have the information on the product label available when contacting the factory so we may better serve you.



This is the safety alert symbol. It is used to alert you to potential personal injurt hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.



Indicates a hazardous situation which, if not avoided, will result in death or serious injury.



Indicates a hazardous situation which, if not avoided, could result in death or serious injury.



Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.



Is used to address practices not related to personal injury.



Indicates an important part of text. Read thoroughly.

# Table of Contents

<b>Introduction .....</b>	<b>4</b>
Product Description .....	4
Audience.....	4
Purpose .....	4
AH-MA Documents.....	4
Related Documents .....	4
<b>Safety .....</b>	<b>5</b>
Safety Warnings .....	5
Capabilities .....	5
Operator Training .....	5
Replacement Parts .....	5
<b>System Design .....</b>	<b>6</b>
Design Structure.....	6
Step 1: Burner Design .....	6
Step 2: Control Methodology .....	15
Step 3: Ignition System.....	16
Step 4: Flame Monitoring System .....	17
Step 5: Gas Valve Train Selection.....	17
<b>Appendix.....</b>	<b>i</b>
<b>Notes .....</b>	<b>ii</b>

# Introduction

## Product Description

Eclipse AH-MA V2.1 Air Heat burners produce a uniform, odorless and smokeless flame ideal for heating fresh air in make-up and process air heating applications. The AH-MA design provides stable operation over a wide range of velocities, inputs and fuels.

AH-MA V2.1 burners are line type burners constructed of cast iron or aluminum burner bodies and diverging stainless steel air wings. The burner bodies supply fuel to the center of the air wings to control the air and fuel mixture inside the burner and to optimize emissions and efficiency. Completely corrosion resistant design options are available using aluminum burner bodies or electroless nickel plated cast iron burner bodies.

The AH-MA V2.1 Air Heat burner is assembled from straight sections, tees and crosses to produce nearly any configuration required. Large burners can be built as a combination of staged, individually controlled sections to increase turndown.

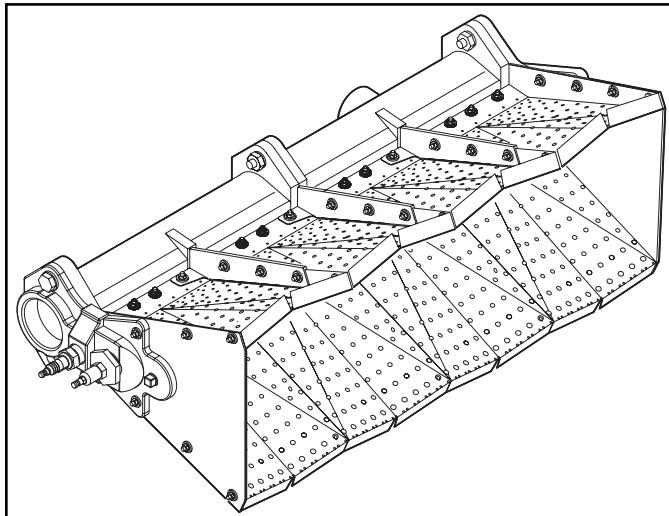


Figure 1.1 AH-MA AirHeat Burner

## Audience

This manual has been written for personnel already familiar with all aspects of an air heat burner and its add-on components, also referred to as the burner package.

These aspects are:

- Design/Selection
- Installation
- Use
- Maintenance

The audience is expected to be qualified and have experience with this type of equipment and its working environment.

## Purpose

The purpose of this manual is to make sure that you carry out the installation of a safe, effective and trouble-free system.

## AH-MA Documents

### **Installation Guide No. 160**

- Used with Datasheet to complete Installation

### **Datasheet No. 160**

- Required to complete design and selection

### **Design Guide No. 160**

- This document

## Related Documents

- EFE 825 (Combustion Engineering Guide)
- Eclipse Bulletins and Information Guides: 818, 820, 826, 832, 852, 854, 856

# Safety

Important notices which help provide safe burner operation will be found in this section. To avoid personal injury and damage to the property or facility, the following warnings must be observed. All involved personnel should read this entire manual carefully before attempting to start or operate this system. If any part of the information in this manual is not understood, contact Eclipse before continuing.

## Safety Warnings



### DANGER

- The burners, described herein, are designed to mix fuel with air and burn the resulting mixture. All fuel burning devices are capable of producing fires and explosions if improperly applied, installed, adjusted, controlled or maintained.
- Do not bypass any safety feature; fire or explosion could result.
- Never try to light a burner if it shows signs of damage or malfunction.



### WARNING

- The burner and duct sections are likely to have HOT surfaces. Always wear the appropriate protective equipment when approaching the burner.
- Eclipse products are designed to minimize the use of materials that contain crystalline silica. Examples of these chemicals are: respirable crystalline silica from bricks, cement or other masonry products and respirable refractory ceramic fibers from insulating blankets, boards, or gaskets. Despite these efforts, dust created by sanding, sawing, grinding, cutting and other construction activities could release crystalline silica. Crystalline silica is known to cause cancer, and health risks from the exposure to these chemicals vary depending on the frequency and length of exposure to these chemicals. To reduce the risk, limit exposure to these chemicals, work in a well-ventilated area and wear approved personal protective safety equipment for these chemicals.

## NOTICE

- This manual provides information regarding the use of these burners for their specific design purpose. Do not deviate from any instructions or application limits described herein without written approval from Eclipse.

## Capabilities

Only qualified personnel, with sufficient mechanical aptitude and experience with combustion equipment, should adjust, maintain or troubleshoot any mechanical or electrical part of this system. Contact Eclipse for any needed commissioning assistance.

## Operator Training

The best safety precaution is an alert and trained operator. Train new operators thoroughly and have them demonstrate an adequate understanding of the equipment and its operation. A regular retraining schedule should be administered to ensure operators maintain a high degree of proficiency. Contact Eclipse for any needed site-specific training.

## Replacement Parts

Order replacement parts from Eclipse only. All Eclipse approved valves or switches should carry UL, FM, CSA, CGA and/or CE approval where applicable.

# System Design

## Design Structure

Designing a burner system is a straightforward exercise of combining modules that add up to a reliable and safe system.

The design process is divided into the following steps:

1. Burner Design
  - a. Calculating maximum input requirements
  - b. Choosing design heat input at high fire
  - c. Determining needed length of the burner
  - d. Calculating minimum input requirements
  - e. Layout of the burner sections
  - f. Sizing and layout of the gas manifold
  - g. Sizing the profile plates
  - h. Burner staging
2. Control Methodology
3. Ignition System
4. Flame Monitoring System
5. Gas Valve Train Selection

**NOTE:** Information in Datasheet 160 is necessary to complete some of the procedures.

## Step 1: Burner Design

### **Calculating maximum input requirements**

To calculate the total burner maximum input required:

$$\text{Maximum Input (Btu/h)} = 1.3 \times \text{SCFM} \times \Delta T \text{ (max)}$$



### **CAUTION**

- This is an approximation based on the gross heating value of the Eclipse Combustion Engineering Guide (EFE-825).

### **Choosing design heat input at high fire**

See Datasheet 160 for the following:

1. Use the "Operating Range" chart to determine the maximum and minimum heat inputs per foot of burner based on the known air pressure drop.
2. Use the "Flame Length" chart to check flame length versus available distance downstream of the burner for uniform temperature distribution.

