

## Venting & Combustion Air Design Guide

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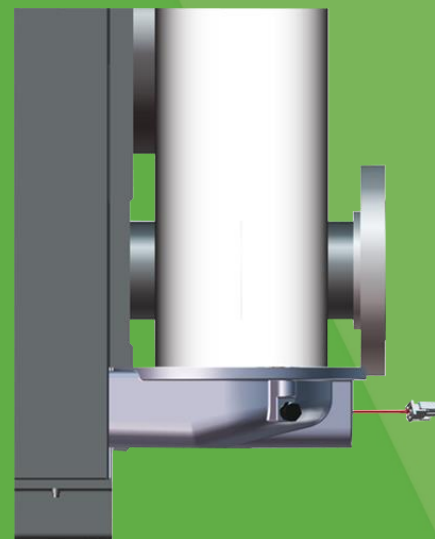
# Benchmark<sup>®</sup> Boilers

Models 750 through 6000

### Other documents for this product include:

OMM-0127 BMK750K-3000K Installation-Startup KOREA  
OMM-0128 BMK750K-3000K Operation- Maintenance KOREA  
OMM-0136 BMK750-6000 Edge Installation-Startup  
OMM-0137 BMK750-6000 Edge Operation-Service  
OMM-0138 BMK750-6000 Edge Reference Manual  
OMM-0144 BMK750-6000 Edge [I] Installation-Startup  
OMM-0145 BMK750-6000 Edge [I] Operation-Service  
OMM-0146 BMK750-6000 Edge [I] Reference Manual

TAG-0019 Benchmark Boiler Application Guide  
TAG-0022 Benchmark Vent & Combustion Air Guide  
TAG-0048 Benchmark Electrical Power Guide



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**TABLE OF CONTENTS**

- 1. GENERAL ..... 3**
- 2. APPROVED VENT MATERIALS ..... 3**
- 3. CODE REQUIRED VENT TERMINATIONS ..... 4**
- 4. EXHAUST AND COMBUSTION AIR SUPPLY ..... 8**
  - 4.1 Combustion Air Quality ..... 9
  - 4.2 Combustion Air From *Within* The Building ..... 10
  - 4.3 Combustion Air From *Outside* The Building ..... 11
  - 4.4 Two-Permanent-Openings Method (Usa Only) ..... 11
  - 4.5 One Permanent Opening Method ..... 14
  - 4.6 Opening A Louver Through The Benchmark Boiler ..... 15
  - 4.7 Ducted Combustion Air ..... 15
  - 4.8 Exhaust Vent And Combustion Air Systems ..... 16
  - 4.9 Gross Natural Draft ..... 16
  - 4.10 Acceptable Pressure Ranges ..... 17
  - 4.11 Exhaust Fans ..... 17
  - 4.12 Corrections For Altitude ..... 17
  - 4.13 Manifolded Systems ..... 17
  - 4.14 Elbow Quantity And Separation ..... 17
  - 4.15 Exhaust Muffler Guidelines ..... 18
  - 4.16 Vent & Combustion Air System Design Requirements ..... 19
- 5. CONDENSATE REMOVAL ..... 23**
- 6. INDIVIDUALLY VENTED SYSTEMS ..... 24**
  - 6.1 Bmk1500 Example ..... 25
- 7. MANIFOLDED DUCTED COMBUSTION AIR ..... 26**
  - 7.1 Installation Requirements For Vertical Venting ..... 31
- 8. COMMON VENT BREECHING (MANIFOLDED) ..... 32**
- 9. PRESSURE DROP AND DRAFT DATA TABLES ..... 34**
  - 9.1 Discharge Flue Vent Pressure Drop ..... 34
  - 9.2 Ducted Combustion Air Duct Pressure Drop ..... 37
  - 9.3 Gross Natural Draft ..... 55
  - 9.4 Altitude Correction ..... 61
  - 9.5 Round Vs Square Duct ..... 62

## 1. GENERAL

The AERCO Benchmark gas-fired boiler is a high efficiency, forced draft, hydronic-heating unit with unique venting capabilities. All Benchmark venting options (which include horizontal and vertical discharges, individual vent, and manifolded vent breeching), typically exceed the capabilities of competing combustion equipment. These and other features enable Benchmark boilers to provide extremely high thermal efficiencies and optimum temperature control under widely varying conditions. It is therefore critical that the flue gas vent and combustion air system be designed to maintain these objectives.

