Honeywell
ECLIPSE

Immerson tube burners ImmersoJet IJ

OPERATING INSTRUCTIONS

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CONTENTS

SAFETY

Disclaimer Notice

In accordance with the manufacture's policy of continual product improvement, the product presented in this brochure is subject to change without notice or obligation.

The material in this manual is believed adequate for the intended use of the product. If the product is used for purposes other than those specified herein, confirmation of validity and suitability must be obtained. Honeywell-Eclipse warrants that the product itself does not infringe upon any United States patents. No further warranty is expressed or implied.

Liability and Warranty

We have made every effort to make this manual as accurate and complete as possible. Should you find errors or omissions, please bring them to our attention so that we may correct them. In this way we hope to improve our product documentation for the benefit of our customers. Please send your corrections and comments to our Marketing Communications Manager.

It must be understood that Honeywell's liability for its product, whether due to breach of warranty, negligence, strict liability, or otherwise is limited to the furnishing of replacement parts and Honeywell-Eclipse will not be liable for any other injury, loss, damage or expenses, whether direct or consequential, including but not limited to loss of use, income, or damage to material arising in connection with the sale, installation, use of, inability to use, or the repair or replacement of Honeywell-Eclipse's products.

Any operation expressly prohibited in this manual, any adjustment, or assembly procedures not recommended or authorized in these instructions shall void the warranty.

Document Conventions

There are several special symbols in this document. You must know their meaning and importance.

1 2 3 a b c ... = Action

➔ = Instruction/Note

Audience and Purpose

This manual has been written for people who are already familiar with all aspects of a gas burner and its add-on components, also referred to as "the burner system". These aspects are:

– Installation
– Use
– Maintenance

The audience is expected to have previous experience with this type of equipment.

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

Further documents

For further information about this product see Technical Information

Safety instructions

Information that is relevant for safety is indicated in the instructions as follows:

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

All interventions may only be carried out by qualified gas technicians. Electrical interventions may only be carried out by qualified electricians.

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 Honeywell before continuing.

⚠ DANGER

The burners covered in this manual are designed to mix fuel with oxygen and burn the resulting mixture. All fuel burning devices are capable of producing fires and explosions when improperly applied, installed, adjusted, controlled or maintained.

– Do not bypass any safety feature; fire or explosion could result.
– Never try to light the burner if it shows signs of damage or malfunction.

⚠ WARNING

– The burner is likely to have HOT surfaces. Always wear protective clothing when approaching the burner.
– Honeywell 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.

⚠ CAUTION

– This manual gives information for the use of these burners for their specific design purpose. Do not deviate from any instructions or application limits in this manual without written advice from Honeywell.

Capabilities

Only qualified personnel, with good mechanical aptitude and experience with combustion equipment, should adjust, maintain, or troubleshoot any mechanical or electrical part of this system.

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.

Replacement Parts

Order replacement parts from Honeywell only. Any customersupplied valves or switches should carry UL, FM, CSA, CGA and/or CE approval where applicable.

PRODUCT DESCRIPTION

The ImmersoJet (IJ) is a nozzle-mix tube-firing burner that is designed to fire at high velocities through small diameter immersion tubes. The standard burner includes a packaged blower, actuator control motor, integral butterfly valve, ratio regulator, burner body, combustion chamber, nozzle (specific to fuel used), rear cover, spark and flame rods, and gas orifice (also specific to fuel used).

SYSTEM DESIGN

The design process is divided into the following steps:

1 Burner Model Selection
- Determine net input required for the tank or process
- Select tube efficiency
- Calculate gross input required
- Select burner model

2 Tube Design
3 Control Methodology
4 Ignition System
5 Flame Monitoring System
6 Combustion Air System: blower and air pressure switch
7 Main Gas Shut-Off Valve Train
8 Process Temperature Control System

Burner Model Selection

Determine the Net Input Required to the Tank

The net input to the tank is determined from heat balance calculations. These calculations are based on the heatup and steady-state requirements of the process, and take into account surface losses, tank wall losses and tank heat storage. Detailed guidelines for heat balance calculations are in the Eclipse Combustion Engineering Guide (EFE 825).

Select Tube Efficiency

The efficiency of the tube is the net heat input to the tank divided by the heat input to the tube. Efficiency is determined by the effective tube length. The diameter of the tube has little influence on the efficiency. At a given burner input, the net input to the tank is higher for a longer tube than for a relatively short tube.

It is customary to size conventional immersion tubes for 70% efficiency, a reasonable compromise between fuel economy and tube length. Small diameter tubes occupy less tank space than conventional tubes, however, so their length can easily be increased to provide efficiencies of 80 % or more.

Calculate the Gross Burner Input

Use this formula to calculate gross burner input in Btu/h:

$$\frac{\text{net output to tank}}{\text{tube efficiency}} = \text{gross burner input}$$

Fuel Type

Fuel	Symbol	Gross Heating Value	Specific Gravity	WOBBE Index
Natural Gas	CH_4 90 %+	1000 Btu/ft^3 (40.1 MJ/m^3)	0.60	1290 Btu/ft^3
Propane	C_3H_8	2525 Btu/ft^3 (101.2 MJ/m^3)	1.55	2028 Btu/ft^3
Butane	C_4H_{10}	3330 Btu/ft^3 (133.7 MJ/m^3)	2.09	2303 Btu/ft^3

Btu/ft^3 at standard conditions (MJ/m^3 at normal conditions) BTU/h is based on HHV while kW is based on LHV.
If using an alternative fuel supply, contact Honeywell with an accurate breakdown of the fuel components.

Applications Requiring Special Consideration

ImmersoJet burners are used for firing spray wash tanks, dip tanks, and storage tanks such as those used for fire sprinkler systems. Generally, the small bore system can be used wherever conventional immersion burner systems are used, except where high heat flux off the small bore tube can break down the contents of the tank.

Zinc Phosphate Solutions

High heat fluxes break down the phosphate, forming a heavy insulating sludge, which deposits on tube surfaces and causes rapid tube burnout. To reduce early tube failure, make the immersion tube with electro-polished stainless steel, and limit the burner to the capacity shown in the limited capacity portion of Table "Capacity guide" where capacity is based on tube size.

Iron Phosphate Solutions

These are susceptible to the same problem described above for zinc phosphate solutions. To reduce early tube failure, make the immersion tube with stainless steel. Electro-polishing is not required. Limit the burner to the capacity shown in the limited capacity portion of Table "Capacity guide" where capacity is based on tube size.

Cooking Oils

To avoid burning the oil, limit heat flux to 50 Btu/h per in^2 of the tube area.

Highly Viscous Liquids

All immersion systems depend on natural convection currents to carry heat away from the tube and throughout the tank. Convection is minimal in high viscosity solutions such as asphalt, residual oil or molasses. This can severely overheat the liquid around the tube.

Do not use the ImmersoJet for highly viscous fluids!

Select Burner Model

Choose a burner model with a maximum capacity greater than the gross burner input calculated previously. Refer to Table "Capacity guide".

Capacity guide

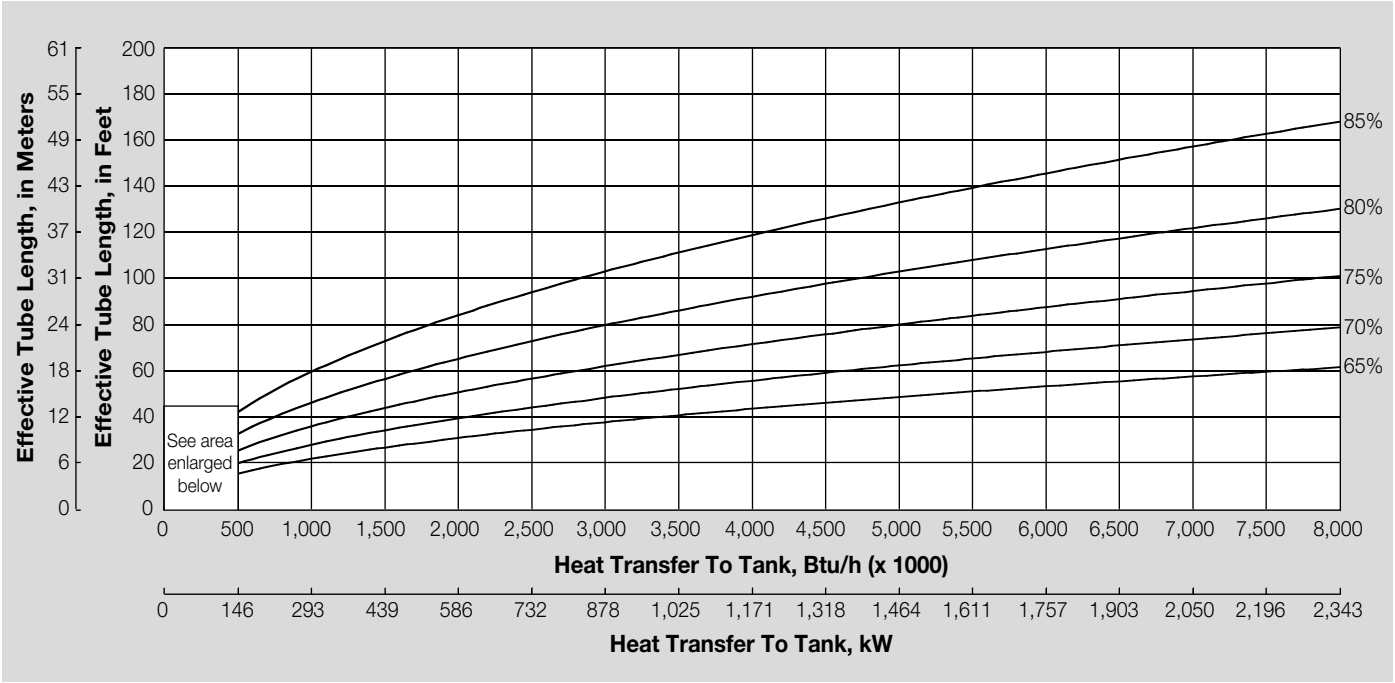
Model	Tube Size, in (mm)	Low-Pressure Packaged Blower, Btu/h (kW)	High-Pressure Packaged Blower, Btu/h (kW)	Remote Blower, Btu/h (kW)	Limited Capacity Zinc Phospate, Btu/h (kW)	Limited Capacity Iron Phospate, Btu/h (kW)
IJ-2	2 (50)	190,000 (55)	235,000 (69)	370,000 (108)	110,000 (32)	220,000 (64)
IJ-3	3 (80)	440,000 (129)	550,000 (161)	850,000 (249)	250,000 (73)	500,000 (146)
IJ-4	4 (100)	800,000 (234)	1,000,000 (293)	1,800,000 (527)	440,000 (129)	880,000 (258)
IJ-6	6 (150)	2,000,000 (586)	2,500,000 (733)	3,600,000 (1054)	1,000,000 (293)	2,000,000 (586)
IJ-8	8 (200)	3,200,000 (938)	N/A	4,700,000 (1377)	1,800,000 (527)	3,600,000 (1055)

Tube Design

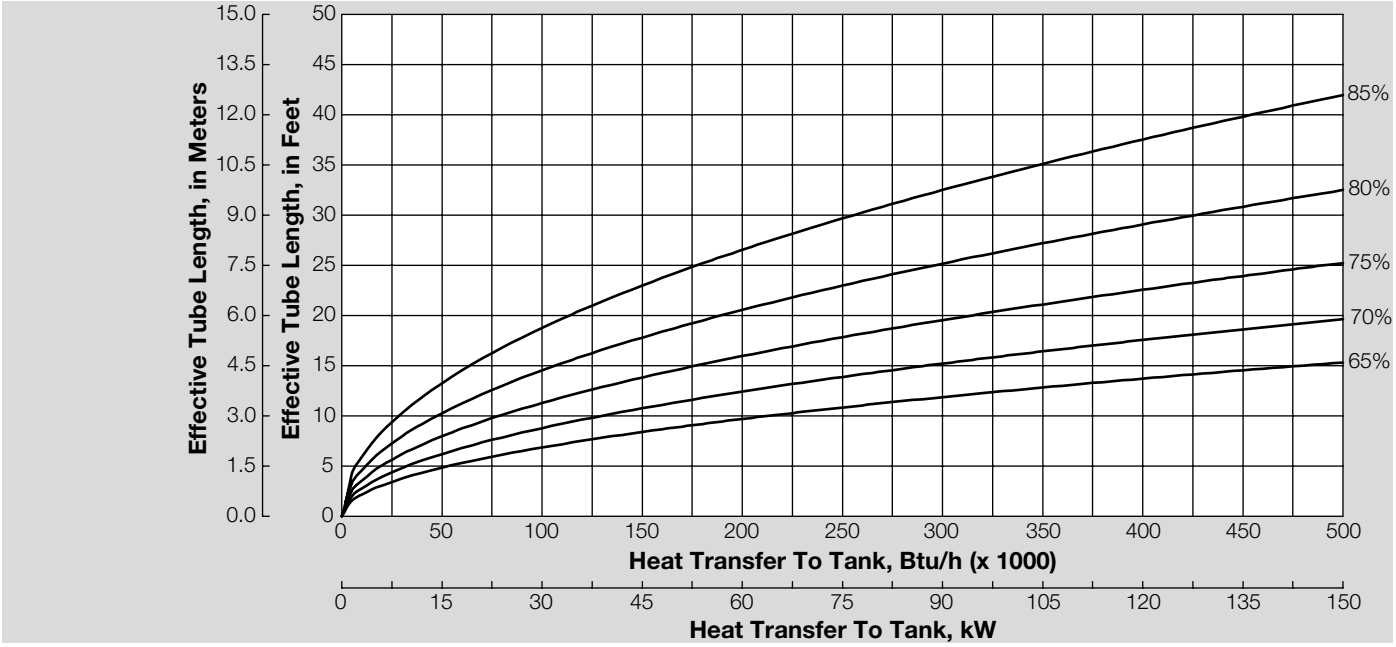
Determine Effective Tube Length

Find the required effective tube length using the previously selected tube efficiency, net heat input values, and Figures" Effective Tube Length…". The effective length of a tube is the total centerline length of the tube covered by liquid.

Effective Tube Length to 200 ft.



Effective Tube Length to 50 ft.