### **Determining the length of the burner needed**

$$\text{Burner length (ft)} = \frac{\text{total burner max. heat input (Btu/h)}}{\text{heat input per foot (Btu/h/ft)}}$$

**NOTE:** Round fractional lengths (in feet) up to the next half-foot

### **Calculating minimum input required**

$$1. \text{ Minimum Input (Btu/h)} = 1.3 \times \text{SCFM} \times \Delta T \text{ (min)}$$

$$2. \text{ Minimum Heat Input per foot (Btu/h/ft)} =$$

$$\frac{\text{total burner min. heat input (Btu/h)}}{\text{burner length (ft)}}$$

3. With the minimum heat input per foot, go to the "Operating Range" chart in Datasheet 160 and confirm that the burner can operate at the input for the air pressure drop the burner will see. If the minimum input required is too low, there are two options to obtain this operating condition:

- a. Use a staged burner control. See Burner Fuel Staging pg 16 and Contol Methodology pg 15.
- b. Modulate the air flow to a lower pressure drop, thus lowering the minimum input capability of the burner.

**Example:** A make-up air heat burner will be used to heat 60,000 SCFM air from 0°F to 80°F maximum, and from 75°F to 80°F minimum. Air DP across the burner is designed to be 0.7" w.c. at high fire. The fuel is natural gas.

$$1. \text{ Max. Input} = 1.3 \times 60,000 \times 80 = 6,240,000 \text{ Btu/h}$$

2. From the "Operating Range" chart in Datasheet 160, the maximum heat input at 0.7" w.c. air pressure drop is 80,000 Btu/h/ft. The flame length from the "Flame Length" chart in Datasheet 160 is 30 inches.

$$\text{Burner length} = \frac{6,240,000 \text{ Btu/h}}{800,000 \text{ Btu/h/ft}} = 7.8 \text{ ft}; \text{ round to } 8 \text{ ft}$$

3. Min. Input =  $1.3 \times 60,000 \times 5 = 390,000 \text{ Btu/h}$   
 4. Minimum per foot =  $390,000 \text{ Btu/h} = 48,750 \text{ Btu/h/ft}$   
 8 ft  
 5. From the "Operating Range" chart in Datasheet 160, the minimum input at 0.7" w.c. is 20,000 Btu/h/ft. Therefore, the burner can operate over the desired input range.

### Fuel Type

**Table 3.1 Fuel Type**

Fuel	Symbol	Gross Heating Value	Specific Gravity	WOBBE Index
Natural Gas	CH <sub>4</sub> 90%+	1000 BTU/ft <sup>3</sup> (40.1 MJ/m <sup>3</sup> )	0.60	1290 BTU/ft <sup>3</sup>
Propane	C <sub>3</sub> H <sub>8</sub>	2525 BTU/ft <sup>3</sup> (101.2 MJ/m <sup>3</sup> )	1.55	2028 BTU/ft <sup>3</sup>
Butane	C <sub>4</sub> H <sub>10</sub>	3330 BTU/ft <sup>3</sup> (133.7 MJ/m <sup>3</sup> )	2.09	2303 BTU/ft <sup>3</sup>
BTU/ft <sup>3</sup> @ standard conditions (MJ/m <sup>3</sup> @ normal conditions)				

If using an alternative fuel supply, contact Eclipse with an accurate breakdown of the fuel components.

**Table 3.1 Gas Feed Inlet Capacities**

Gas Inlet Pipe Size	Direction	Section Type	Gas Pressure	Max. Burner Length Per Inlet*
1"	Side	300mm straight section	standard	1
1-1/2"	Rear	300mm straight section, cast iron	standard	4
1-1/2"	Side	300mm straight section	standard	3
2"	Rear	300mm straight section, aluminum	standard	4
2"	Rear	300mm x 300mm cross section	standard	6
2"	Side	300mm straight section	standard	4
1"	Side	300mm straight section	low	.5
1-1/2"	Rear	300mm straight section, cast iron	low	2
1-1/2"	Side	300mm straight section	low	1.5
2"	Rear	300mm straight section, aluminum	low	2
2"	Rear	300mm x 300mm cross section	low	4
2"	Side	300mm straight section	low	2

\* Number of feet or 300mm sections

**Example:** A six-foot burner for standard gas pressure will use 2" NPT rear inlets to supply gas. How many gas inlets are required?