Benchmark’s high efficiency is achieved through air/fuel modulation and the release of energy from the moisture condensing in the combustion products. Because condensation can occur in the exhaust vent system, means must be provided to remove the moisture accumulation. Each Benchmark model is fitted with a condensate removal trap, as indicated in Figures 1a – 1e, which illustrate the air inlet, vent connections and condensate removal connections for the BMK750 (0.75 MMBTU), BMK1000 (1.0 MMBTU), BMK1500 (1.5 MMBTU), BMK2000 (2.0 MMBTU), BMK2500 (2.5 MMBTU), BMK3000 (3.0 MMBTU), BMK4000 (4.0 MMBTU), BMK5000N (4.99 MMBTU), BMK5000 (5.0 MMBTU) and BMK6000 (6.0 MMBTU) models.

The design guidelines in this guide provide broad latitude while meeting the objectives of safety, longevity and optimum performance.

## 2. APPROVED VENT MATERIALS

The Benchmark boiler is a Category II and IV or Type BH appliance, which require special attention to exhaust venting and combustion air details. The exhaust vent **MUST** be UL listed for use with Category II and IV appliances. The following materials are allowed:

- The BMK750 and BMK1000 boilers can use PVC, CPVC or Category II or IV UL1738 or Type BH under ULCS636 listed Polypropylene and Stainless-Steel vent materials.
- The BMK750, 1000, 1500, 2000, 2500, 3000, 4000, 5000N, 5000 and 6000 boilers can use Category II or IV under UL1738 or Type BH under ULCS636 listed Polypropylene and Stainless-Steel vent materials.
- AERCO recommends the use of Stainless Steel and Polypropylene as the preferred venting material for all Benchmark boilers.
- Where codes allow, BMK750 and 1000 models may be vented with UL 1738 Category II or IV PVC and CPVC.
- Stainless Steel venting thickness should conform to the following thickness requirements:

<b>Diameter:</b>	3" to 8"	9" to 16"	18" to 24"	26" to 30"
<b>Material Thickness:</b>	0.015" (0.38mm)	0.020" (0.51mm)	0.024" (0.61mm)	0.034" (0.86mm)

It is the responsibility of the design engineer and installing contractor to ensure all vent system designs and installations follow industry best practices, including proper pitch, support, and drainage to prevent failure. While UL is the industry standard guideline for venting, it is highly recommended that exhaust vent passing through confined or enclosed building spaces be made of AL29-4C as the most corrosion resistant vent material currently available.

If needed, a PVC Vent Adapter is provided in the Spares Kit included with each BMK750 through 1000 boiler. Proper clearances to combustibles must be maintained per UL and the vent manufacturer requirements. The UL, National Fuel Gas Code (ANSI Z223.1/ NFPA54)<sup>1</sup> and CSA B149.1-10 guidelines are often the basis for state and local codes. AERCO's recommendations follow the guidelines of these agencies, unless more stringent codes govern the installation site. The venting and combustion air systems must meet all applicable code requirements.

All Canada installations must comply with CSA B149.1 installation code.

### 3. CODE REQUIRED VENT TERMINATIONS

The guidelines provided in this bulletin should be followed to comply with AERCO, UL, NFPA 54 (National Fuel Gas Code, ANSI Z223.1) and in Canada: CSA B149.1-10 recommendations and regulations.

Vent terminations must be at least **4 feet (1.22 m)** below, **1 foot (0.30 m)** above or **4 feet (1.22 m)** removed horizontally from any window, door or gravity air inlet of a building. Such terminations must extend beyond the outside face of the wall by at least **6 inches (15.2 cm)**.

The bottom of the vent termination must be at least **12 inches (30.5 cm)** above both finished grade and any maximum snow accumulation level to avoid blocking the vent or air intake. The vent termination must be least **3 feet (0.91 m)** above any forced-air building inlet within **10 feet (3.05 m)**. Design must prevent flue gases from recirculating through the boiler air intake.

Vents must not terminate over public walkways or areas where condensate or vapor could create a nuisance or be detrimental to the operation of regulators, meters or related equipment.