Elbows

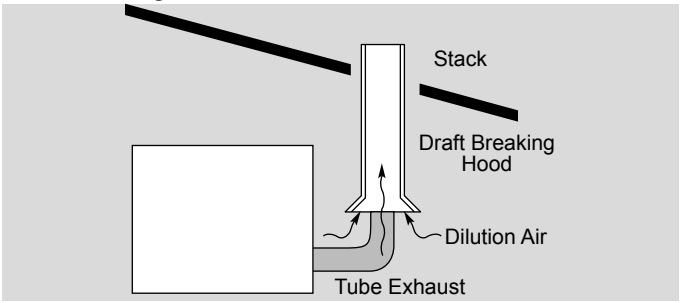
– Use standard and sweep elbows only.
– For optimal burner operation and maximum tube life place the first elbow eight tube diameters from the burner

Stack

– Make sure that the stack is large enough to handle the heated exhaust flow plus the dilution air.
– The stack must be at least one pipe size larger than the tube exhaust.

NOTE: If you use a common stack for more than one burner, then make sure that the stack is large enough to handle the exhaust flow plus any dilution air from all the burners. Detailed guidelines for flue sizing calculations are in the Eclipse Combustion Engineering Guide (EFE 825).

Draft Breaking Hood



A draft breaking hood is an open connection between the heater tube exhaust and the exhaust stack. It allows fresh dilution air to pass into the exhaust and mix with the exhaust gases.

The advantages of a draft hood are:

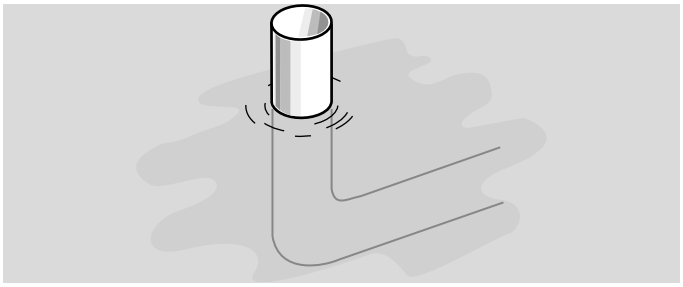
– the burner operation is less sensitive to atmospheric conditions.
– the temperature of the exhaust gases is lower when they pass through the roof.

NOTE: Leave access between the draft hood and the tube exhaust. Install a damper plate if acoustic feedback occurs in the tube.

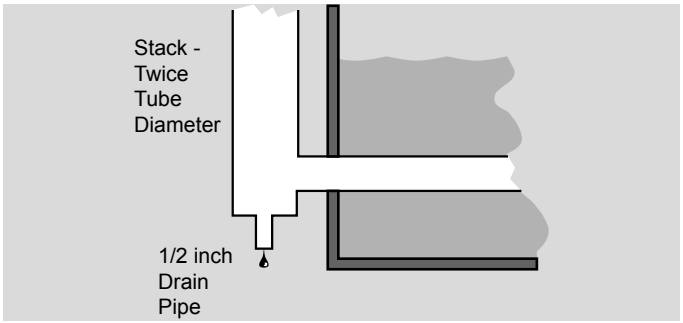
Condensate provisions

If the immersion tube will operate at efficiencies less than 80 %, the exhaust leg can be raised through the liquid surface. For efficiencies of 80 % or higher, locate the exhaust stack outside of the tank and provide a drain. See following figures:

Efficiencies less than 80 %



Efficiencies 80 % or more



NOTE: Regardless of the exhaust design, pitch the immersion tube down towards the exhaust so condensate will not collect at the burner.

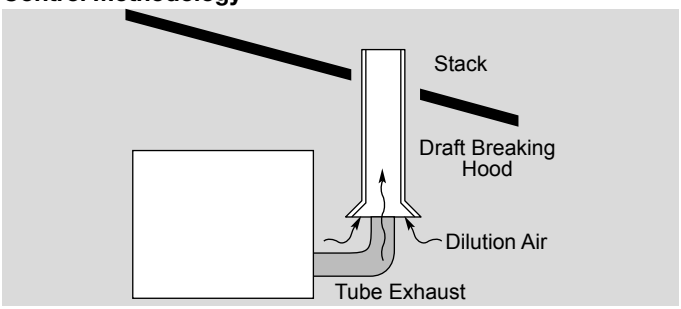
– At efficiencies of 80 % or greater, low exhaust temperatures will cause condensation to form in the tube at start-up or during long idling periods. The higher the efficiency the more condensation will increase.
– To prevent condensation/corrosion from shortening tube life or disrupting burner operation, provide a condensate drain at the exhaust and slope the immersion tube downward, away from the burner.

Tube placement in tank

The tube placement height in the tank should be high enough to avoid the possibility of sludge build-up on the bottom of the tank; however, it should be low enough to avoid tube exposure due to liquid level variations caused by evaporation or displacement. In the latter case use a liquid level switch to shut down the burner

Control System

Control Methodology

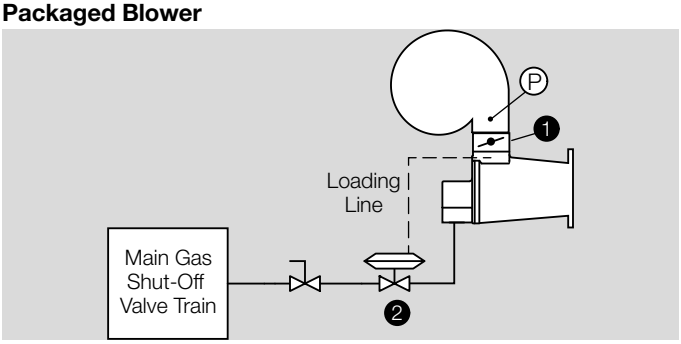


ImmersoJet burners use a modulating on-ratio control system as shown in the figure. To control the heat delivered by the burner, adjust the air flow to the burner. The gas flow will change in proportion to the air flow.

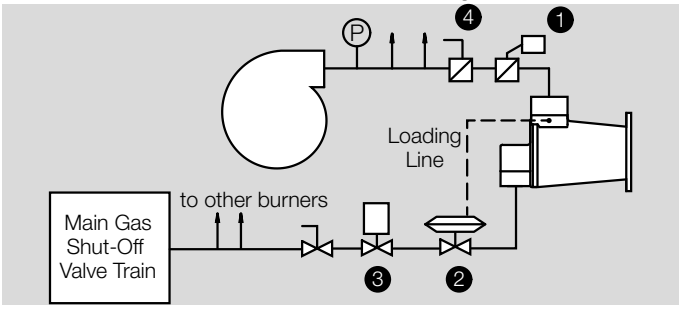
The burner will operate reliably at any input between the low fire and high fire limits stated on the page 12 (Technical data).

Components

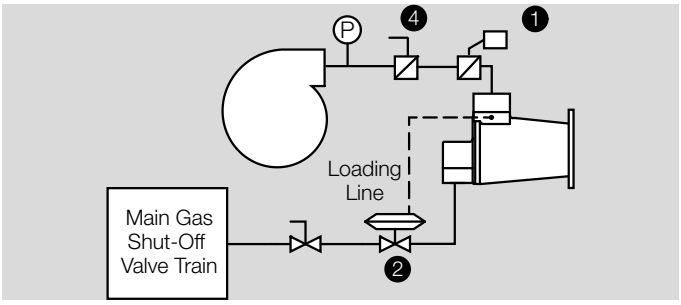
Packaged Blower



Remote Blower with External Air Butterfly Valve



Remote Blower with External Air Butterfly Valve for Multiple Burner Zones



1 Automatic butterfly valve
2 Ratio regulator: varies gas flow to burner in proportion to air flow.
3 Automatic shut-off valve (optional).
4 Manual butterfly valve

Ignition System

For the ignition system you should use
- 6000 VAC transformers
- full wave spark transformers
- one transformer per burner

Do not use
- 10,000 VAC transformers
- twin outlet transformers
- distributor type transformers
- half wave spark transformers

ImmersoJet burners will ignite reliably at any input within the ignition zone shown in the appropriate burner datasheet, however, it is recommended that low fire start be used. 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.

The time that a burner takes to ignite depends on:
- the distance between the gas shut-off valve and the burner
- the air/gas ratio
- the gas flow at start conditions.

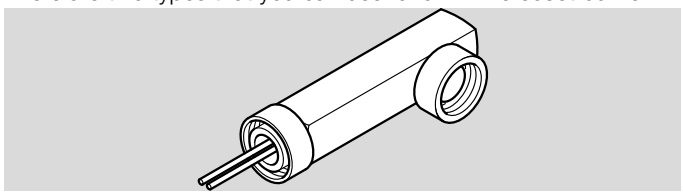
In the USA, with a time of 15 s to ignition, there should be sufficient time to ignite the burners. It is possible, however, to have the low fire too low to ignite within the time limit. Under these circumstances you must consider the following options:
- start at higher input levels
- resize and/or relocate the gas controls

Flame Monitoring System

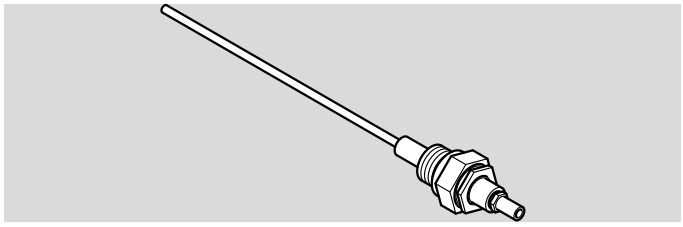
A flame monitoring system consists of two main parts:
a flame sensor
flame monitoring control

Flame sensor

There are two types that you can use for an ImmersoJet burner:



U.V. scanner



flame rod

You can find U.V. scanner information in:
- Info Guide 852; 90º U.V. scanner
- Info Guide 854; straight U.V. scanner
- Info Guide 855; Solid State U.V.I.R. scanner
- Info Guide 856; self-check U.V. scanner.

You can find flame rod information in Bulletin 832 and Information Guide 832.

Flame Monitoring Control

The flame monitoring control is the equipment that processes the signal from the flame rod or the U.V. scanner.

For flame monitoring control you may select several options:
- flame monitoring control for each burner: if one burner goes down, only that burner will be shut off
- multiple burner flame monitoring control: if one burner goes down, all burners will be shut off

Other manufacturer's flame monitoring systems can be used with the burner if spark is maintained for a fixed time interval and is not interrupted when a flame signal is detected during trial for ignition

Combustion Air System

ImmersoJet burners are sold in these configurations:
- Burner with integral low pressure blower.
- Burner with integral high pressure blower.
- Burner less blower.

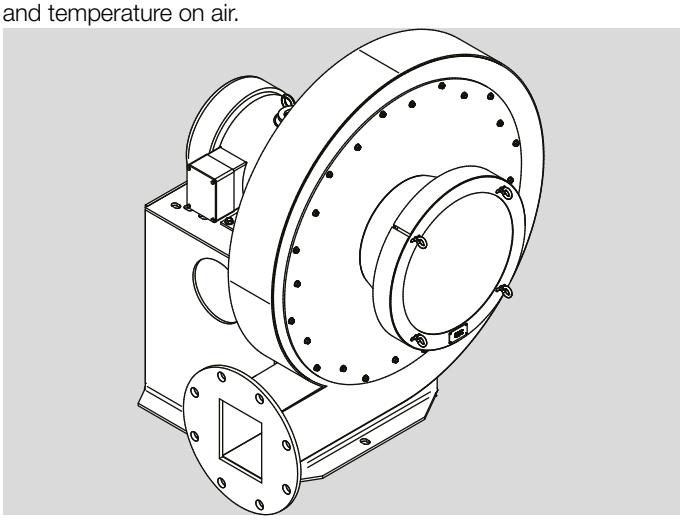
NOTE: This section describes how to size a blower for burners purchased without a blower.

Effects of atmospheric conditions

The blower data is based on the International Standard Atmosphere (ISA) at Mean Sea Level (MSL), which means that it is valid for:

– sea level
– 29.92 "Hg (1,013 mbar)
– 70ºF (21ºC)

The make-up of the air is different above sea level or in a hot area. The density of the air decreases, and as a result, the outlet pressure and the flow of the blower decrease. An accurate description of these effects is in the Eclipse Combustion Engineering Guide (EFE 825). The Guide contains tables to calculate the effect of pressure, altitude and temperature on air.



SMJ Turbo Blower

Blower

The rating of the blower must match the system requirements. You can find all the blower data in Bulletin 610.

Follow these steps:

1. Calculate the outlet pressure.

When calculating the outlet pressure of the blower, the total of these pressures must be calculated.

– the static air pressure required at the burner
– the total pressure drop in the piping
– the total of the pressure drops across the valves
– the pressure in the immersion tube
– recommend a minimum safety margin of 10%

2. Calculate the required flow

The blower output is the air flow delivered under standard atmospheric conditions. It must be enough to feed all the burners in the system at high fire.

Combustion air blowers are normally rated in terms of standard cubic feet per hour (scfh) of air.

An example calculation follows the information tables below:

Required Calculation Information

Description	Unit of Measure	Formula Symbol
Total system heat input	Btu/h	Q
Number of burners	–	
Type of fuel	–	
Gross heating value of fuel	Btu/ft^3	q
Desired excess air percentage (Typical excess air percentage @ high fire is 15%)	percent	%
Air/Gas ratio (Fuel specific, see table below)	–	
Air flow	scfh	V_{air}
Gas flow	scfh	V_{gas}

Fuel Gas Heating Values

Fuel Gas	Stoichiometric* Air/Gas Ratio α (ft^3_{air}/ft^3_{gas})	Gross Heating Value q (Btu/ft^3)
Natural Gas (Birmingham, AL)	9.41/1	1002
Propane	23.82/1	2572
Butane	30.47/1	3225

** Stoichiometric: No excess air: The precise amount of air and gas are present for complete combustion.*

Application example

A designer of a spray washer has determined the heat input for the water tank requires 857,500 Btu/h. Based on the size of his tank, he has selected a tube efficiency of 70% which results in a gross burner input of 1,225,000

Calculation example to determine the air flow requirement

a. Decide which ImmersoJet model is appropriate

– From the capacity table, either the 4" with a remote blower (1,800,000 Btu/h), or the 6" with the low pressure packaged blower (2,000,000 Btu/h) have sufficient capacity. For this example, the designer selects the 4" tube because his tank size limits the amount of the larger 6" tube that will fit.
– Select an IJ004, 4" diameter tube ImmersoJet burner with a remote blower for a maximum firing rate of 1,225,000 Btu/h.

b. Calculate the required gas flow

V_{gas} = Q/q = 1,225,000 Btu/h / 1,002 Btu/ft^3 = 1,223 ft^3/h

Gas flow of 1,223 ft^3/h is required.

c. Calculate the required stoichiometric air flow

$V_{air\text{-}stoichiometric}$ = α (air/gas ratio) x V_{gas} = 9.41 x 1,223 ft^3/h = 11,508 ft^3/h

Stoichiometric air flow of 11,508 scfh required

d. Calculate the final blower air flow requirement based on 15% excess air at high fire

V_{air} = (1 + excess air %) x $V_{air\text{-}stoichiometric}$ = (1 + 0.15) x 11,508 ft^3/h = 13,234 ft^3/h

For this example, final blower air flow requirement is 13,234 scfh at 15% excess air.