**Solution:** Each 2" back inlet can supply 4 feet of burner.

Therefore,  $6/4 = 1.5$ , or 2 inlets are required

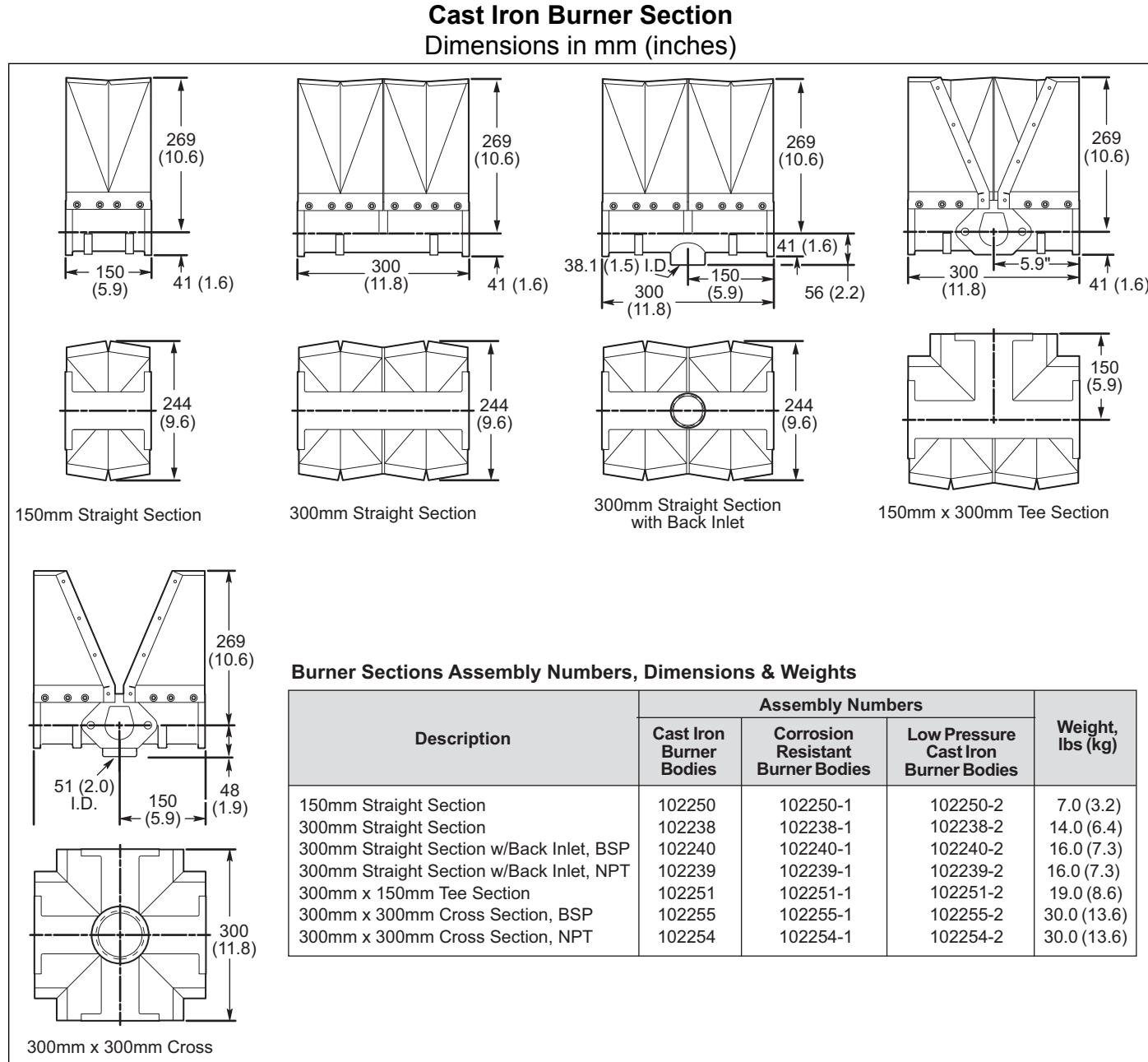
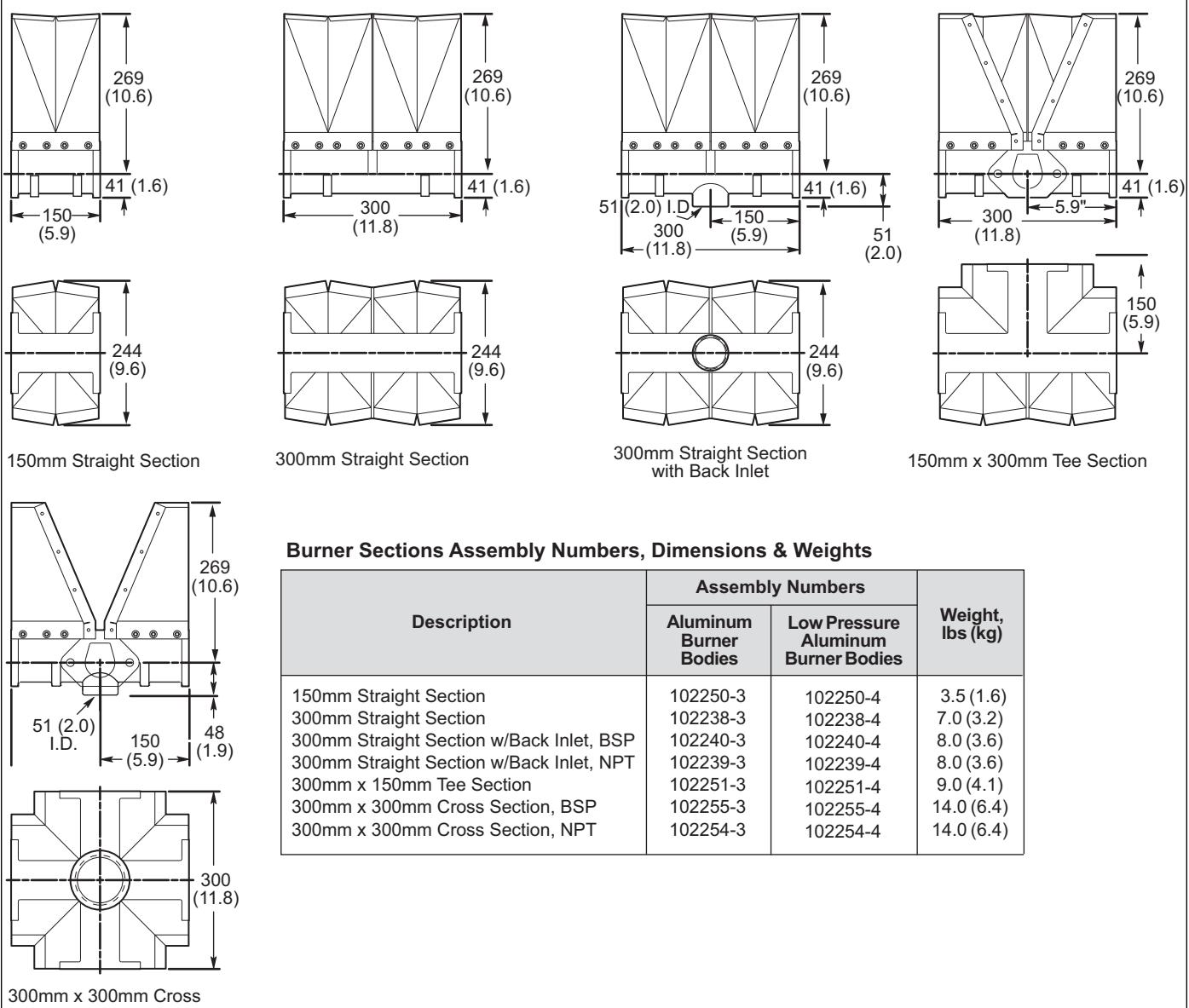


Figure 3.1

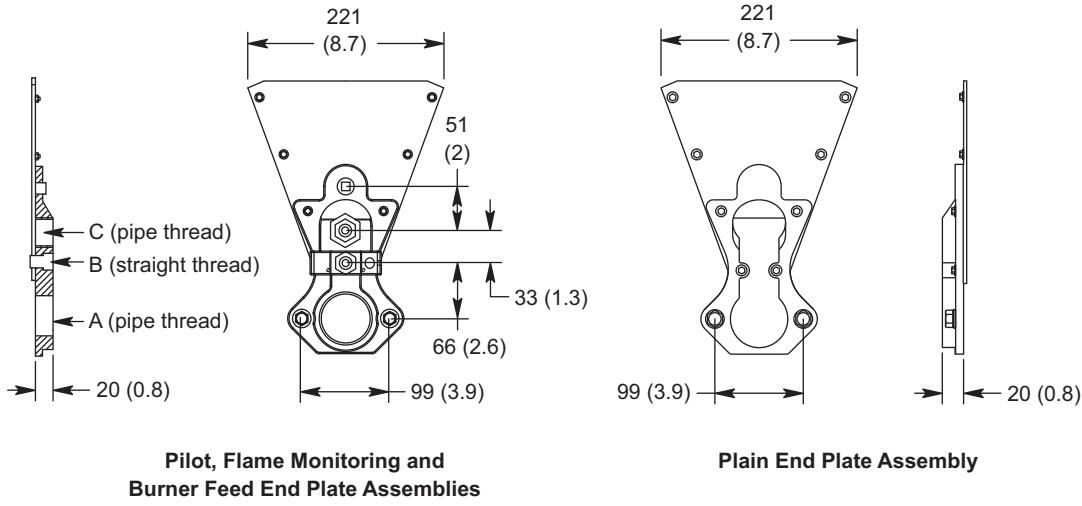
**Aluminum Burner Section**  
Dimensions in mm (inches)



**Figure 3.1 Continued**

## End Plate Assemblies

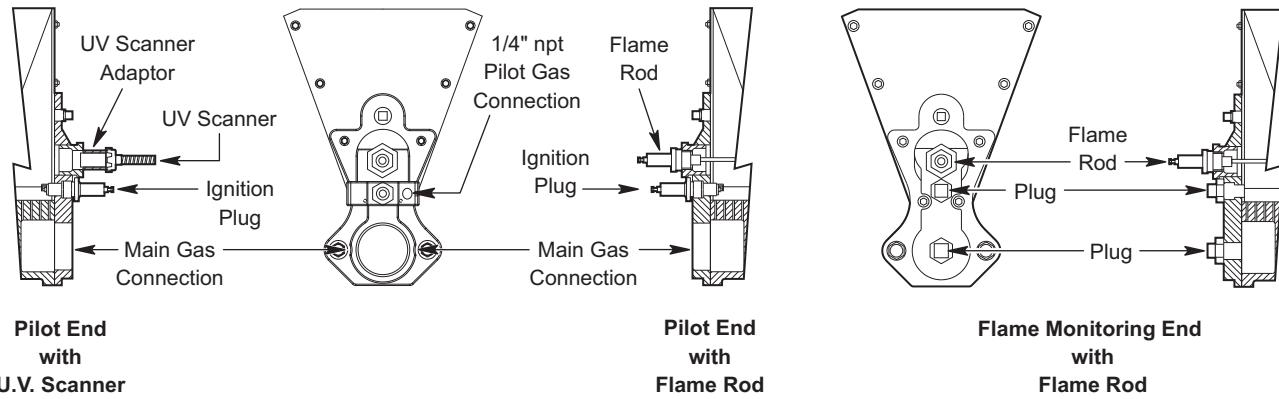
Dimensions in mm (inches)