Discharges must not be in high wind areas or corners, or be located directly behind vegetation. Discharges in these locations may cause the flue pressures to fluctuate and result in flame instability. Generally, designs should minimize wind effects.

Wall and roof penetrations must follow all applicable codes and the vent manufacturer's instructions. Vents must never be installed at less than required clearances to combustible materials, as enumerated in UL, NFPA, CSA B149.1-10 or local codes "Double-wall" or "Thimble" assemblies are required when vents penetrate combustible walls or roofs.

Vertical discharges must extend at least **3 feet (0.9 M)** above the roof through properly flashed penetrations, and at least **2 feet (0.61 m)** above any object within a **10 foot (3.05 m)** horizontal distance.

Large-mesh screens can be applied to the vent termination to protect against the entry of foreign objects, but the "free area" should be at least 50% larger than the required flue cross-sectional area preceding the vent termination. It is recommended that a T termination be used if a screen is desired. Do not use mesh screens on velocity cones.

If the vent system is to be connected to an existing stack, the stack must be UL listed for Category II and IV appliances (capable of **280 °F (138 °C)**, positive pressure and condensing flue gas operation). Masonry stacks must be lined, and the vent penetration must terminate flush with, and be sealed to, this liner. Vents may enter the stack through the bottom or side. All side connections must enter at a 45-degree connection in the direction of flow and must enter at different elevations, with the smallest vent connection at the highest elevation. Benchmark vents must not be connected to another manufacturer's equipment.

The exhaust vent must be pitched upward toward the termination by a minimum of **¼ inch per foot (21 mm per m)** of length. Condensate must flow back to the Benchmark unit freely, without accumulating in the vent.