NOTE: It is common practice to add an additional 10% to the final blower air flow requirement as a safety margin.

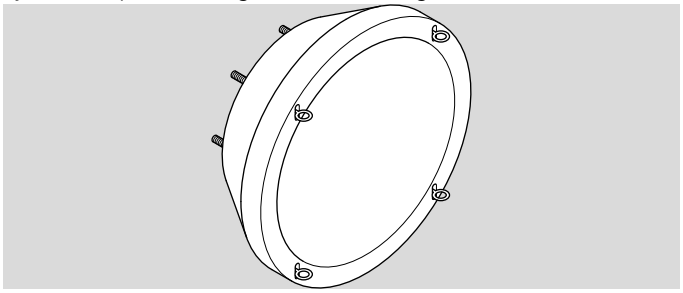
3. Find the blower model number and motor horsepower (hp).

With the output pressure and the specific flow, you can find the blower catalog number and the motor hp in Bulletin 610.

4. Select the other parameters

– inlet filter or inlet grille
– inlet size (frame size)
– voltage, number of phases, frequency
– blower outlet location, and rotation direction Clockwise (CW) or Counter Clockwise (CCW)

NOTE: The use of an inlet air filter is strongly recommended. The system will perform longer and the settings will be more stable.



Inlet filter with replaceable filter element

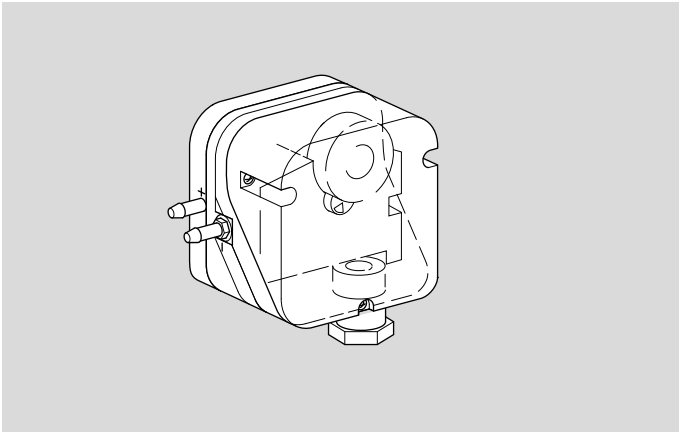
NOTE: When selecting a 60 Hz blower for use on 50 Hz, a pressure and capacity calculation is required. See Eclipse Combustion Engineering Guide (EFE 825).

The total selection information you should now have:

– blower model number
– motor hp
– motor enclosure (TEFC)
– voltage, number of phases, frequency
– rotation direction (CW or CCW).

Air pressure switch

The air pressure switch gives a signal to the monitoring system when there is not enough air pressure from the blower.
You can find more information on pressure switches in Blower Bulletin 610.



Eclipse Combustion supports NFPA regulations, which require the use of an air pressure switch in conjunction with other safety components, as a minimum standard for main gas safety shut-off systems.

Main Gas Shut-Off Valve Train

Consult Honeywell

Honeywell can help you design and obtain a main gas shutoff valve train that complies with the current safety standards.
The shut-off valve train must comply with all the local safety standards set by the authorities that have jurisdiction.
For details, please contact your local Honeywell representative.
NOTE: Honeywell Combustion supports NFPA regulations (two shut-off valves) as a minimum standard for main gas safety shut-off systems.

Process Temperature Control System

Consult Honeywell

The process temperature control system is used to control and monitor the temperature of the system. There is a wide variety of control and measuring equipment available.
For details, please contact your local Honeywell representative.

INSTALLATION

Introduction

In this section you will find the information and instructions needed to install the burner and system components.

Handling and Storage

Handling

➔ Make sure the area is clean.
➔ Protect the components from weather, damage, dirt and moisture.
➔ Protect the components from excessive temperatures and humidity.

Storage

➔ Make sure the components are clean and free of damage.
➔ Store the components in a cool, clean, dry room.
➔ After making sure everything is present and in good condition, keep the components in original packages as long as possible.

Position of Components

The position and amount of components are determined by the kind of control method chosen. All the control methods can be found here: Technical Information - System Design. Use the schematics in that chapter to build your system.

Approval of Components

Limit Controls and Safety Equipment

All limit controls and safety equipment must comply with all applicable local codes and/or standards and must be listed for combustion safety by an independent testing agency. Typical application examples include:
– American: NFPA 86 with listing marks from UL, FM, CSA
– European: EN 746-2 with CE mark from TuV, Gastec, Advantica

Electrical Wiring

All the electrical wiring must comply with all applicable local codes and/or standards such as:
– NFPA Standard 70
– IEC 60364
– CSA C22
– BS7671

Gas Piping

All the gas piping must comply with all applicable local codes and/or standards such as
– NFPA Standard 54
– ANSI Z223
– EN 746-2

Where to Get the Standards?

The NFPA Standards are available from:
National Fire Protection Agency
Batterymarch Park
Quincy, MA 02269
www.nfpa.org

The ANSI Standards are available from
American National Standard Institute
1430 Broadway
New York, NY 10018
www.ansi.org

The UL Standards are available from
333 Pfingsten Road
Northbrook, IL 60062
www.ul.com

The FM Standards are available from
1151 Boston-Providence Turnpike
PO Box 9102
Norwood, MA 02062
www.fmglobal.com/approvals

Information on the EN standards and where to get them is available from
Comité Européen de Normalisation
Stassartstraat 36
B-1050 Brussels
Phone: +32-25196811
Fax: +32-25196819
www.cen.eu

Comité Européen de Normalisation Electronique
Stassartstraat 36
B-1050 Brussels
Phone: +32-25196871
Fax: +32-25196919
www.cenelec.org

Checklist Before Installation

Intake

Provide an opening in the burner room of at least one square inch per 4000 BTU/hr (6 cm^2 per 1 kW) to supply the burner intake with fresh, outdoor, combustion air.

If there are corrosive fumes or materials in the surrounding air, find an uncontaminated source to supply air to the burner, or provide a sufficient air filtering system.

Exhaust

Do not allow exhauct fumes to accumulate in the work area. Provide some positive means for exhausting from the furnace and the building.

Access

Make sure that you install the burner in such a way that you can gain easy access for inspection and maintenance.

Environment

Make sure the local environment matches the original operating specifications. Check the following items:

– Voltage, frequency and stability of the electrical power
– Fuel type and supply pressure of the fuel
– Availability of enough fresh, clean combustion air
– Humidity, altitude and temperature of air
– Presence of damaging corrosive gases in the air
– Prevent direct exposure to water

Configuration

Verify the configuration of the IJ burner package:

– Make sure piping orientation is correct. For guidance on changing the orientation see page 8 (Prepare the Burner).
– Make sure spark plug is installed and adjusted correctly.
– Make sure flame sensor is installed. It may be either a flame rod or a UV scanner, depending on the type of flame monitoring control system being used.

For detailed information on how to install and connect a flame rod, refer to:

– Bulletin / Info guide 832

For detailed information on how to install and connect a UV scanner, refer to:

– straight UV scanner; Bulletin / Info Guide 854
– 90° UV scanner; Bulletin / Info Guide 852
– self-check UV scanner; Bulletin / Info Guide 856
– solid state UV IR scanner; Bulletin / Info Guide 855

Prepare the Burner

ImmersoJet burners are designed to be easily installed under a variety of conditions. Some minor preparation may be required to install the new ImmersoJet into specific systems.

Burner Piping

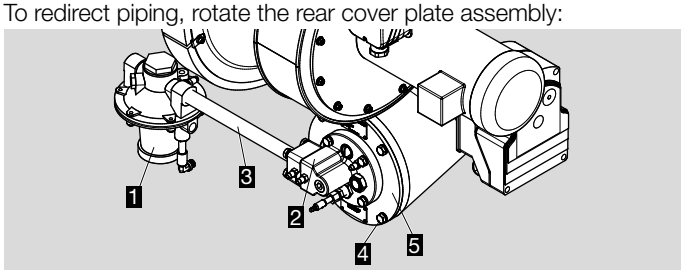
The burner is factory assembled and shipped as ordered.

➔ It is not recommended to redirect piping. If necessary, be sure the:

– ratio regulator spring column **1** is pointing down
– arrow on the ratio regulator points in the direction of gas flow
– integral fuel orifice and o-rings **2** are re-installed
– same straight run of pipe **3** remains between the ratio regulator and the burner

Redirecting Piping

To redirect piping, rotate the rear cover plate assembly:



1 Disconnect loading line at ratio regulator.
2 Remove outer bolts **4**.
3 Rotate rear cover plate assembly **5** to desired position.
4 Reinstall outer bolts **4**.

⚠ CAUTION

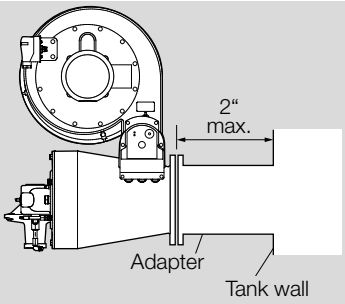
– The rear cover is connected to the combustion housing which slides into the burner housing on the tube mounting end. Be certain the combustion housing seats in the burner housing as indicated by no gap between the rear cover and the housing. Do not use the bolts to seat the cover.

5 Position the ratio regulator with the spring housing in a vertical downward position.
6 Reconnect loading line at ratio regulator. If necessary, connect loading line to the burner pressure tap connection on opposite side of air inlet.

Installation

Dimensions

Bolt the burner to the immersion tank wall or immersion tube flange. For bolt hole patterns, see Technical Information IJ - Dimensions and Specifications.



⚠ CAUTION

– If adapters are used, burner flange should not be spaced farther than 2" from tank wall.

Tank wall

Make sure that the wall of the tank is strong enough to carry the weight of the burner. If necessary, reinforce the tank wall area where you plan to install the burner.

⚠ CAUTION

– Burner body surface temperature near the flange can exceed 200°F (100°C) If an adapter flange is used, higher temperatures may occur. Allow a free, convective flow of air around the burner and do not cover with insulation.

Piping

Install all the piping as shown in the Technical Information IJ - System Design.

Supply Piping

Install the piping using the following steps:

– Locate the valve train close to the burner. The gas must reach the burner during the fixed trial for ignition.
– Sufficiently size shut off valves in the valve train.
– Make sure piping is large enough.
– Minimize piping elbows.

Pipe Connections

– Installation of a pipe union in the gas line is recommended to simplify burner removal.
– Use of flexible pipe is optional.

➔ Flexible pipe causes higher pressure drops than standard pipe. Consider this when sizing your gas lines.

Support the Piping

Use brackets or hangers to support the piping; don’t let burner support the weight of the piping. If you have questions, consult your local gas company.

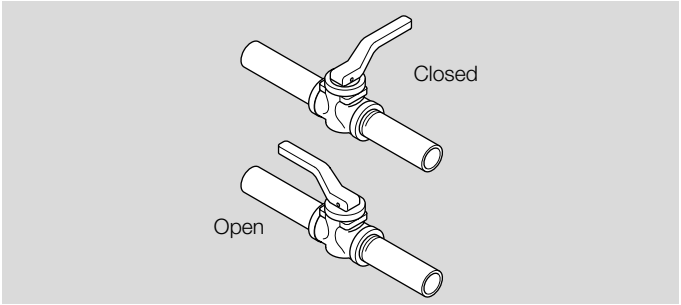
➔ The pressure drop of the gas and the air in the piping is a critical parameter. Make sure that the size of all the piping is large enough to prevent excessive pressure losses. Refer to Eclipse Engineering Guide EFE 825 for details.

Valves

Valve Orientation

Install all the valves in such a way that the arrow (if present) on the valve body points in the direction of flow.

Gas Cocks



Make sure that the handle of a gas cock is at a right angle to the valve body when the valve is in the closed position. This is an important position indicator.

Ratio Regulator

The ratio regulator is installed on the burner at the factory. When mounting the burner, be sure that gas flow through the regulator is horizontal and the spring housing points downward.

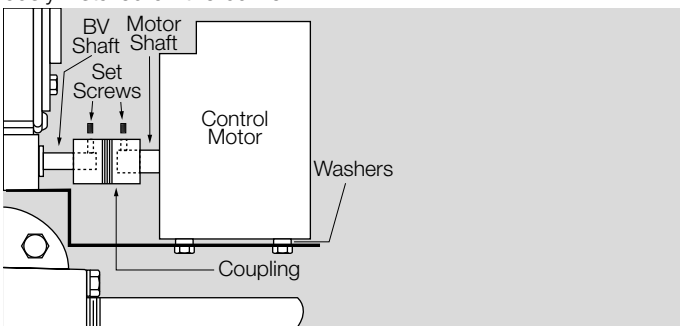
Flame Monitoring Control System

For information, refer to the Bulletins of the flame monitoring control system:

– Veriflame; Bulletin 818
– Multiflame; Bulletin 820
– Bi-Flame; Bulletin 826

Control Motor

Install a control motor to modulate the air butterfly valve if not previously installed on the burner.



➔ Be sure the control motor shaft and air butterfly valve shaft are aligned properly. If using an Eclipse Actuator Mounting Parts Kit, the supplied washers may be used as shims (stacked 0, 1, or 2 high) to ensure proper alignment. Additionally, a flexible coupling can be used to handle minor misalignment.

Checklist after Installation

To verify the system was properly installed, perform the following checks:

1 Be sure there are no leaks in the gas lines.
2 Be sure all the components contained in the flame monitoring and control system are properly installed. This includes verifying that:
– all the switches are installed in the correct locations.
– all wiring, pressure, and impulse lines are properly connected.
3 Be sure all components of the spark ignition system are installed and functioning properly.
4 Be sure the blower rotates in the proper direction. If the rotation is incorrect, have a qualified electrician rewire the blower to rotate in the proper direction.
5 Be sure all valves are installed in the proper location and correctly oriented relative to the flow direction.

ADJUSTMENT, START AND STOP

Introduction

In this chapter, you will find instructions on how to adjust, start, and stop the burner system. Become familiar with burner control methods before attempting to make adjustments.

⚠ DANGER

– The ImmersoJet 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.

Adjustment Procedure

Step 1: Reset the System

1 Set the air pressure switch so that it drops out at 4" w.c. (10 mbar) below the air inlet pressure listed in the Technical Information IJ - Technical Data.
2 Set the low gas pressure switch at 4" w.c. (10 mbar) below the gas pressure measured at the inlet to the main gas valve train.
3 Set the high gas pressure switch at 4" w.c. (10 mbar) above the gas pressure measured at the inlet to the main gas valve train.
4 Close all the burner gas cocks.