**Pilot, Flame Monitoring and  
Burner Feed End Plate Assemblies**

**Plain End Plate Assembly**

## End Plate Examples



**Figure 3.1 Continued**

## End Plate Assembly Numbers, Dimensions and Weights

Description	Assembly Numbers		Dimensions			Weight, lbs (kg)
	Cast Iron End Plates*	Corrosion Resistant End Plates	A	B, mm (inches)	C	
Plain End Plate	102257	102257-1	-	-	-	4 (1.8)
Pilot End Plate, No Gas Feed	10010970	10010970-1	-	14 (0.6)	1" NPT	4 (1.8)
Pilot End Plate, 1" Gas Feed NPT	10010972	10010972-1	1" NPT	14 (0.6)	1" NPT	4 (1.8)
Pilot End Plate, 1" Gas Feed BSP	10010974	10010974-1	1" BSP	14 (0.6)	1" BSP	4 (1.8)
Pilot End Plate, 1.5" Gas Feed NPT	10010975	10010975-1	1.5" NPT	14 (0.6)	1" NPT	4 (1.8)
Pilot End Plate, 1.5" Gas Feed BSP	10010976	10010976-1	1.5" BSP	14 (0.6)	1" BSP	4 (1.8)
Pilot End Plate, 2" Gas Feed NPT	10010977	10010977-1	2" NPT	14 (0.6)	1" NPT	4 (1.8)
Pilot End Plate, 2" Gas Feed BSP	10010978	10010978-1	2" BSP	14 (0.6)	1" BSP	4 (1.8)
Pilot End Plate, Angled Flame Monitor NPT	10010979	10010979-1	-	14 (0.6)	1" NPT	4 (1.8)
Pilot End Plate, Angled Flame Monitor BSP	10010980	10010980-1	-	14 (0.6)	1" BSP	4 (1.8)
Flame Monitoring End Plate, BSP	101237	101237-1	-	-	1" BSP	4 (1.8)
Flame Monitoring End Plate, NPT	101238	101238-1	-	-	1" NPT	4 (1.8)
Burner Feed/Flame Monitoring End Plate, BSP	101233	101233-1	1-1/2" BSP	**	1" BSP	4 (1.8)
Burner Feed/ Flame Monitoring End Plate, NPT	101234	101234-1	1-1/2" NPT	**	1" NPT	4 (1.8)
Burner Feed End Plate, BSP	101235	101235-1	1-1/2" BSP	-	-	4 (1.8)
Burner Feed End Plate, NPT	101236	101236-1	1-1/2" NPT	-	-	4 (1.8)

\* Standard cast iron end plates with powder coated surface finish are supplied on burners with aluminum gas manifolds.

\*\* 14mm (0.6") plug may be replaced by an ignition plug for direct spark ignition of burners 450mm (18") or less.

### Accessories

Description	Part Number
Mtg. Brkt. for Hanger Rods	21509
Ignition Plug	13047-1
Flame Rod <sup>1</sup>	13093
Divider Plate for Staging	76506
UV Scanner Adapter - 1/2" NPT <sup>2</sup>	202010
UV Scanner Adapter - 3/4" NPT	202011
UV Scanner Adapter - 1" NPT <sup>3</sup>	18767
Pilot Gas Cock	12659

<sup>1</sup> Flame rod ordered with burner includes adapter to pilot or flame monitoring endplate

<sup>2</sup> Adapter fits Eclipse straight, Eclipse 90 and Honeywell C7027A UV scanners

<sup>3</sup> Adapter fits Eclipse self-check and Honeywell C7035A UV scanners

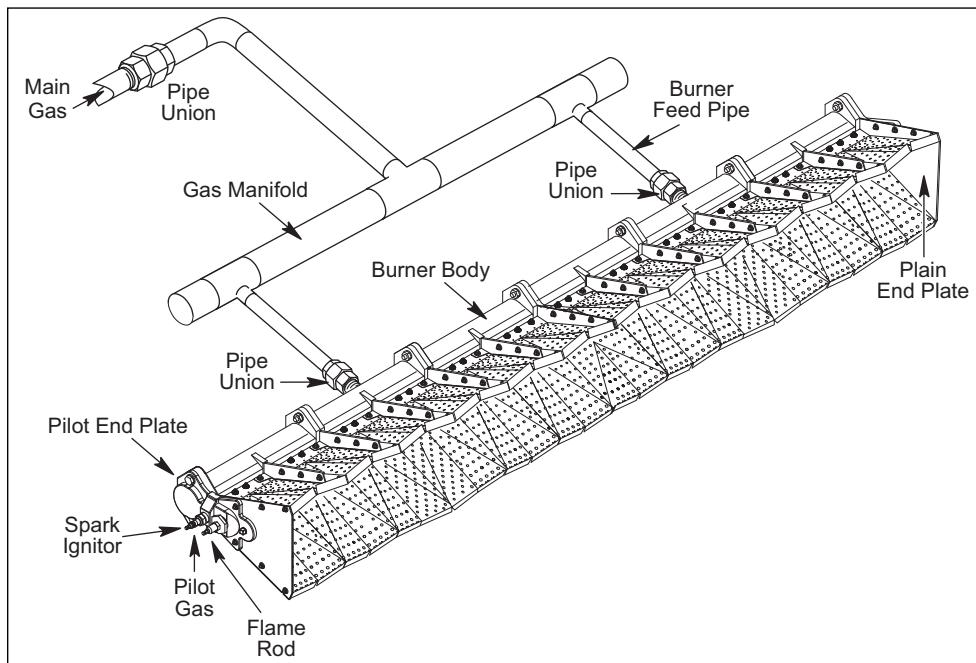
### Sizing and layout of the gas manifold

Choose the gas manifold size to evenly supply gas to each of the sections, using Table 3.2 and Figure 3.1.

**Table 3.2 Gas Pipe Sizing and Layout**

Maximum Gas Input, MMBtu/h (MW)	Manifold Pipe Size	Maximum Gas Input, MMBtu/h (MW)	Main Gas Pipe Size
1.4 (0.4)	1-1/2"	0.3 (0.1)	1/2"
2.5 (0.7)	2"	0.6 (0.2)	3/4"
5.2 (1.5)	2-1/2"	1.1 (0.3)	1"
8.0 (2.3)	3"	3.2 (0.9)	1-1/2"
14.0 (4.1)	4"	6.6 (1.9)	2"
45.0 (13.2)	6"	13.0 (3.8)	2-1/2"
80.0 (23.4)	8"	20.0 (5.9)	3"

**NOTE:** Maximum inputs shown for natural gas only. For propane, multiply inputs by 1.5; for butane, multiply inputs by 1.7.



**Figure 3.2 Gas Manifold Sizing and Layout**

Example: A gas manifold is supplying gas to two 1-1/2" NPT rear inlets on a burner. Each of the rear inlets supplies a maximum of 2,000,000 Btu/h.

Solution: The total fuel supplied is  $2 \times 2,000,000 = 4,000,000$  Btu/h.

Referring to Table 3.2, the choice for manifold size is 2-1/2"; the choice for main gas pipe size is 2".

### Profile plate sizing

Profile plates are required to ensure sufficient air pressure drop across the burner. An example of profile plate layout is shown in Figure 3.4 on the next page

Where:  $A_g$  = Area in square inches of the gap between the profile plates and the burner.