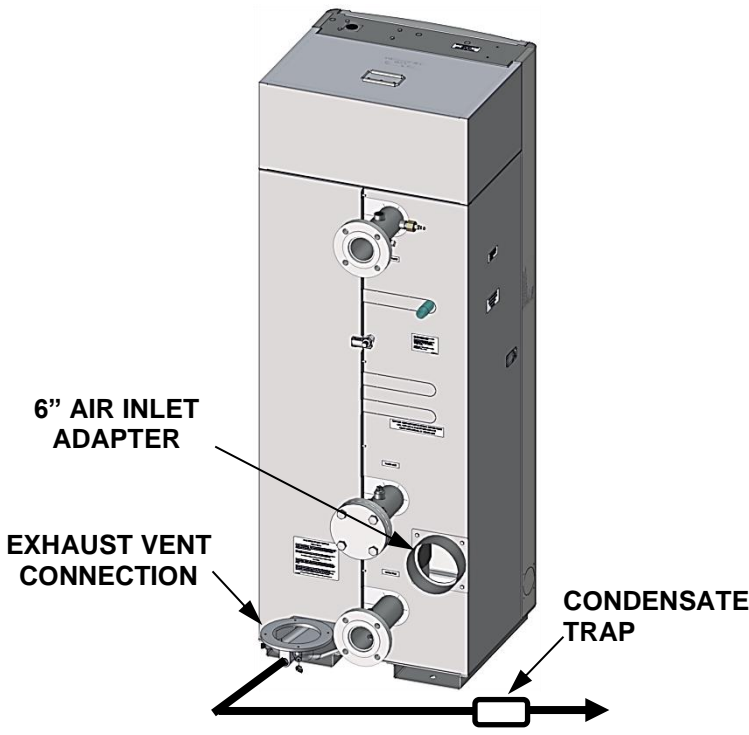


Figure 1a: BMK750/1000

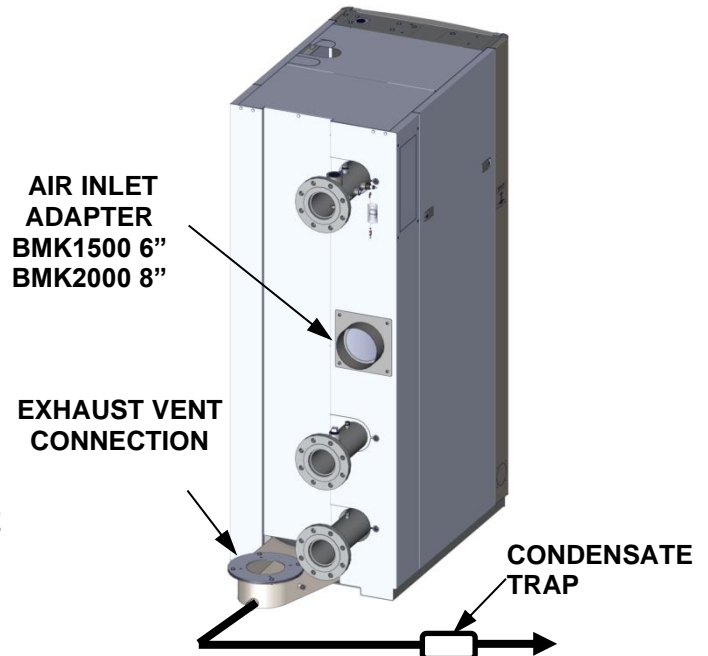


Figure 1b: BMK1500/2000

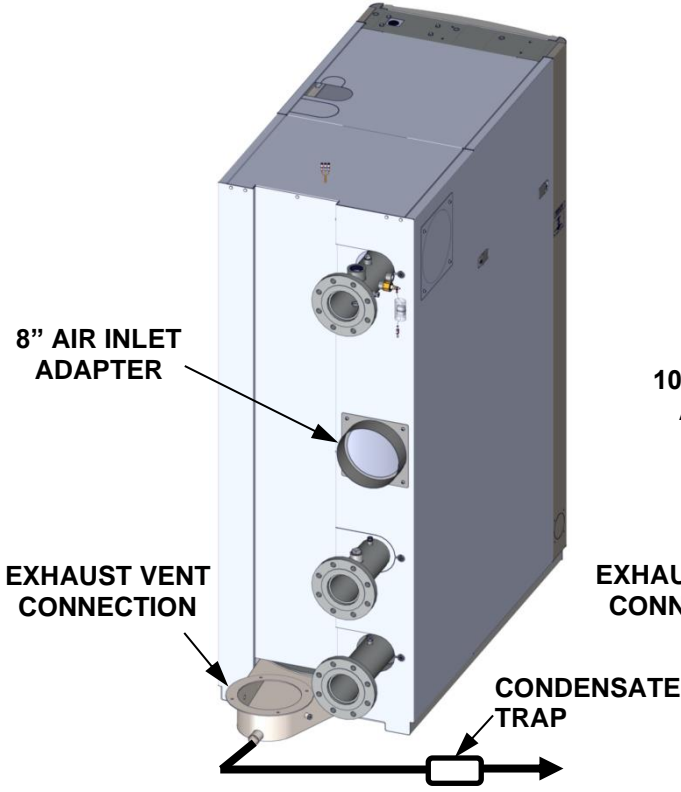


Figure 1c: BMK2500/3000

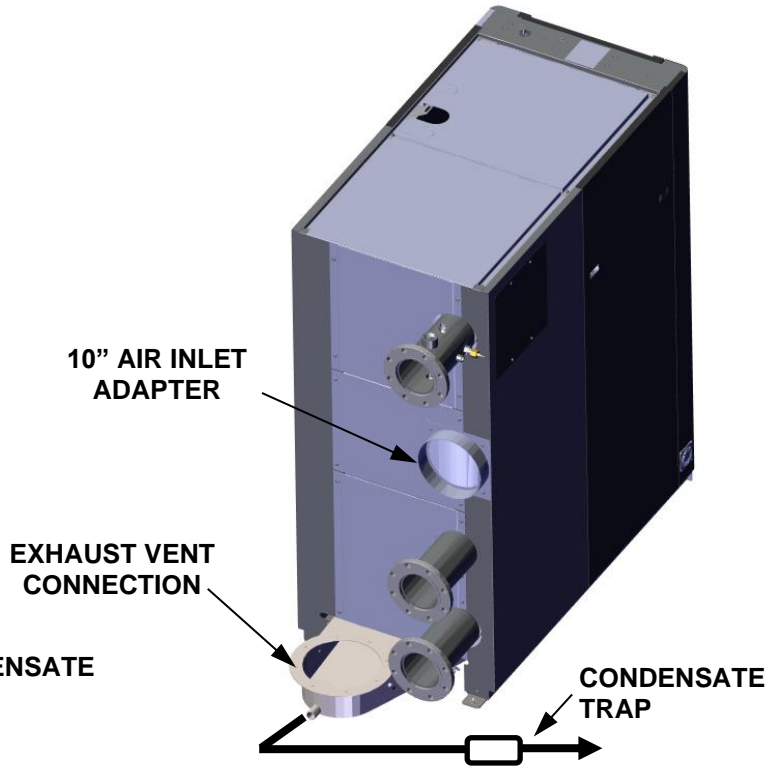


Figure 1d: BMK4000/5000N

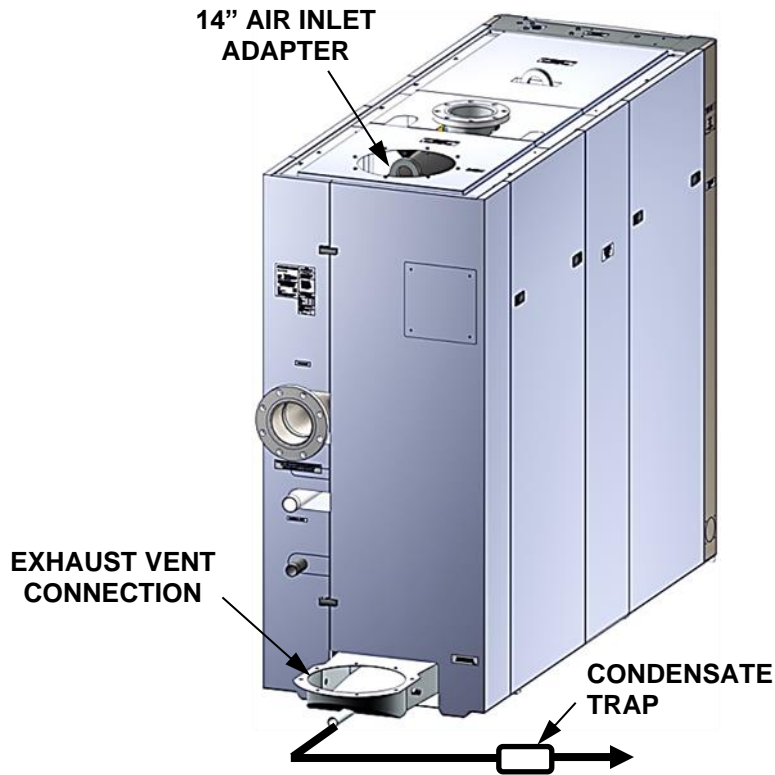


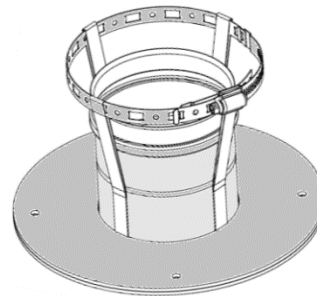
Figure 1e: BMK5000/6000

The following Vent Adapters are available from AERCO. All non-PVC adapters must be purchased along with the rest of the venting.

**BMK750 & 1000**  
 6" (152 mm) (PVC) Kit # 24286

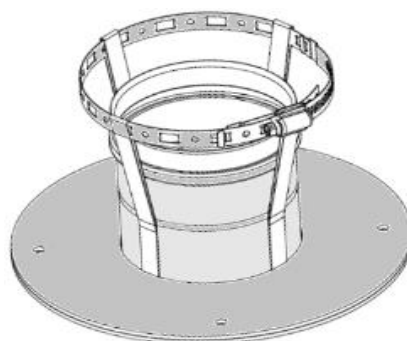


**BMK750-1500**  
 6" (152 mm) PolyPro Adapter P/N 39006-2,  
 for Duravent venting system only.  
 For other manufacturers, consult the  
 manufacturer.



**BMK2000 - 3000**

8" (203 mm) PolyPro Adapter P/N 39006-4, for DuraVent venting system only.



**Figure 1e: Exhaust Vent Adapters**

## 4. EXHAUST AND COMBUSTION AIR SUPPLY

Benchmark boilers require the following combustion air volumes when operating at full capacity.