⚠ DANGER

– If simulated limits or simulated flame failures do not shut down the fuel system within the required failure response time, immediately correct the problem before proceeding.

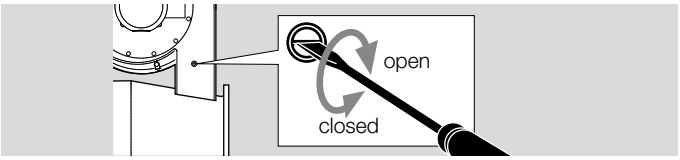
5 Start the combustion air blower.
6 Try to light the burner to be sure that the flame monitoring system indicates a flame failure.
7 Activate pressure switches and other limit interlocks. Make sure that the main gas valve train closes.
8 Adjust main gas inlet pressure to the ratio regulator within the range specified in the Technical Information IJ - Technical Data.

⚠ WARNING

– Gas inlet pressures must stay within the specified range. Pressure above the specified range can damage the ratio regulator.
– Pressure below the specified range can impair the ability of the ratio regulator to control the gas flow.
– Operating the system outside the specified range can cause excess fuel consumption and the possible accumulation of unburned fuel in the tube.
– In extreme cases, this accumulation of unburned fuel may cause fires or explosions.

Step 2: Verify Air Flow

1 With manual and automatic gas valves remaining closed, set the system to high fire. **DO NOT** ignite the burner(s).
➔ The slot on the end of the butterfly valve shaft is parallel to the plane of the butterfly. This can be used as a visual indication of valve position.
2 Start the combustion air blower.
3 Use the data from the Technical Information IJ - Technical Data to find the static air pressure at high fire. This is now the target value for high fire.
➔ Tube back pressure may limit the burner from reaching the Technical Information value.



➔ A pressure tap is open when the screw inside the tap is unscrewed approximately half a turn.

1 Make sure that pressure tap is open.

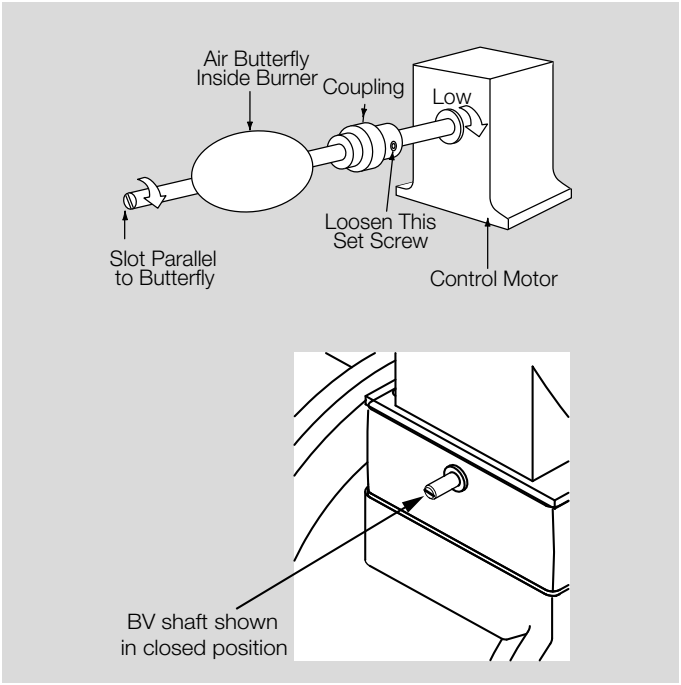
2 Connect the manometer to the tap

3 Verify target value from step 3 above.

Packaged Blower: Verify that the slot on the end of the butterfly valve shaft (if applicable) is parallel to flow (fully open). If necessary, adjust the control motor travel for high fire.

Remote Blower: Adjust the manual butterfly valve to achieve the target value.

Step 3: Set Low Fire Air



1 Start combustion air blower.

2 Drive control motor to low fire position.

3 Set low fire air.

Packaged Blower

a Loosen the set screw on burner side of coupling.

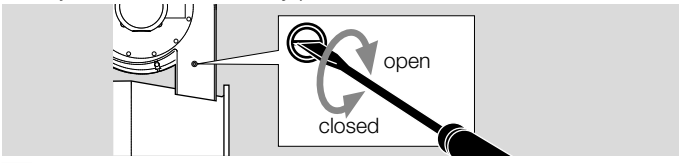
➔ The BV is closed when the shaft slot is perpendicular to the direction of air flow through the BV.

b Rotate air BV shaft to fully closed position. (Holes in BV damper will supply low fire air.)

c Hold BV shaft firmly in place and tighten set screw.

Remote Blower

a Adjust automatic butterfly position for low fire air.



4 Check the pressure at tap. It should be 0.1" w.c. to 0.4" w.c. The low fire butterfly valve position can be adjusted to change the pressure.

➔ The pressure at the tap without the blower on is a pressure that must be overcome to ignite the burner. The pressure measured in step four should be approximately two times higher.

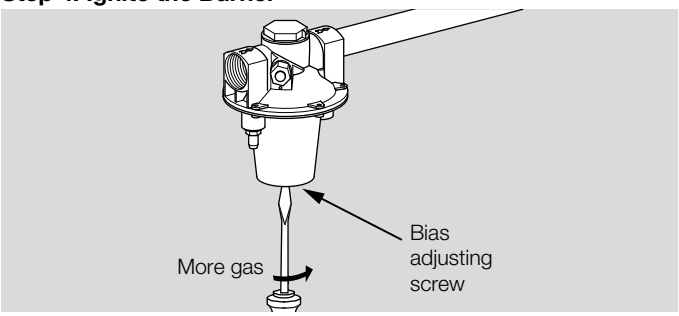
5 Cycle the control motor several times, checking high and low fire positions. If they don't repeat, check for a loose valve shaft coupling or binding of the motor or valve.

6 Close the pressure taps.

⚠ WARNING

– This procedure is written with the assumption the burner has a flame monitoring control system installed and operating. A proper purge cycle must be part of the system and purge timing should not be bypassed.

Step 4: Ignite the Burner



1 Drive the air butterfly valve to low fire.

2 Be sure combustion air blower is running.

3 Open main gas manual shut off valves.

4 Set system control to stay at low fire during and after ignition sequence.

5 Attempt to ignite burner.

6 If burner does not ignite:

a Attempt to ignite burner again to purge air from the gas piping.

b If burner still does not ignite, turn bias adjusting screw a half turn to increase gas flow.

c Attempt to ignite burner.

d Repeat steps b and c until burner ignites. If necessary, refer to page 11 (Assistance in the event of malfunction).

7 Flame signal strength: Adjust gas flow with bias adjusting screw for lowest gas flow that maintains a stable flame signal and provides reliable ignition.

➔ If viewing the flame, it should be blue with flashes of yellow. When firing propane or butane, a proper low fire flame may have sustained flashes of yellow.

8 Verify low fire flame:

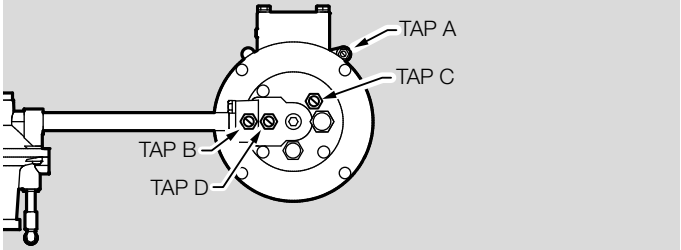
a Shut off gas. Allow process to cool.

b Verify repeatability of ignition and low fire flame signal at cold conditions.

Step 5: Verify Settings

1 With burner lit, go to high fire. Make sure the burner stays lit.

2 Wait for the process to reach normal operating conditions.



3 Measure high fire fuel differential pressure between tap "D" and tap "B". Compare this to the "Fuel Orifice Δp vs. Input" graph in the Technical Information IJ - Gas and air orifices for your burner.

➔ Adjustment of the control motor to set high fire gas to the desired input /efficiency calculated for your process may be necessary.

4 Measure high fire air Δp between tap "A" and tap "C". Compare this pressure to the Technical Information IJ - Gas and air orifices for your burner. Check O_2 levels at maximum burner input. O_2 levels should be between 2.5 and 5%.

5 Go to low fire and verify low fire flame signal and flame appearance (if viewing).

➔ Gas pressure at low fire will be too low to measure and verify the fuel settings.

6 Cycle burner from high to low several times to check repeatability of settings.

7 Readjust burner if the settings do not repeat as expected. If necessary, refer to page 11 (Assistance in the event of malfunction).

8 Record all setup data as an aid for future troubleshooting and setup operations.

⚠ CAUTION

– Do not turn the combustion air blower off immediately.
– Allow time for the process to cool. This will prevent hot gases from flowing back into the burner and blower causing damage to the burner.

9 Stop the burner.

MAINTENANCE AND TROUBLESHOOTING

Introduction

This section is divided into two parts:

1 The first part describes the maintenance procedures.

2 The second part helps identify problems that may occur, and gives advice on how to solve these problems.

Maintenance

Preventive maintenance is the key to a reliable, safe and efficient system. The core of any preventive maintenance program is a list of periodic tasks. Following are suggestions for a monthly list and a yearly list.

➔ The monthly list and the yearly list are an average interval. If your environment is dirty, then the intervals may be shorter. Other standards may take precedence for your particular application.

Monthly Checklist

– Inspect flame-sensing and ignition devices for good condition and cleanliness.
– Test all the alarm systems for proper signals.
– Check valve motors and control valves for free, smooth action and adjustment.
– Test the interlock sequence of all safety equipment; manually make each interlock fail, noting that related equipment closes or stops as specified by the manufacturer.
– Test main fuel hand-valves for operation.
– Clean or replace the combustion air blower filter

Yearly Checklist

Perform all monthly checklists plus:

– Leak test shut-off valves for tightness of closure.
– Inspect loading lines for leaks.
– Make sure that the following components are not damaged or distorted:
  - the burner nozzle
  - the spark plug
  - the flame sensor
– Inspect the immersion tube for leaks and excessive corrosion.

Assistance in the event of malfunction

Explanation of symbols

? = Problem

! = Possible Cause
• = Solution

? Cannot initiate start sequence

! Main power is off
• Make sure power is on to control system

! No power to control
• Call qualified electrician to investigate

! Air pressure switch has not made contact
• Check air-pressure switch adjustment
• Check air filter
• Check blower rotation
• Check outlet pressure from blower
• Check tubing and electrical connections to pressure switches

! High gas pressure switch has tripped
• Check incoming gas pressure
  Adjust gas pressure if necessary
• Check pressure switch setting and operation

! Low gas pressure switch has activated
• Check incoming gas pressure
  Adjust gas pressure if necessary
• Check pressure switch setting and operation

! Malfunction of flame monitoring control system such as shorted out flame sensor or electrical noise in the sensor line
• Have a qualified electrician investigate and rectify

! Purge cycle not completed
• Check flame monitoring control system, purge timer, interlocks and limit switches

? Start-up sequence runs but burner does not light

! No ignition: There is no power to the ignition transformer
• Restore power to the ignition transformer
• Check flame monitor control

! No ignition: Open circuit between the ignition transformer and the spark plug
• Repair or replace the wiring and connectors to the spark plug
• Check ground connection to the transformer

! No ignition: The spark plug needs cleaning
• Clean the spark plug

! No ignition: The spark plug is not correctly grounded to the burner
• Clean the threads of the spark plug and the burner
• Do not apply grease to the thread of the spark plug

! Too much gas: Wrong orifice or no orifice installed or wrong nozzle
• Check orifice size for fuel type
• Check nozzle number for fuel type

! Too much gas: Damaged ratio regulator
• Replace ratio regulator

! Too much gas: Gas pressure out of the main gas pressure regulator is too high
• Adjust main gas regulator
  If necessary, remove regulator and investigate

! Not enough gas: Gas valve not open
• Check all manual valves
• Check wiring to automatic gas shut-off valve

! Not enough gas: Start gas solenoid valve does not open
• Check solenoid valve coil for proper operation. Replace if necessary

! Not enough gas: Air in the gas line
• Open gas cock
• Purge gas line

! Not enough gas: Damaged or missing ratio regulator loading line
• Inspect and replace as required

! Not enough gas: Damaged ratio regulator
• Inspect and replace as required

! Not enough gas: Improper orifice
• Check orifice size for fuel type

! Not enough gas: The gas pressure out of the main gas pressure regulator is too low
• Adjust main gas regulator
• If necessary, remove regulator and investigate

! Not enough gas: Wrong nozzle for fuel type
- Check nozzle number for fuel type

? The low fire flame is weak or unstable

! Low fire adjusted too low
- Increase low fire gas setting

! Not enough gas
- Check gas adjustment and modify to increase gas flow

! Not enough air
- Check air adjustment
- Investigate any change, i.e. blocked filter, loose connections

? The burner goes off when it cycles to high fire

! Insufficient air (flame too rich)
- Check air adjustment
- Check air filter, clean or replace if required
- Check ratio regulator and loading line

! Insufficient gas
- Check ratio regulator and loading line
- Check main gas regulator

? The burner is erratic and does not respond to adjustment

! Flame signal weak
- Check condition of flame monitoring device

! Internal damage to the burner. Some parts inside the burner may be loose or dirty
- Contact your Eclipse Combustion representative or the Eclipse factory

? The burner is unstable or produces soot or smoke

! The air/gas ratio is out of adjustment
- Check adjustments, ratio regulator and loading lines

? Burner cannot achieve full capacity

! Air filter is blocked
- Clean or replace the air filter

! Gas pressure is too low into the main gas pressure regulator
- Adjust gas pressure

! Increased tube pressures
- Check for blockage

! Poor piping practices
- Contact factory

CONVERTING UNITS

See www.adlatus.org

TECHNICAL DATA

Blower size
CO Emissions: <100 ppm
Piping: NPT or BSP
Flame Detection: Flamerod or UV Scanner
Fuel: Natural Gas, Propane, Butane
For any other mixed gas, contact Eclipse. Different fuels require different nozzles and orifices. See Design Guide 330 for more information about typical fuel composition and properties.