The areas on the sides of the burners should first be calculated based on a fixed gap of 2 inches. Next, calculate the gap size required on the top and bottom to obtain the required profile gap area.

Example: Size a profile plate for a seven-foot long AH-MA v2.0 burner. Air flow around and through the burner will be 60,000 SCFM. The design pressure drop is 0.7" w.c.

**NOTE:** Use a burner wing width of 9.6 inches (226 mm) for profile gap sizing on top and bottom.

From Figure 3.3:  $G_p = 43$

$$A_g = \frac{60,000 \times 43}{1000} = 2580 \text{ in}^2$$

Calculate gap sizes:

$$\text{Side Area} = 2 \times 2" \times 9.6" = 38 \text{ in}^2$$

$$\text{Area Top and Bottom} = 2580 - 38 = 2542 \text{ in}^2$$

$$\text{Therefore, Top and Bottom Gap} = 2542 \text{ in}^2 = 15.1 \text{ inches}$$

$$(7 \times 12)^* \times 2 \text{ gaps}$$

\*where  $7 \times 12$  = burner length in inches

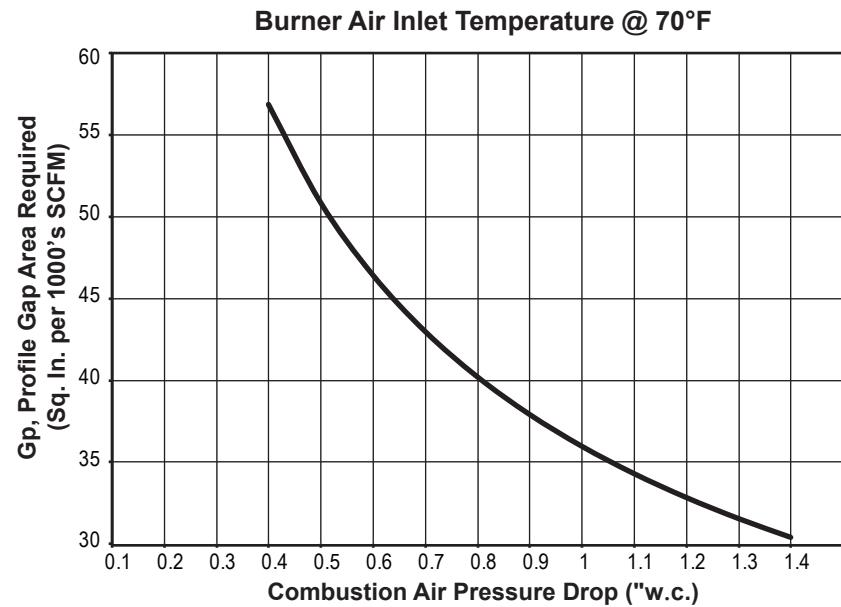
### CAUTION

- It is essential that even air flow is delivered to the burner to obtain optimum performance.

To calculate the profile gap sizes, you will need to know the following:

1. SCFM = Total air flow around and through the burner in cubic feet per minute.
2. Design pressure drop across the burner.
3.  $G_p$  = Profile gap area required per flow from Figure 3.3; see Table 3.4 for corrections at higher or lower burner air inlet temperatures.

$$\text{Profile area (A}_g\text{)} = \frac{\text{SCFM} \times G_p}{1000}$$

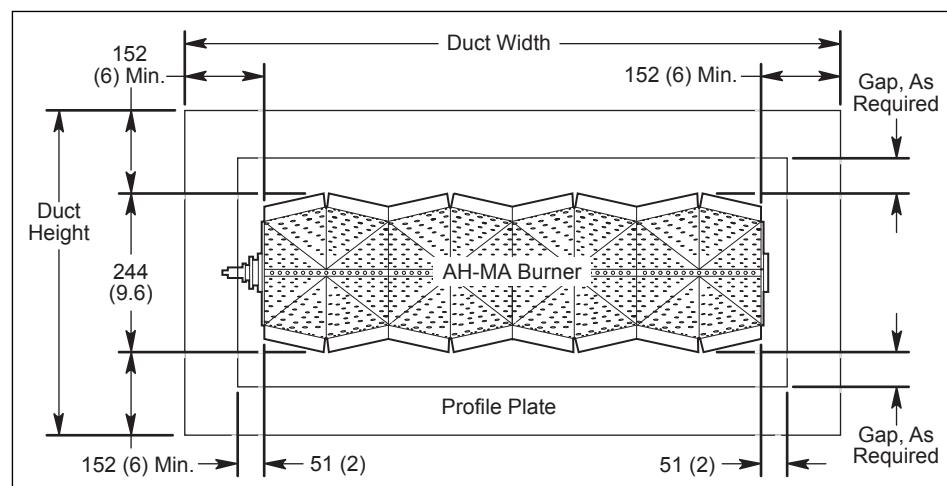


**Figure 3.3 Profile Gap Area vs. Air Pressure Gap**

**Table 3.4 Profile Gap Air Inlet Air Temperature Correction**

G <sub>p</sub> at Air Temperature = G <sub>p</sub> from Figure 3.4 x Correction Factor										
Air Temperature, °F (°C)	0 (-18)	30 (-1)	70 (21)	150 (66)	200 (94)	250 (121)	300 (149)	350 (177)	400 (204)	450 (232)
Correction Factor	0.87	0.92	1.00	1.15	1.25	1.34	1.43	1.53	1.62	1.72

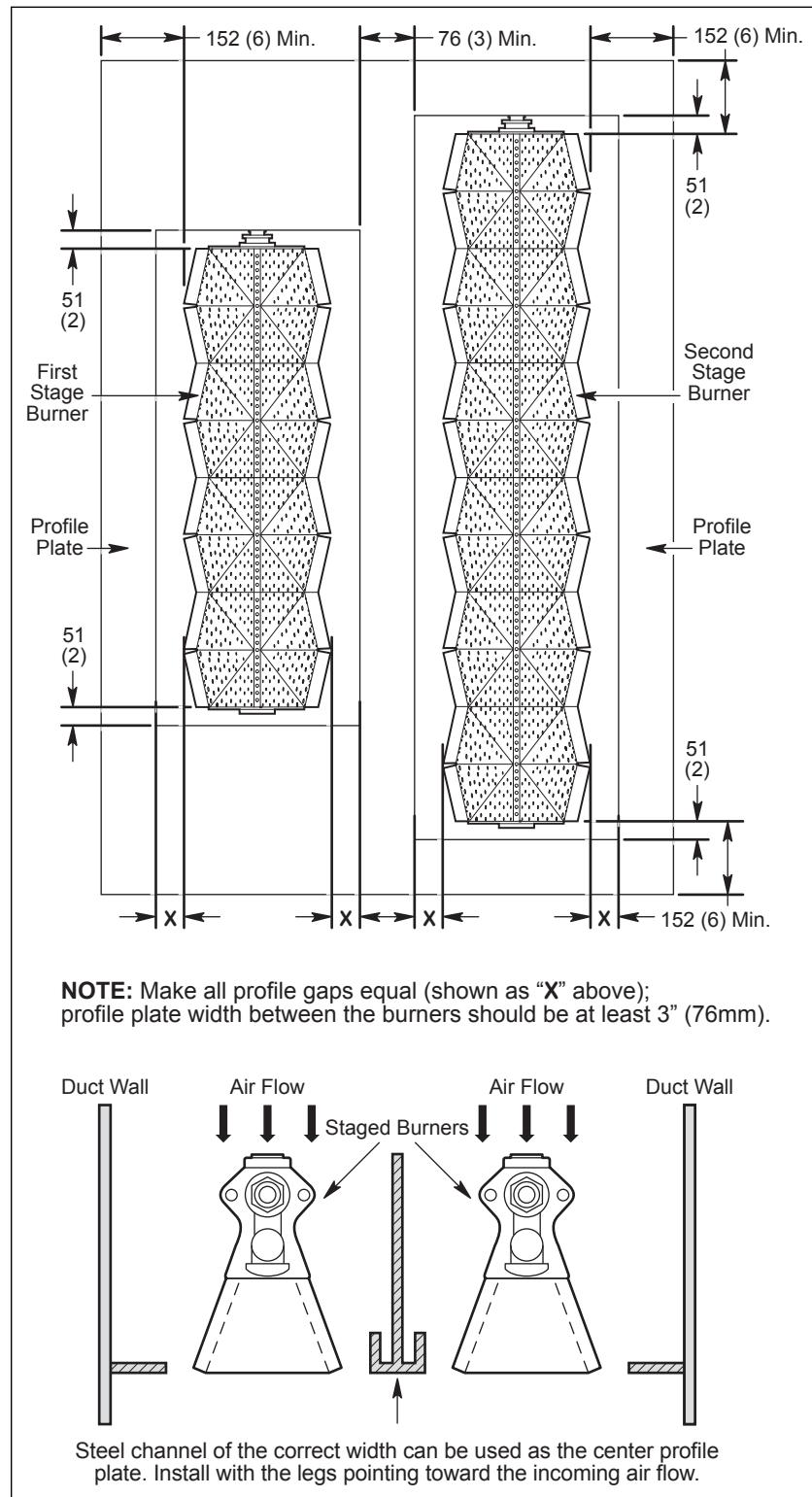
**Single Burner Profile Plates**  
Dimensions in mm (inches)



**Figure 3.4**

## Two-Stage Burner Profile Plates

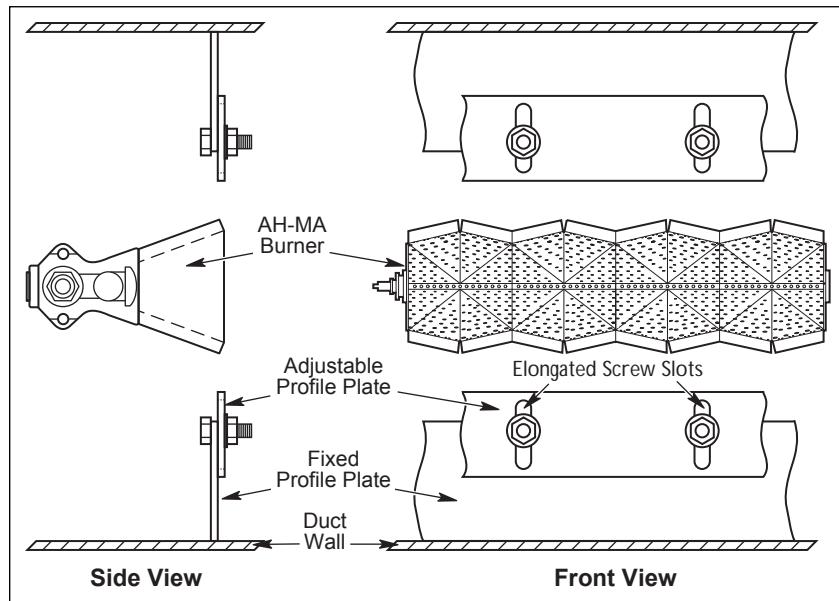
Dimensions in mm (inches)



**Figure 3.5**

**NOTE:** To compensate for changes in actual air flow versus calculated, provide adjustable profile plates so that

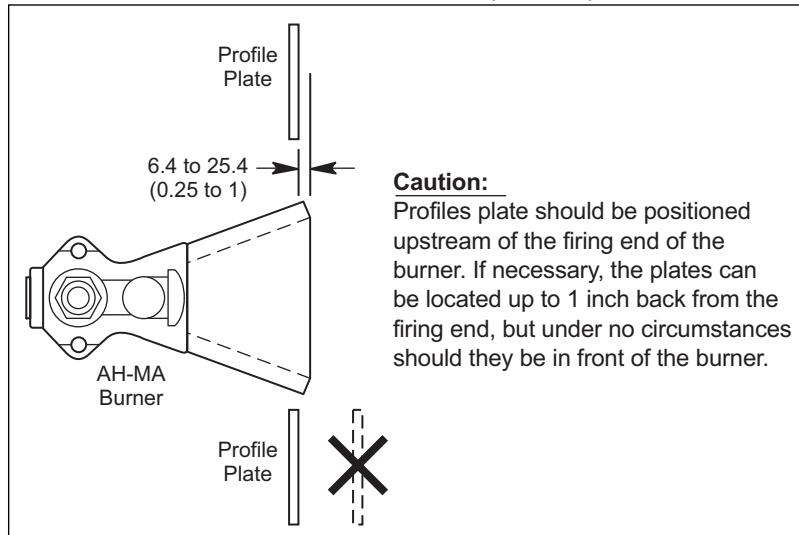
final settings can be made in the field. Figure 3.6 shows an example of an adjustable profile plate design.



**Figure 3.6 Adjustable Profile Plates**

### Profile Plate Positioning

Dimensions in mm (inches)



**Figure 3.7**

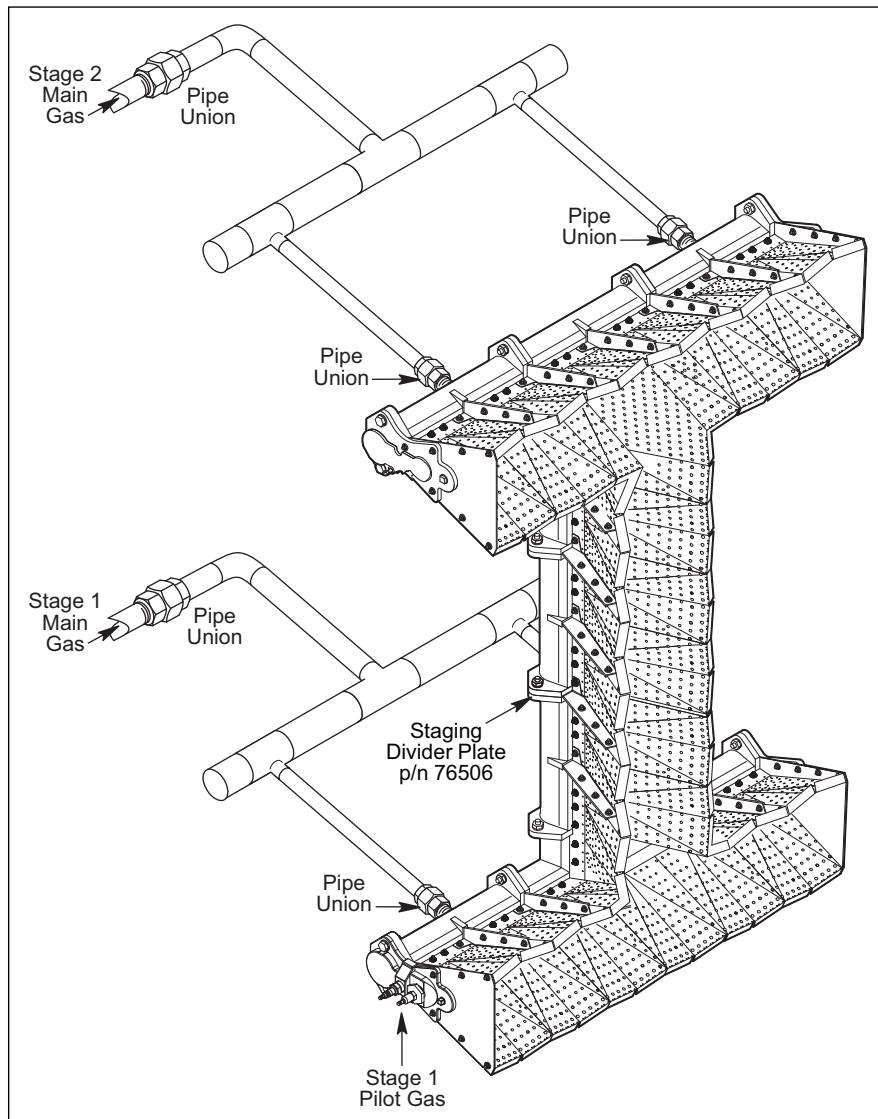
## Step 2: Control Methodology

The simplest control method is fuel modulation at fixed air flow. If required turndown is greater than the burner's capabilities, there are two options, air modulation and burner fuel staging.