Low Pressure Packaged Blower

Model	Maximum Input BTU/h (kW)	Minimum Input BTU/h (kW)	Air Inlet Pressure "w.c. (mbar) @ Max Input Air pressure at burner inlet (Tap "A")	Blower Motor Hp (kW)	Main Gas Pressure Supplied to Regulator "w.c. (mbar)	Backpressure "w.c. (mbar)	Weight lbs (kg)
IJ-2	190,000 (55.6)	25,000 (7.3)	7.4 (18.4)	0.25 (0.2)	12.0 - 27.7 (29.9 - 68.9)	1.0 (2.5)	70 (31.8)
IJ-3	440,000 (129)	28,000 (8.2)	7.7 (19.1)	0.33 (0.3)	14.0 - 27.7 (34.9 - 68.9)	1.6 (3.9)	95 (43)
IJ-4	830,000 (243.3)	100,000 (29.3)	7.8 (19.4)	0.5 (0.37)	10 - 125 (24.9 - 311.4)	2.0 (4.9)	115 (52)
IJ-6	2,000,000 (586.1)	300,000 (87.9)	9.0 (22.4)	1.5 (1.1)	16 - 125 (39.9 - 311.4)	2.6 (6.5)	275 (125)

High Pressure Packaged Blower

Model	Maximum Input BTU/h (kW)	Minimum Input BTU/h (kW)	Air Inlet Pressure "w.c. (mbar) @ Max Input Air pressure at burner inlet (Tap "A")	Blower Motor Hp (kW)	Main Gas Pressure Supplied to Regulator "w.c. (mbar)	Backpressure "w.c. (mbar)	Weight lbs (kg)
IJ-2	235,000 (68.9)	25,000 (7.3)	10.8 (26.8)	0.33 (0.3)	13.0 - 27.7 (32.3 - 68.9)	1.5 (3.7)	75 (34.0)
IJ-3	550,000 (161)	28,000 (8.2)	11.5 (28.6)	0.5 (0.4)	14.0 - 27.7 (34.8 - 68.9)	2.6 (6.4)	100 (45)
IJ-4	1,000,000 (293.1)	100,000 (29.3)	10.5 (26.2)	1.0 (0.75)	13 - 125 (32.4 - 311.4)	3.8 (9.5)	120 (54)
IJ-6	2,500,000 (732.7)	300,000 (87.9)	14.4 (35.8)	3.0 (2.2)	21 - 125 (52.3 - 311.4)	4.0 (9.9)	290 (131)

Packaged Blower

Model	Maximum Input BTU/h (kW)	Minimum Input BTU/h (kW)	Air Inlet Pressure "w.c. (mbar) @ Max Input Air pressure at burner inlet (Tap "A")	Blower Motor Hp (kW)	Main Gas Pressure Supplied to Regulator "w.c. (mbar)	Backpressure "w.c. (mbar)	Weight lbs (kg)
IJ-8	3,500,000 (1024.8)	300,000 (87.9)	16.5 (41.1)	3.0 (2.2)	21 - 125 (52.3 - 311.4)	2.0 (4.9)	290 (131)

Remote Blower

Model	Maximum Input BTU/h (kW)	Minimum Input BTU/h (kW)	Air Inlet Pressure "w.c. (mbar) @ Max Input Air pressure at burner inlet (Tap "A")	Blower Motor Hp (kW)	Main Gas Pressure Supplied to Regulator "w.c. (mbar)	Backpressure "w.c. (mbar)	Weight lbs (kg)
IJ-2	370,000 (108,4) Butane & Propane 340,000 (100) Natural Gas	25,000 (7.3)	26.5 (65.9)	As Specified	27.0 - 27.7 (67.2 - 68.9)	3.7 (9.2)	45 (20.0)
IJ-3	850,000 (249)	28,000 (8.2)	26.0 (64.7)	As Specified	27.0 - 27.7 (67.2 - 68.9)	6.1 (15.1)	60 (27)
IJ-4	1,800,000 (527.5)	100,000 (29.3)	33 (82.2)	As Specified	34 - 125 (84.7 - 311.4)	12.2 (30.4)	75 (34)
IJ-6	3,600,000 (1055.1)	300,000 (87.9)	30.0 (74.7)	As Specified	41 - 125 (102.1 - 311.4)	8.3 (20.6)	185 (84)
IJ-8	4,800,000 (1405.5)	300,000 (87.9)	19.5 (48.6)	As Specified	28 - 128 (69.8 - 318.8)	3.8 (9.5)	185 (84)

All information is based on laboratory testing with a tube effective length of 21.6 feet (6.58 m). Different tube sizes and conditions may affect the data.

All information is based on standard tube design. Changes in the tube will alter performance and pressures.

All inputs based upon gross calorific values (HHV).

Eclipse reserves the right to change the construction and/or configuration of our products at any time without being obliged to adjust earlier supplies accordingly.

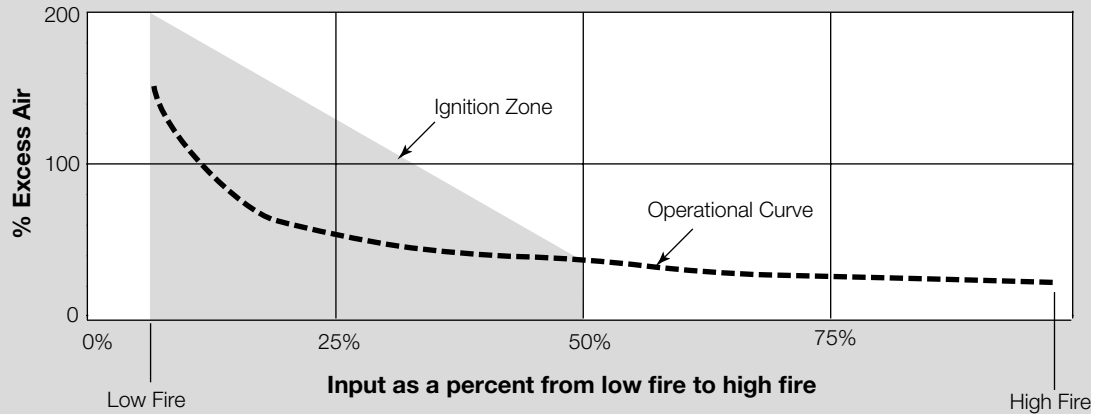
Plumbing of air and gas will affect accuracy of orifice readings. All information is based on generally acceptable air and gas piping practices.

Packaged blower performance data based on 60 Hz.

Performance Graphs

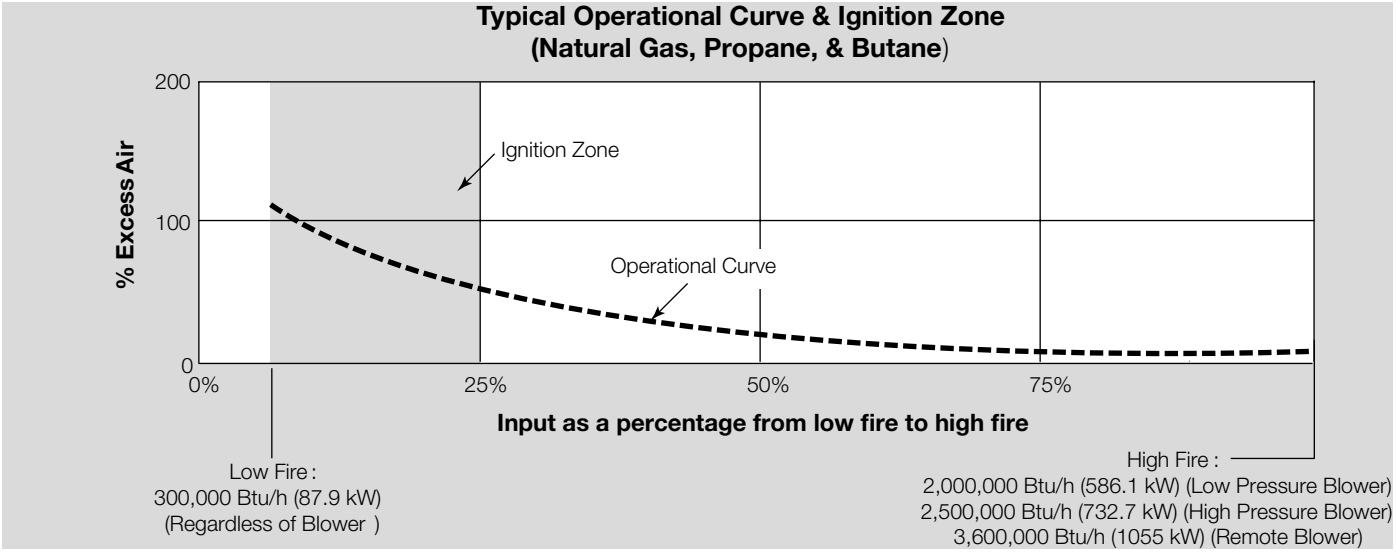
IJ-2, IJ-3, IJ-4

Typical Operational Curve & Ignition Zone (Natural Gas, Propane, & Butane)

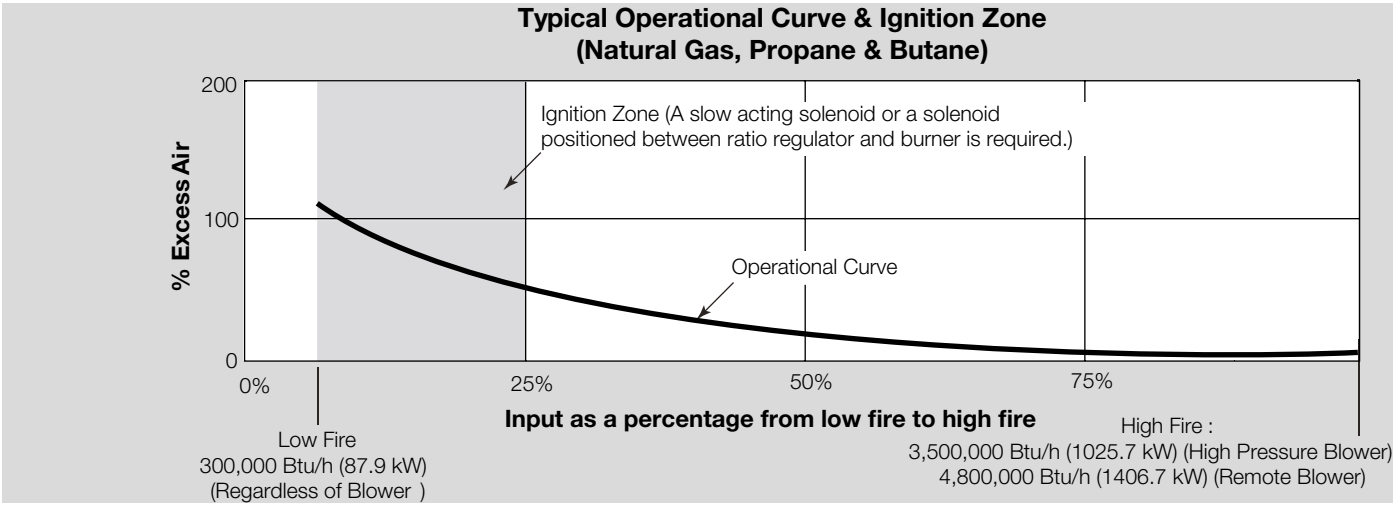


Model	Low Fire (Regardless of Blower)	High Fire
IJ-2	25,000 BTU/hr (8,2 kW)	190,000 BTU/hr (55,7 kW) (6" w.c. Blower) 235,000 BTU/hr (68,9 kW) (10" w.c. Blower) 340,000 BTU/hr (100 kW) (Remote Blower) (Natural Gas) 370,000 BTU/hr (108,4 kW) (Remote Blower) (Butane & Propane)
IJ-3	28,000 BTU/hr (8.2 kW)	440,000 BTU/hr (128.9 kW) (6" w.c. Blower) 550,000 BTU/hr (161.2 kW) (10" w.c. Blower) 850,000 BTU/hr (249.1 kW) (Remote Blower)
IJ-4	100,000 BTU/hr (29.31 kW)	830,000 BTU/hr (243.25 kW) (6" w.c. Blower) 1,000,000 BTU/hr (293.07 kW) (10" w.c. Blower) 1,800,000 BTU/hr (527.53 kW) (Remote Blower)

IJ-6

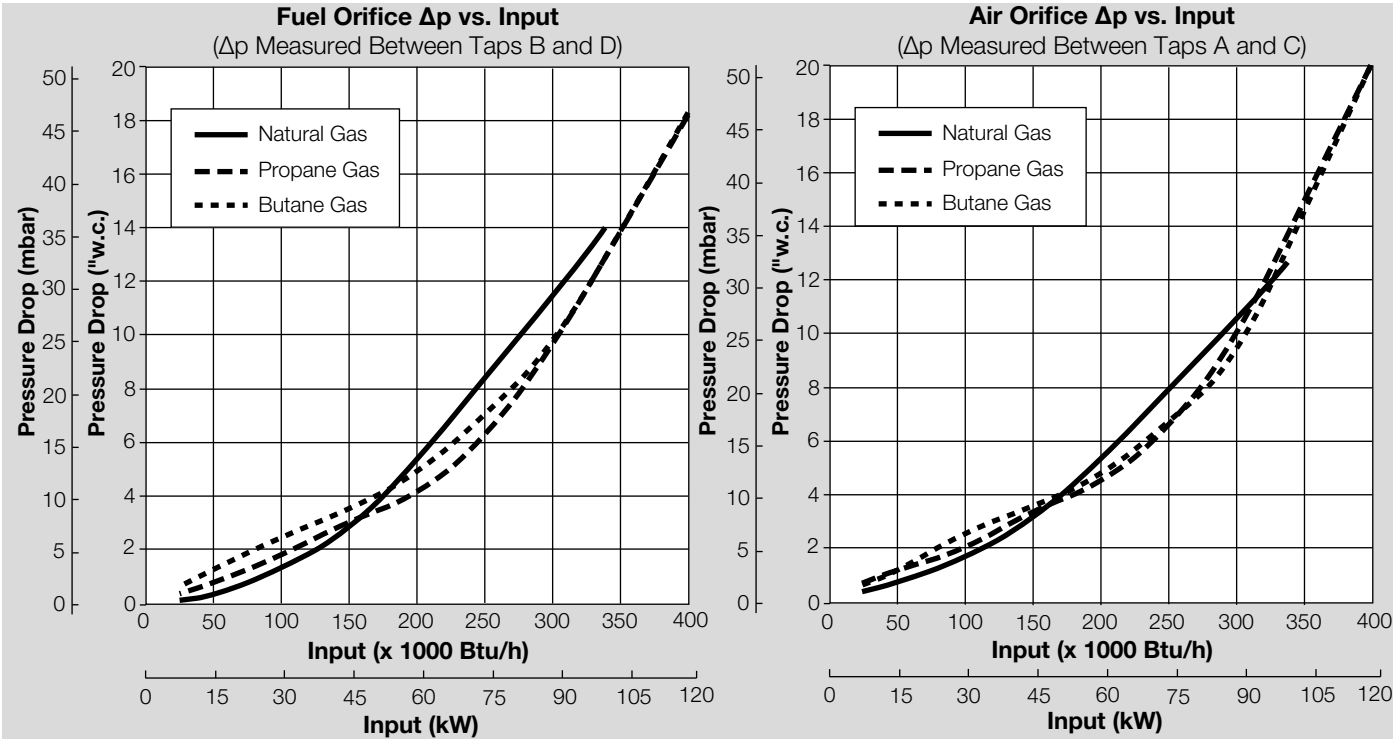


IJ-8

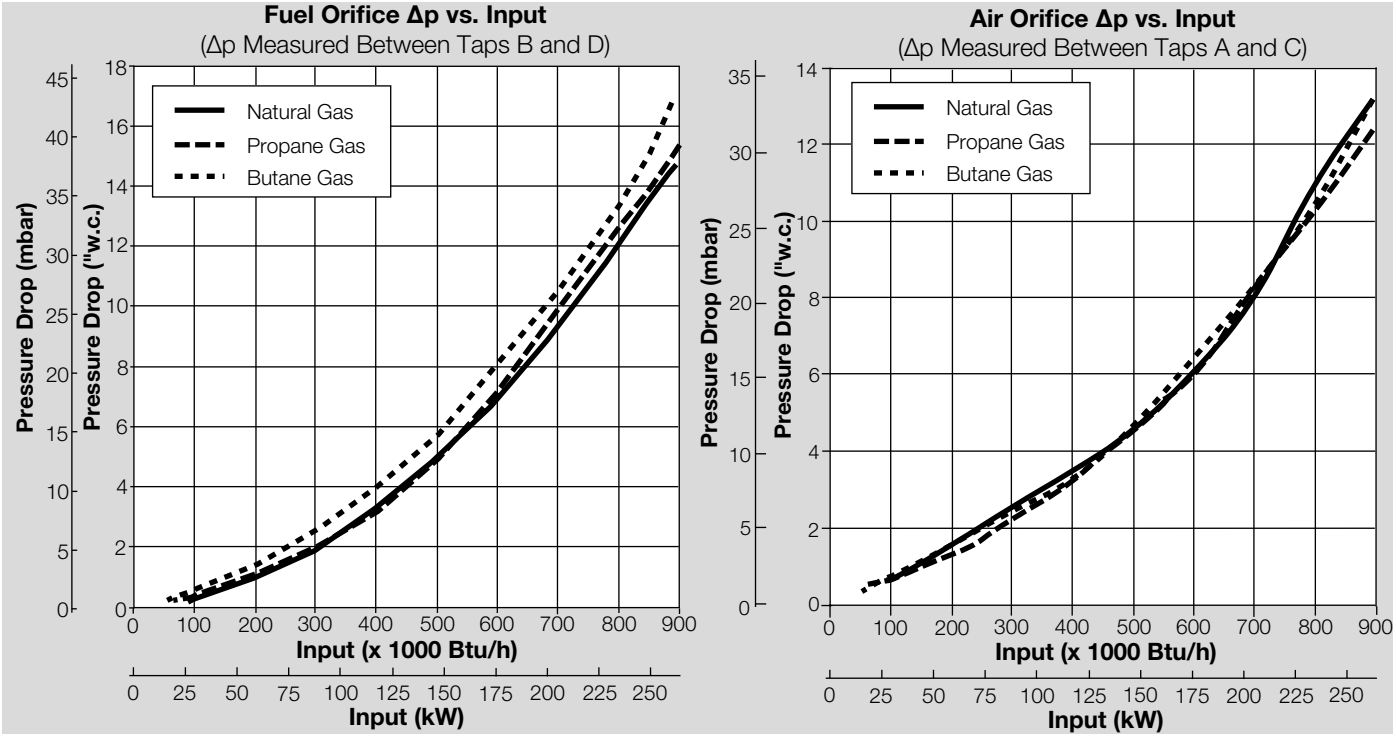


Gas and air orifices

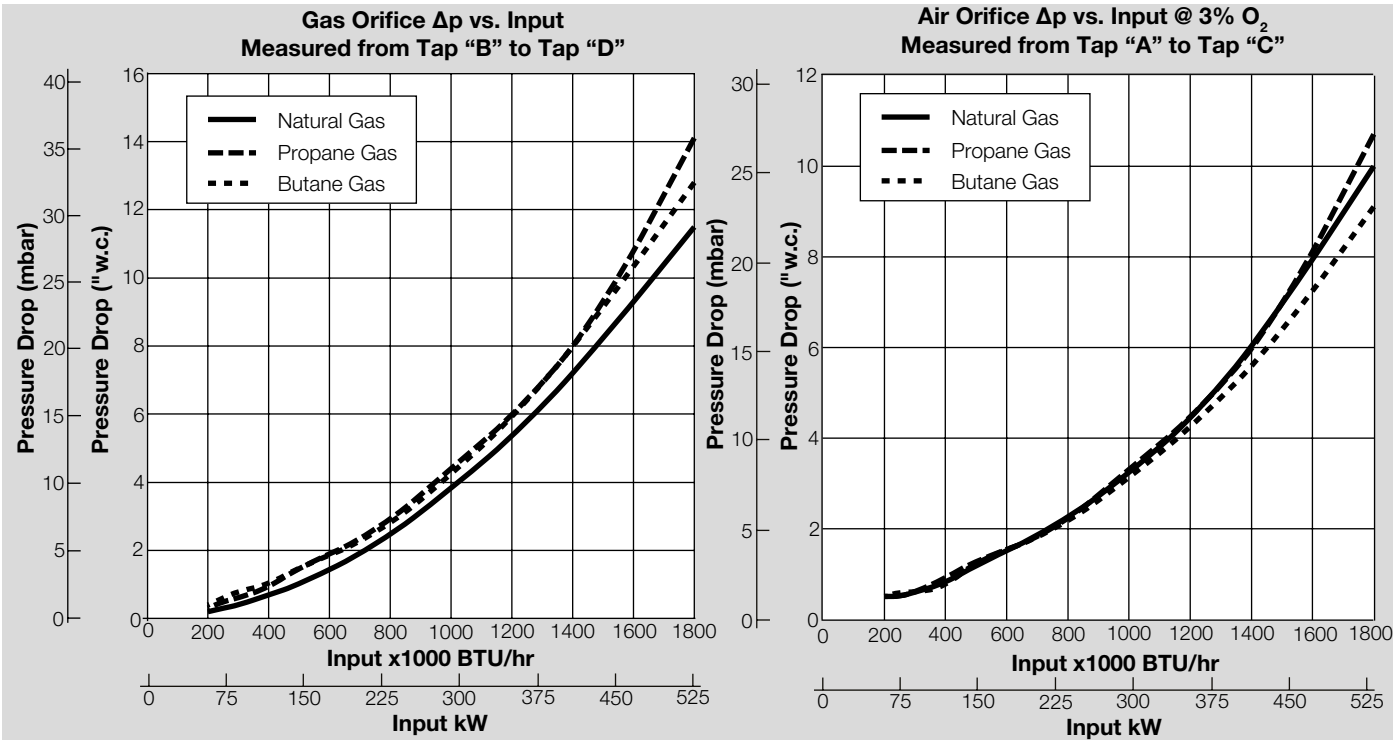
IJ-2



IJ-3

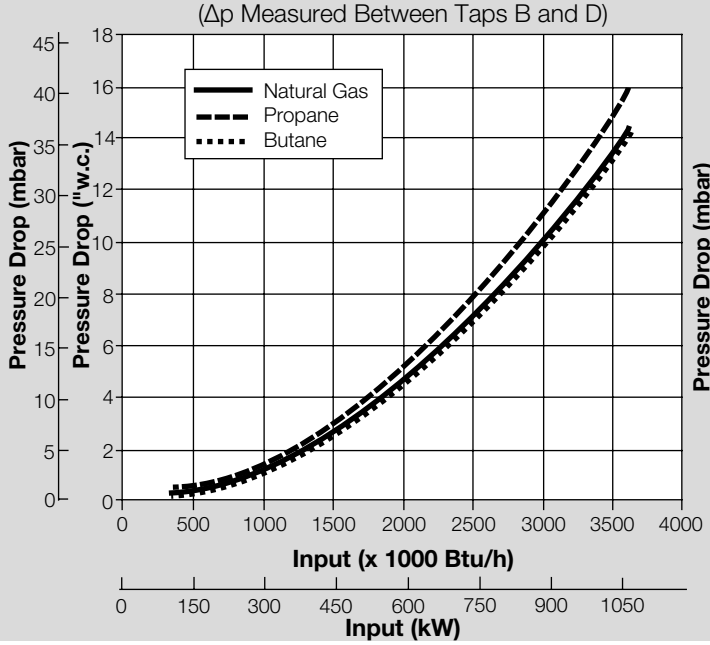

Fuel Orifice Δp vs. Input
(Δp Measured Between Taps B and D)
Natural Gas
Propane Gas
Butane Gas
Pressure Drop (mbar)
Pressure Drop ("w.c.)
Input (x 1000 Btu/h)
Input (kW)
Air Orifice Δp vs. Input
(Δp Measured Between Taps A and C)
Natural Gas
Propane Gas
Butane Gas
Pressure Drop (mbar)
Pressure Drop ("w.c.)
Input (x 1000 Btu/h)
Input (kW)

IJ-4

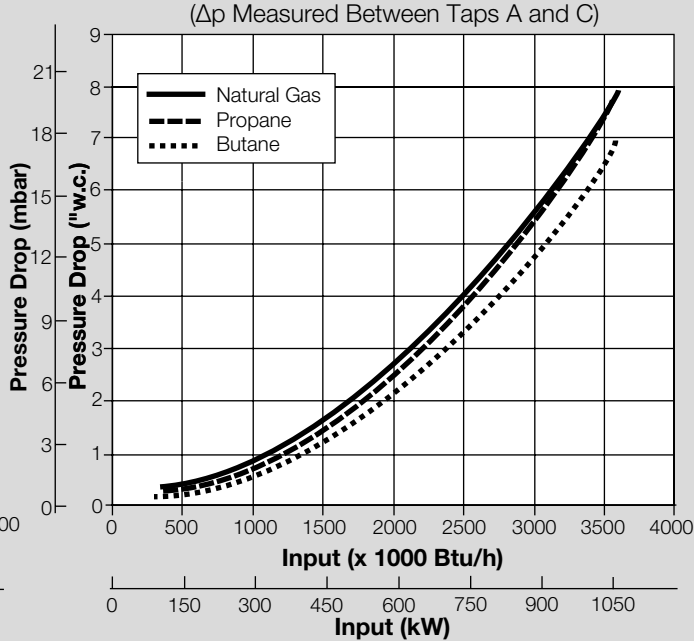

Gas Orifice Δp vs. Input
Measured from Tap "B" to Tap "D"
Natural Gas
Propane Gas
Butane Gas
Pressure Drop (mbar)
Pressure Drop ("w.c.)
Input x1000 BTU/hr
Input kW
Air Orifice Δp vs. Input @ 3% O2
Measured from Tap "A" to Tap "C"
Natural Gas
Propane Gas
Butane Gas
Pressure Drop (mbar)
Pressure Drop ("w.c.)
Input x1000 BTU/hr
Input kW

IJ-6

Fuel Orifice Δp vs. Input
(Δp Measured Between Taps B and D)

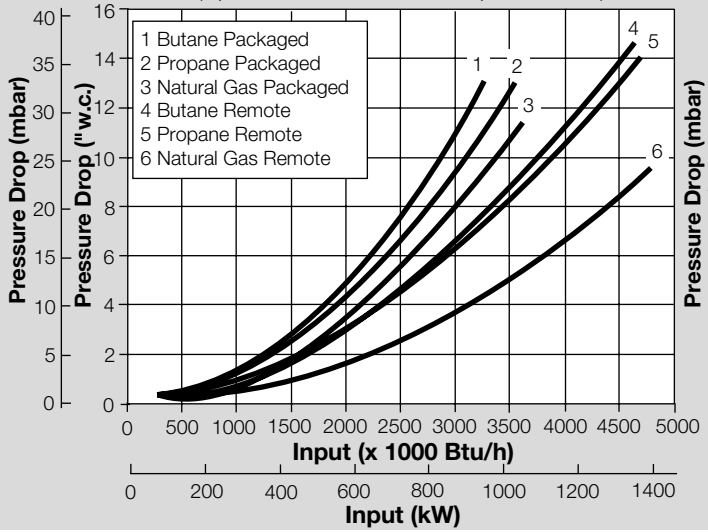


Air Orifice Δp vs. Input
(Δp Measured Between Taps A and C)

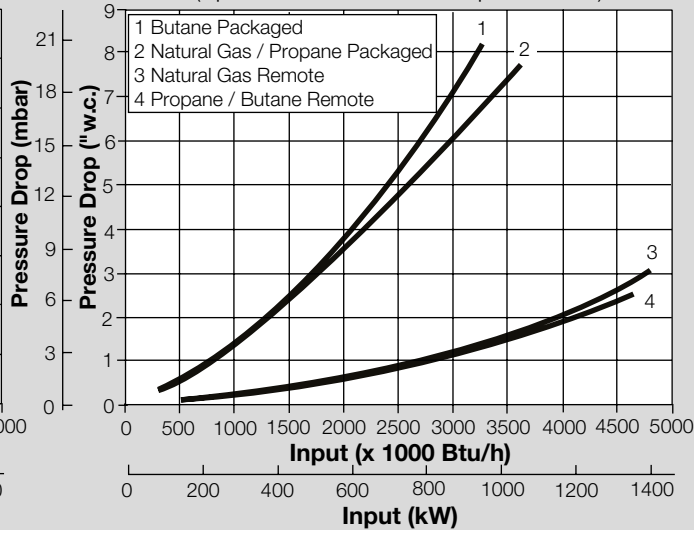


IJ-8

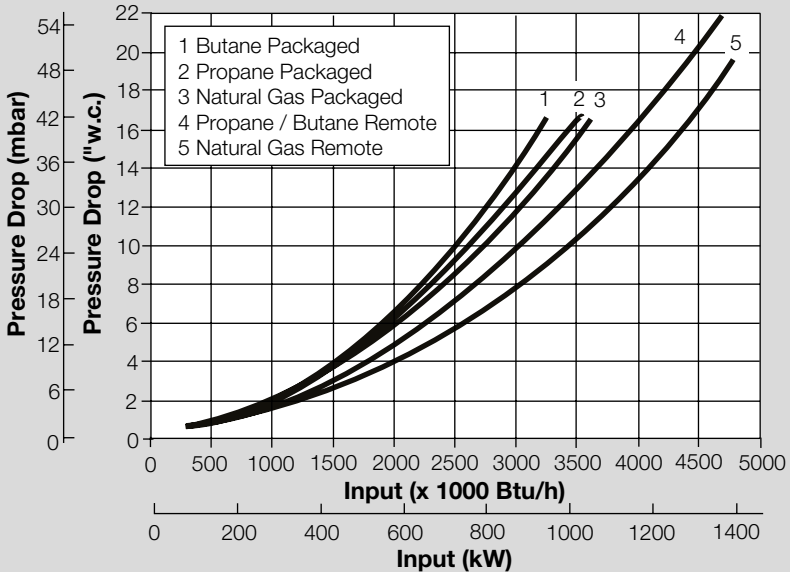
Fuel Orifice Δp vs. Input
(Δp Measured Between Taps B and D)