### Air Modulation

To lower the minimum input of the burner, the air flow can be decreased as long as the pressure drop across the burner does not go outside of the operating limits given in

the "Operating Ranges" chart in Datasheet 160. The air flow can be changed with a two-speed air handling system or a modulated system. As an example, the air flow could be turned down from a pressure drop of 1" w.c. to 0.25" w.c., giving a total air turndown of 2:1. This could extend the minimum input level from 20,000 to 13,000 Btu/h/ft.



**Figure 3.8 Staged Burners**

## Burner Fuel Staging

To further increase the burner turndown, AH-MA v2.10 burners can be fuel staged. This can be done by installing two or more separate burners in a duct, each with its own gas control valve, or by dividing a single burner assembly into separate zoned sections. For example, to double the effective turndown, two burner sections may be “staged” as shown in Figure 3.8 on the previous page. If more heat is required, stage 2 is lit by simply supplying gas to it. It will pilot from the adjacent stage.



### WARNING

- Lockouts must be provided to shut off gas flow to stage 2 unless flame is proven on stage 1.

A staging divider plate (p/n 76506) must be installed between the burner bodies to separate the different gas feed sections.

**NOTE:** Ignition performance is enhanced if the gas inlet to stage 2 is as close to the piloting section as possible.

## Step 3: Ignition System

AH-MA v2.10 Air Heat burners have an integral spark-ignited gas pilot for lighting the burner. The pilot fuel is fed into the pilot end casting, which is separate from the main fuel. A pilot adjusting valve is required to adjust the pilot gas flow (Eclipse p/n 12659 is recommended). The needed pilot capacity is 20,000 Btu/h, but the pilot will operate equally well at higher or lower inputs. The pilot is shut off after successfully igniting the main burner to protect the igniter.

Local safety and insurance requirements demand that you limit the maximum time that a burner takes to ignite. These time limits vary from country to country. For the USA, the time limit is 15 seconds; for Europe, it is typically 3 seconds. Local requirements may require shorter time limits. Verify local regulation and insurance requirements with the authorized jurisdiction.

The time that a burner takes to ignite depends on:

- The distance between the gas shut-off valve and the burner
- The air pressure drop across the burner
- The gas flow at start conditions.

## Step 4: Flame Monitoring System

A flame monitoring system consists of two main parts, a flame sensor and a flame safeguard.

### Flame Sensor

There are two types of flame sensors you can use for an AH-MA v2.1 Air Heat burner, a UV scanner and a flame rod.

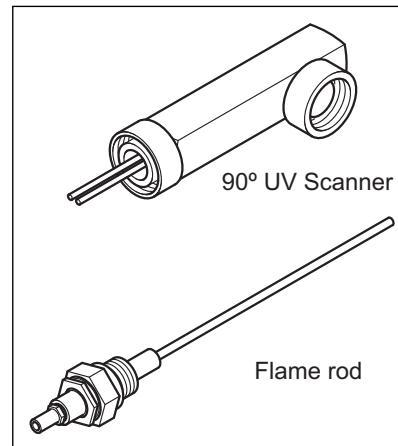


Figure 3.9

You can find information on UV scanners in:

- Instruction Manual No. 852; 90° UV scanner
- Instruction Manual No. 854; straight UV scanner
- Instruction Manual No. 855; solid state UV/IR scanner
- Instruction Manual No. 856; self-check UV scanner.

You can find information on flame rods in:

- Bulletin/Info Guide No. 832.

### Flame Monitoring Control

The Flame Monitoring Control processes the signal from the flame rod or UV scanner and controls both the startup sequence and the main gas shut-off valve sequence.

For flame safeguard selection there are two options for staged burners depending on the application requirements:

- Flame safeguard for each burner: if one burner goes down, only that burner will be shut off
- Multiple burner flame safeguard: if one burner goes down, all burners will be shut off.

Eclipse Inc. recommends the use of flame monitoring control systems which maintain a spark for the entire trial for ignition time when using UV scanners. Some of these flame monitoring models are:

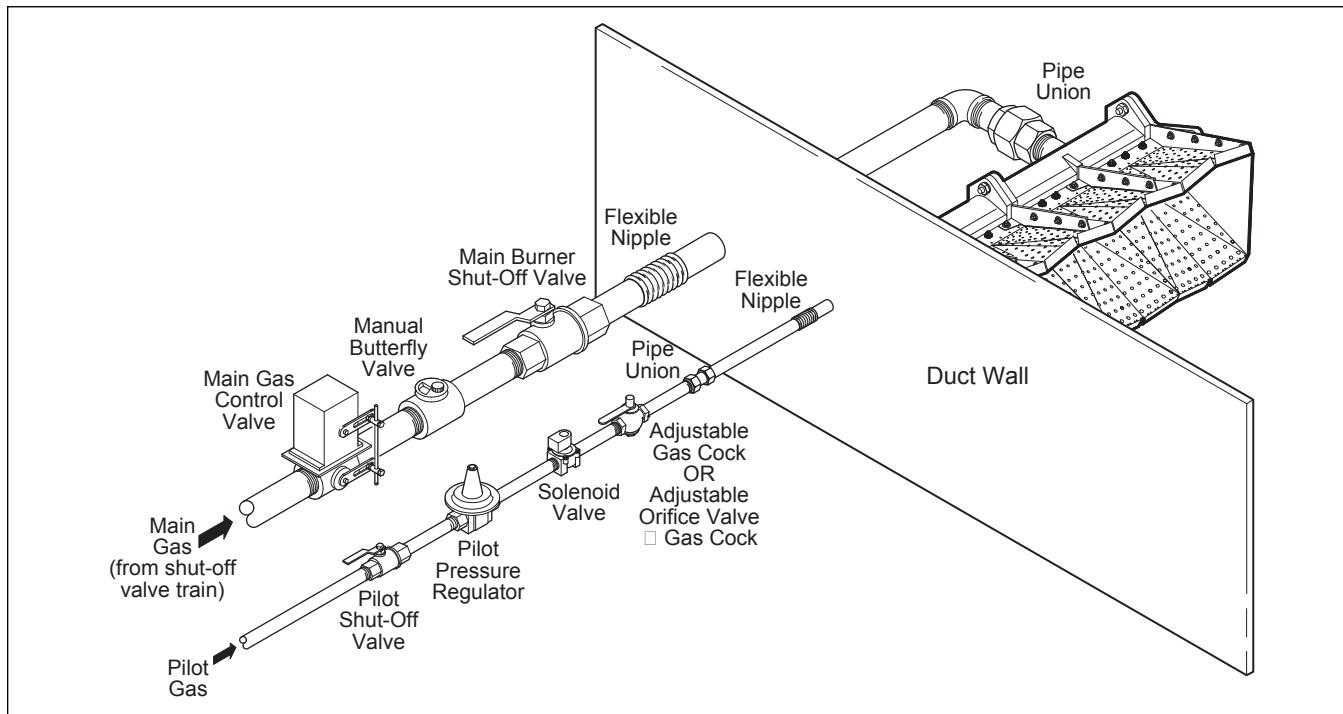
- Veri-Flame series; see Bulletin/Instruction Manual No. 818
- Bi-Flame series; see Bulletin/Instruction Manual No. 826
- Multi-Flame series; see Bulletin/Instruction Manual No. 820.

Burners over 10 lineal feet include flame supervision at the far end. If pilot ignition is being used, two flame supervision units are required, one for the pilot and one for the far end. Per NFPA 86, if using direct spark on the main flame, only flame supervision at the far end is required providing ignition can be accomplished within 15 seconds.

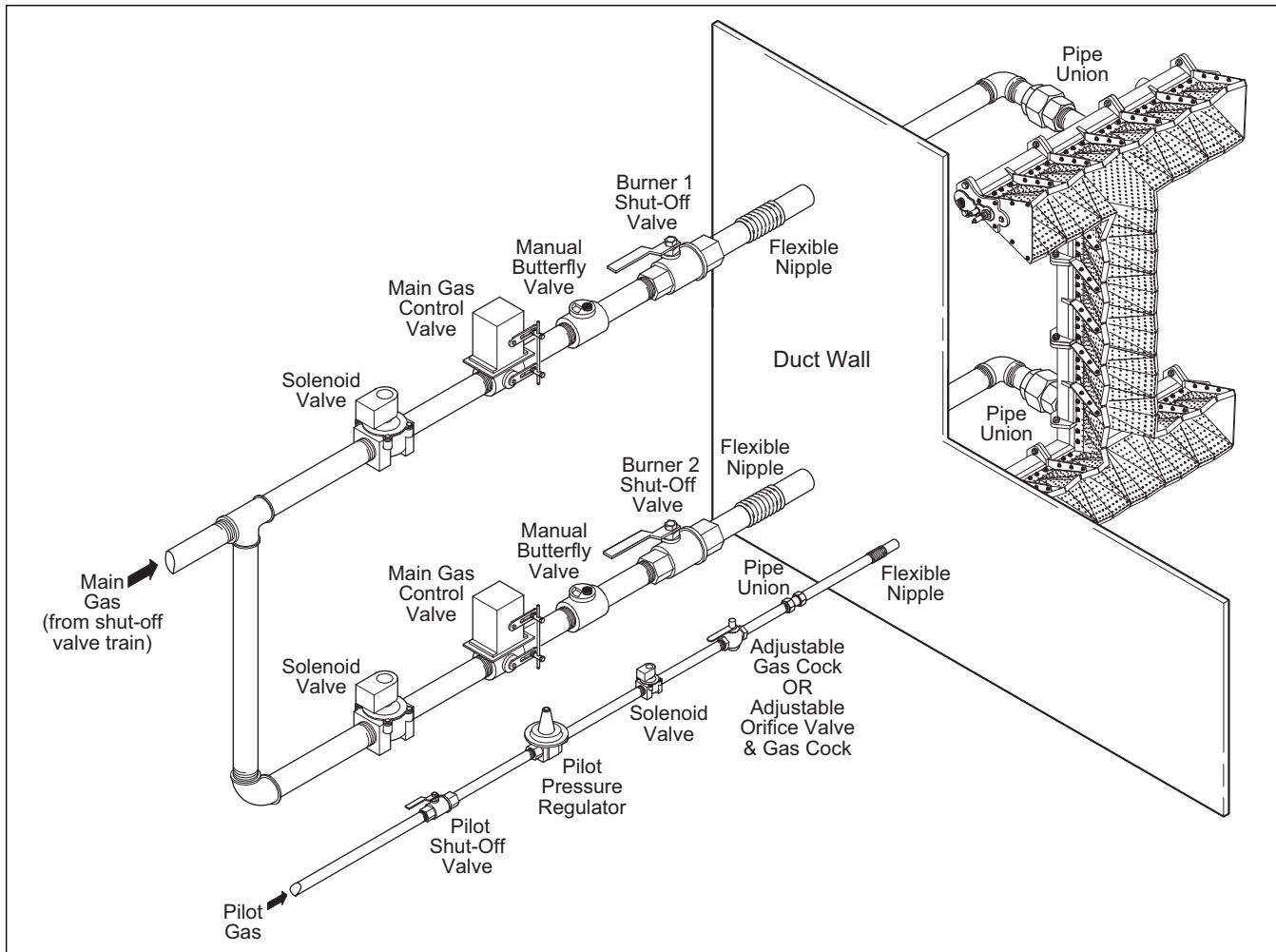
## **Step 5: Gas Valve Train Selection**

Figures 3.9 and 3.10 illustrate gas valve trains for single and staged burner systems respectively.

The typical main gas valve train for a staged burner has the same valve layout as a single burner except each burner has an individual solenoid valve to independently shut down each section. A common gas shut-off valve train can be used.



**Figure 3.10 Single-Staged Burner Valve Layout**



**Figure 3.11 Staged Burner Valve Layout**

**NOTE:** A single pilot fuel feed can be used when the staged burners are piloted by the adjacent burners.

### Consult Eclipse

Eclipse can help you design and obtain a main gas shut-off valve train that complies with the current safety standards.

The shut-off valve train must comply with local safety standards set by authorized jurisdiction.

For details, please contact your local Eclipse representative or Eclipse Inc.

**NOTE:** Eclipse supports NFPA regulations (two shut-off valves) as a minimum standard for main gas "safety shut-off valves."

# Appendix

## Conversion Factors

### Metric to English

From	To	Multiply By
actual cubic meter/h (am <sup>3</sup> /h)	actual cubic foot/h (acfh)	35.31
normal cubic meter/h (Nm <sup>3</sup> /h)	standard cubic foot /h (scfh)	38.04
degrees Celsius (°C)	degrees Fahrenheit (°F)	(°C x 9/5) + 32
kilogram (kg)	pound (lb)	2.205
kilowatt (kW)	Btu/h	3415
meter (m)	foot (ft)	3.281
millibar (mbar)	inches water column ("w.c.)	0.402
millibar (mbar)	pounds/sq in (psi)	14.5 x 10 <sup>-3</sup>
millimeter (mm)	inch (in)	3.94 x 10 <sup>-2</sup>
MJ/Nm <sup>3</sup>	Btu/ft <sup>3</sup> (standard)	26.86

### Metric to Metric

From	To	Multiply By
kiloPascals (kPa)	millibar (mbar)	10
meter (m)	millimeter (mm)	1000
millibar (mbar)	kiloPascals (kPa)	0.1
millimeter (mm)	meter (m)	0.001

### English to Metric

From	To	Multiply By
actual cubic foot/h (acfh)	actual cubic meter/h (am <sup>3</sup> /h)	2.832 x 10 <sup>-2</sup>
standard cubic foot /h (scfh)	normal cubic meter/h (Nm <sup>3</sup> /h)	2.629 x 10 <sup>-2</sup>
degrees Fahrenheit (°F)	degrees Celsius (°C)	(°F - 32) x 5/9
pound (lb)	kilogram (kg)	0.454
Btu/h	kilowatt (kW)	0.293 x 10 <sup>-3</sup>
foot (ft)	meter (m)	0.3048
inches water column ("w.c.)	millibar (mbar)	2.489
pounds/sq in (psi)	millibar (mbar)	68.95
inch (in)	millimeter (mm)	25.4
Btu/ft <sup>3</sup> (standard)	MJ/Nm <sup>3</sup>	37.2 x 10 <sup>-3</sup>

# Notes

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