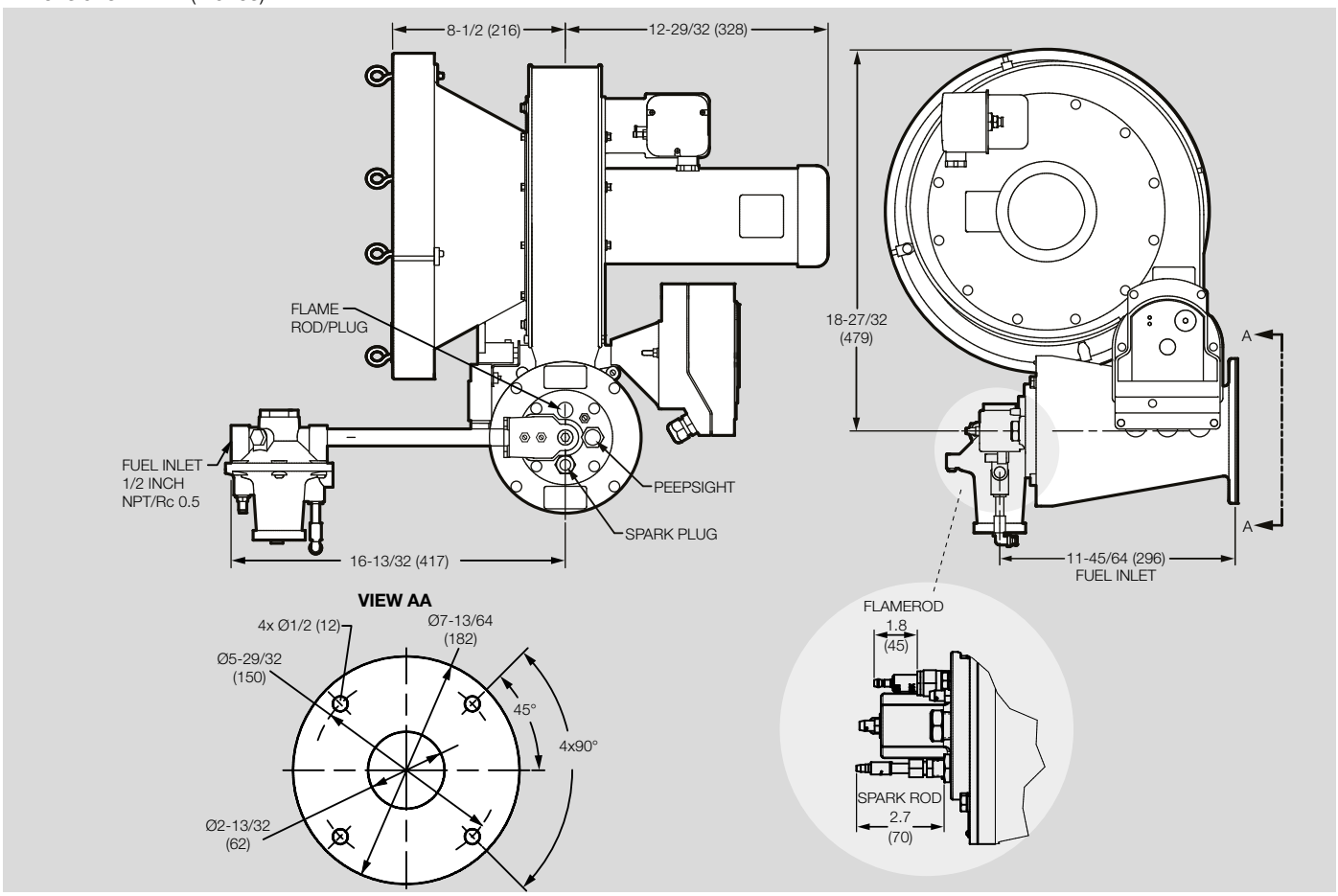
Air Orifice Δp vs. Input
(Δp Measured Between Taps A and C)

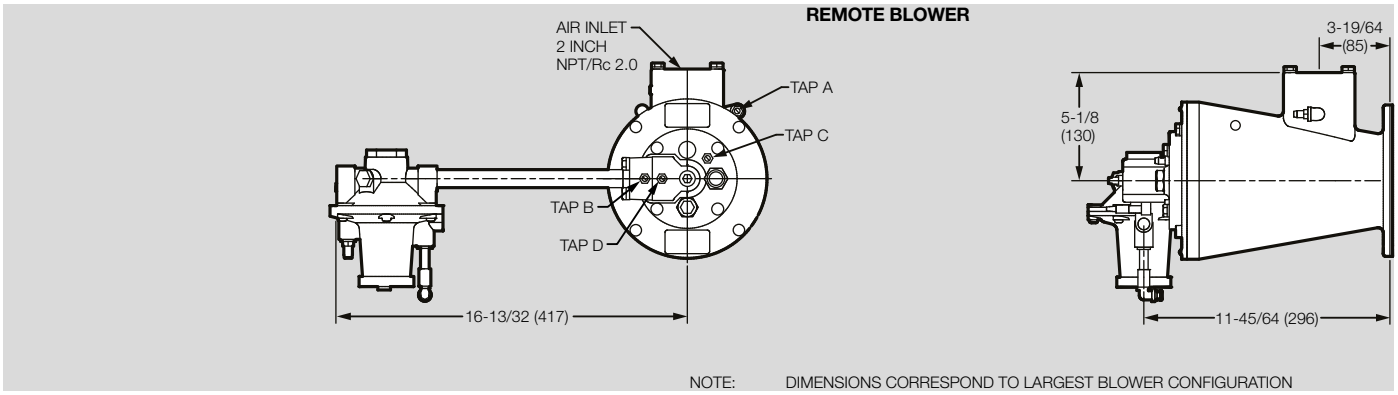


Loading Line Pressure vs. Input
Measured at Tap "A"



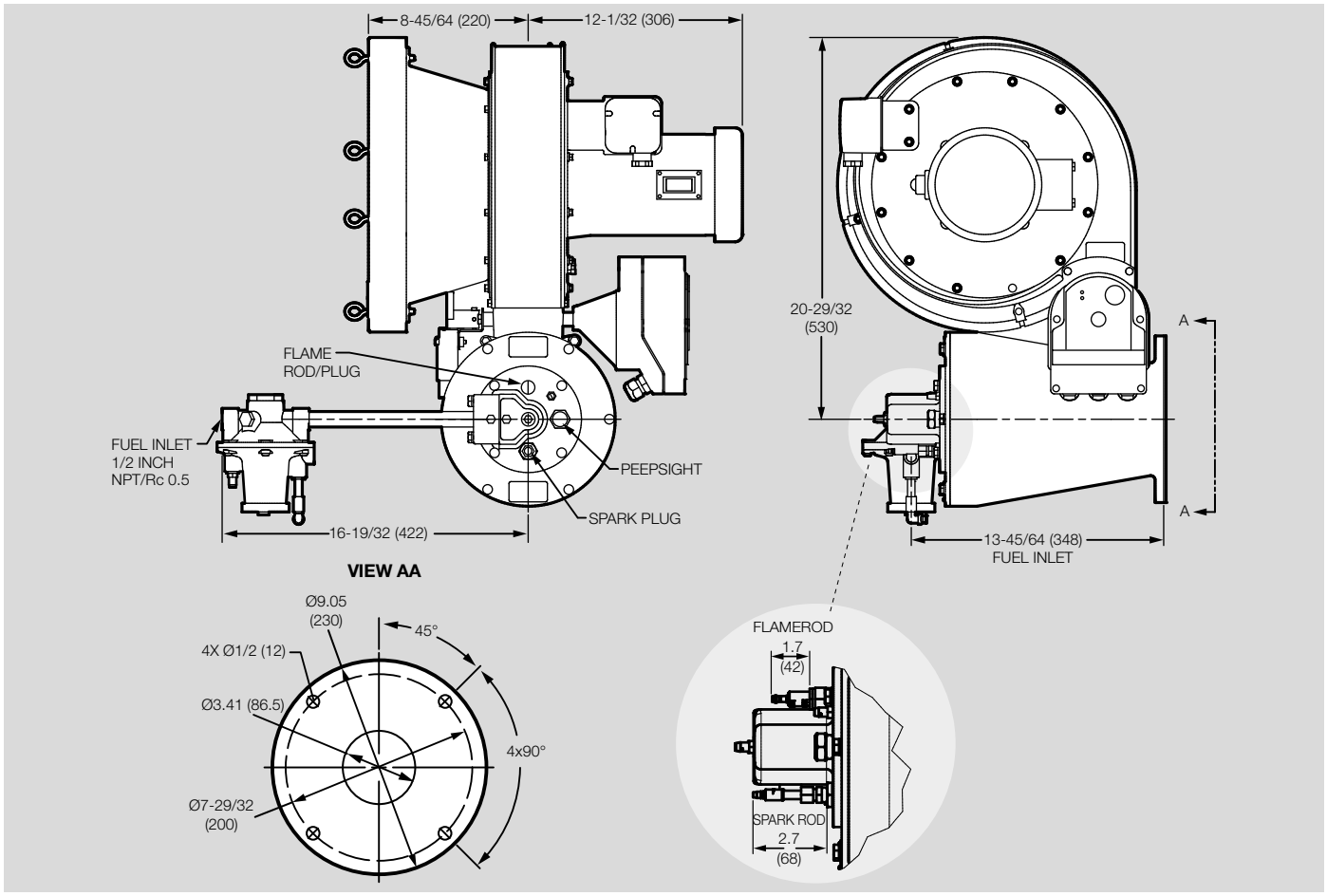
Dimensions in mm (Inches)

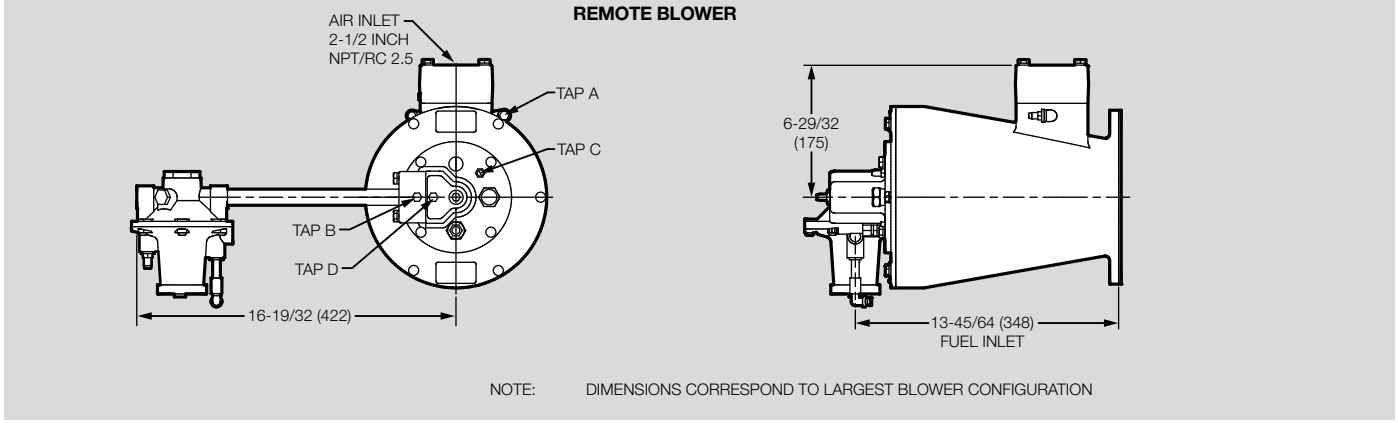




NOTE: DIMENSIONS CORRESPOND TO LARGEST BLOWER CONFIGURATION

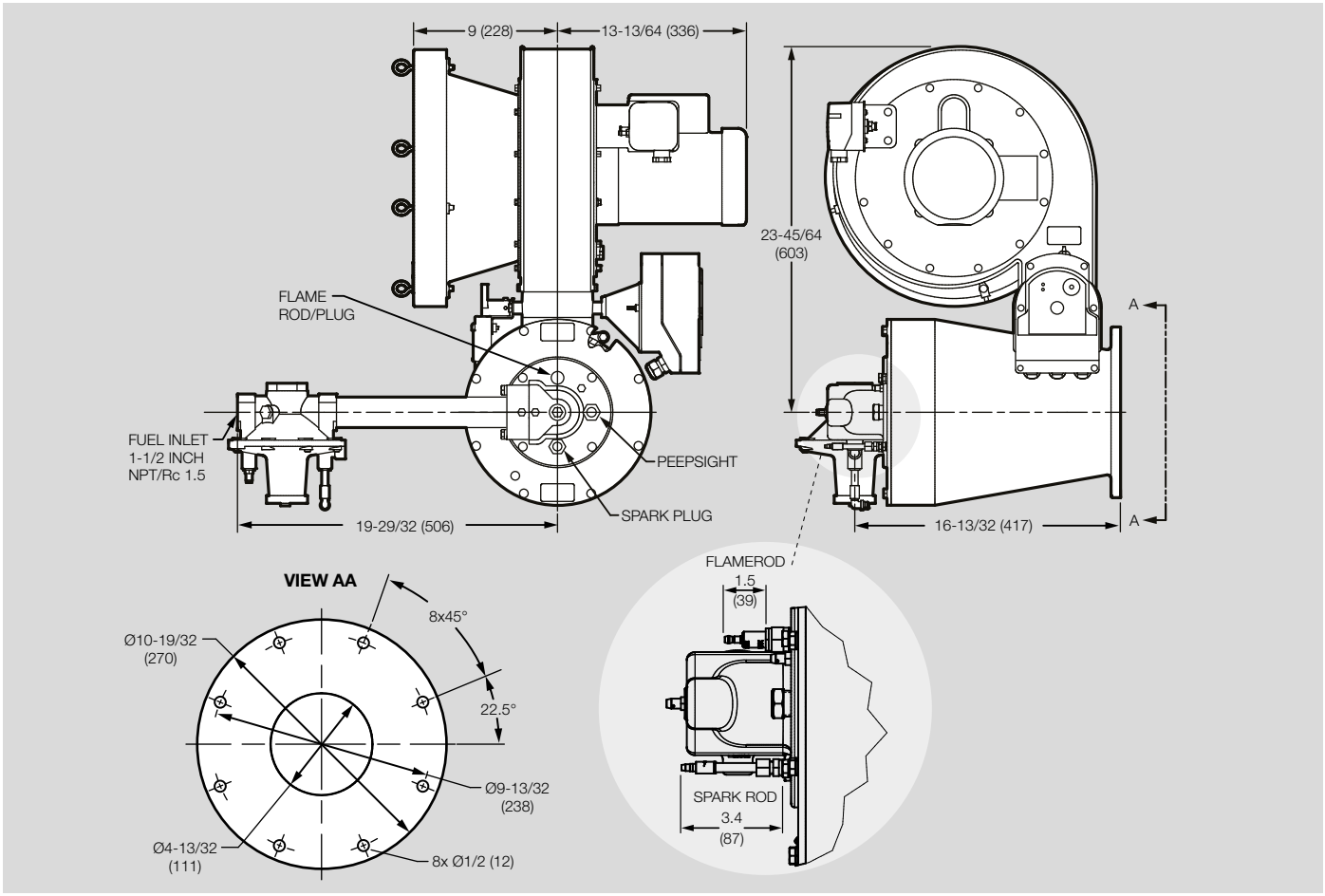
IJ-3

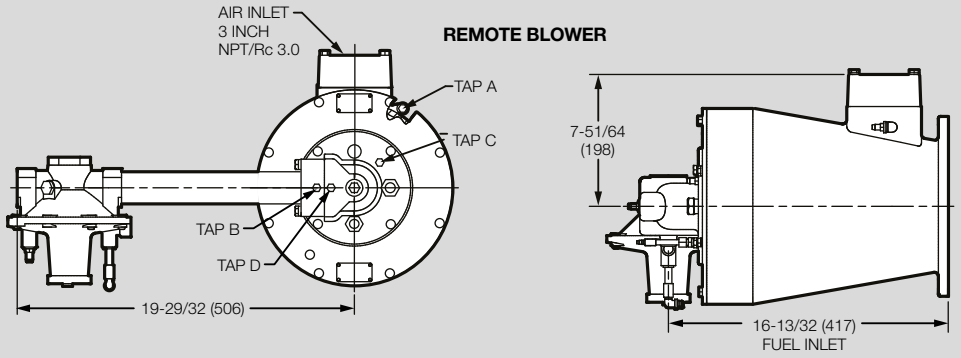




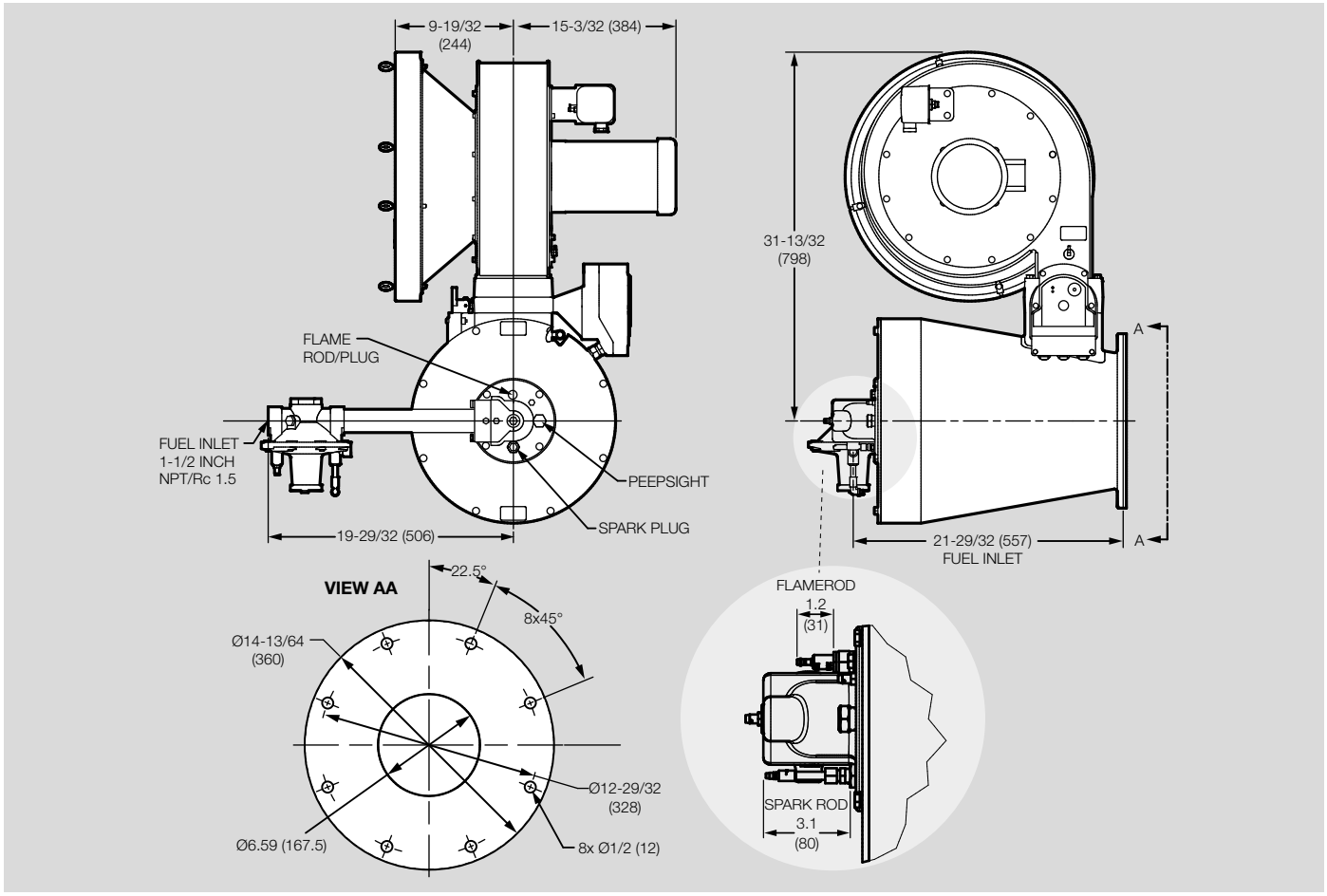
NOTE: DIMENSIONS CORRESPOND TO LARGEST BLOWER CONFIGURATION

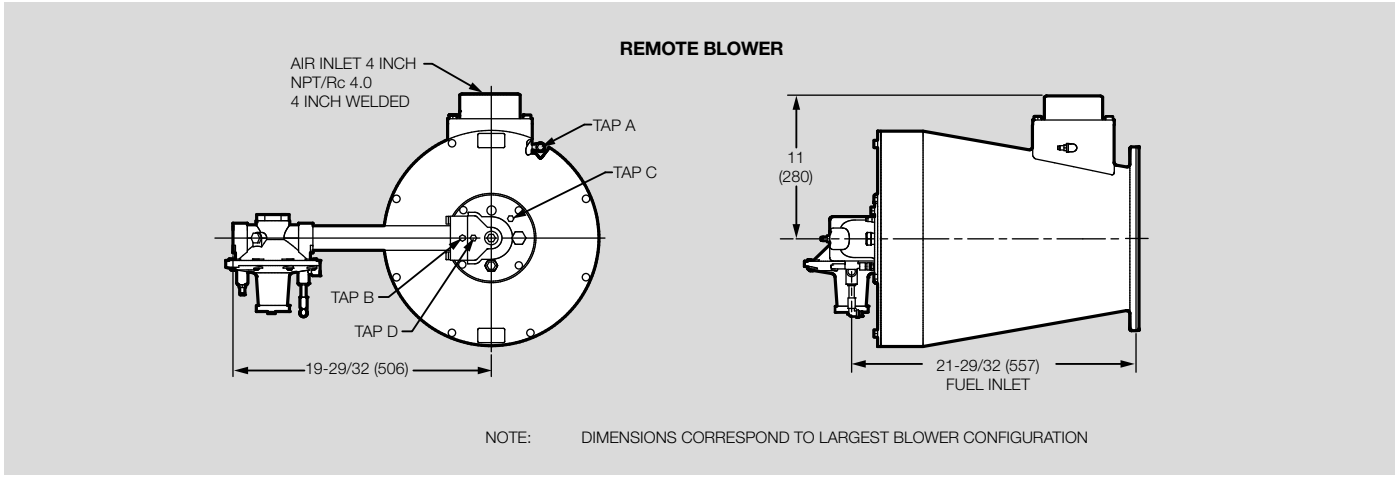
IJ-4



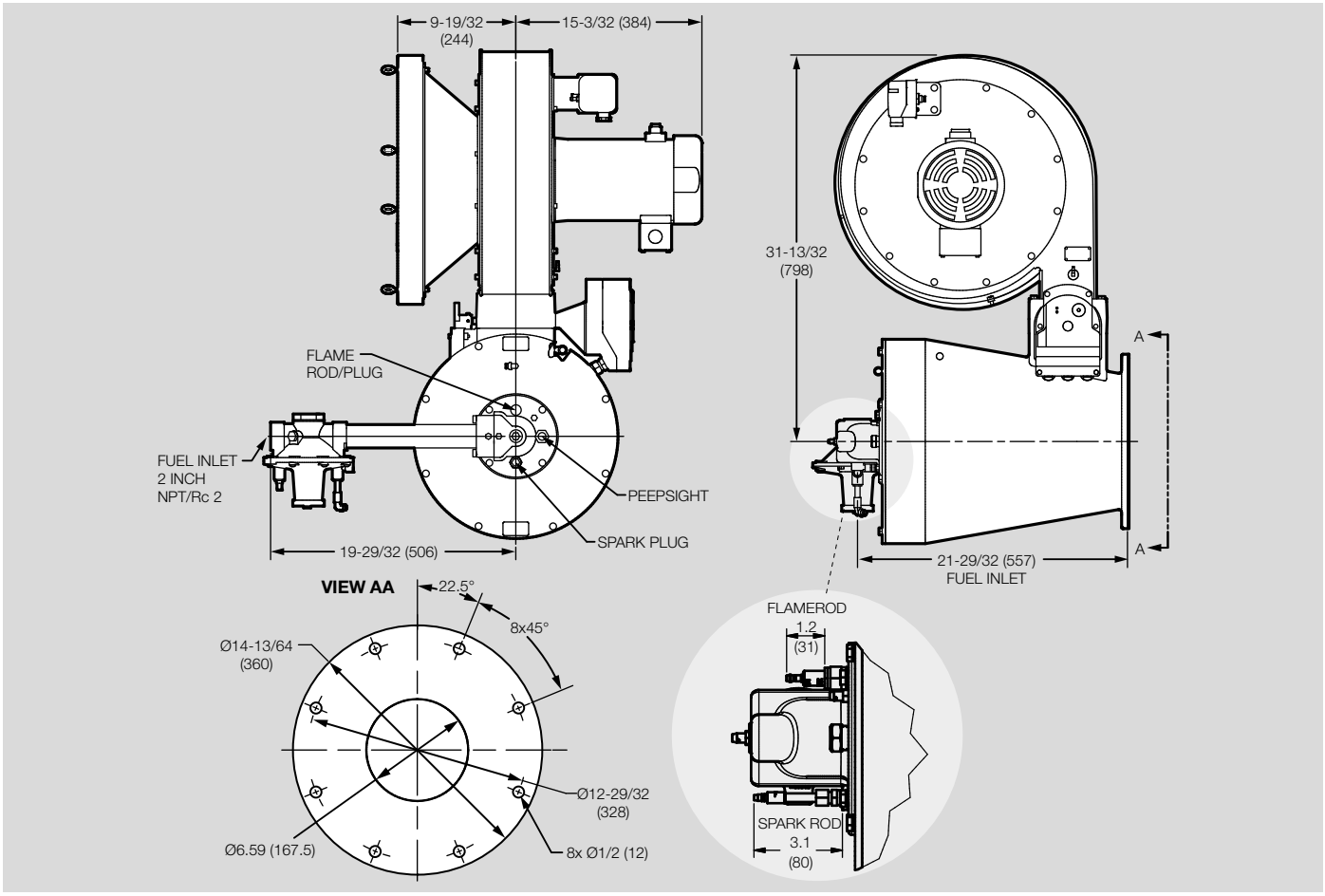


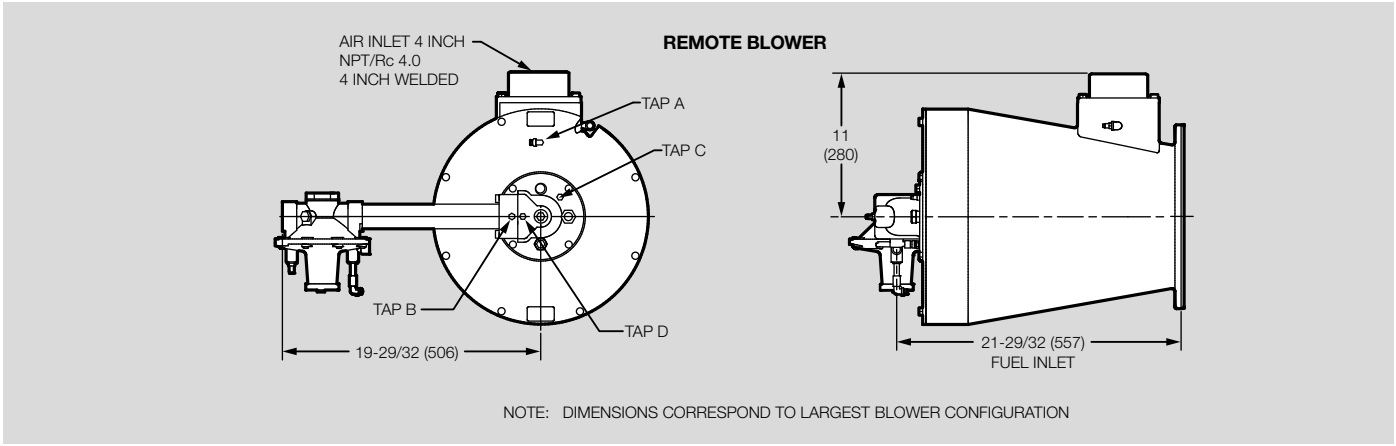
NOTE: DIMENSIONS CORRESPOND TO LARGEST BLOWER CONFIGURATION





NOTE: DIMENSIONS CORRESPOND TO LARGEST BLOWER CONFIGURATION





NOTE: DIMENSIONS CORRESPOND TO LARGEST BLOWER CONFIGURATION

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