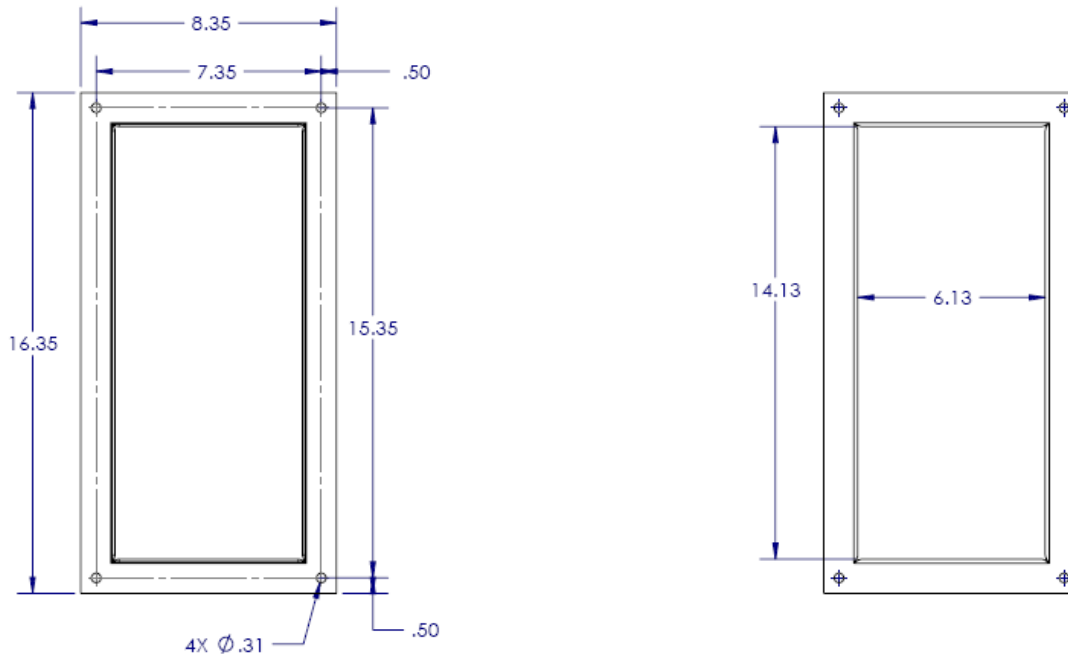
UNIT	VOLUME at 60°F (15.6°C)	Air Inlet Adapter Size
BMK750	165 SCFM (4.67 m <sup>3</sup> /min)	6 inch
BMK1000	200 SCFM (5.66 m <sup>3</sup> /min)	6 inch
BMK1500	325 SCFM (9.20 m <sup>3</sup> /min)	6 inch
BMK2000	500 SCFM (14.16 L/min)	8 inch
BMK2500	600 SCFM (16.99 m <sup>3</sup> /min)	8 inch
BMK3000	700 SCFM (19.82 m <sup>3</sup> /min)	8 inch
BMK4000	1167 SCFM (33.05 m <sup>3</sup> /min)	10 inch
BMK5000N	1167 SCFM (33.05 m <sup>3</sup> /min)	10 inch
BMK5000	1167 SCFM (33.05 m <sup>3</sup> /min)	14 inch
BMK6000	1400 SCFM (39.64 m <sup>3</sup> /min)	14 inch

These flows **MUST** be accommodated. Air supply is a direct requirement of NFPA, CSA B149.1-10 (Canada) and local codes that should be consulted for correct design implementation.

Combustion air typically enters Benchmark boilers through the air inlet on the rear of the unit. Benchmark 2500 and 3000 units have the option of installing a side air inlet adapter kit. Two kits are available, including installation instructions, for Benchmark 2500 and 3000 units only:

1. **58080-1** – 8” Side Air Inlet Adapter Kit
2. **58080-2** – 10” Side Air Inlet Adapter Kit; requires enlarging opening in side panel to fit

The mechanical room must not be under negative pressure, even when the combustion air is direct ducted. If necessary, ventilate the room to prevent negative pressure from occurring.





## 4.1 Combustion Air Quality

In equipment rooms containing other air-consuming equipment — including air compressors and other combustion equipment — the combustion air supply system must be designed to accommodate all such equipment when all are operating simultaneously at maximum capacity.

### WARNING!

Combustion air must provide positive pressure in the enclosure and be free of contaminants.

Combustion air intakes must be located in areas that will not induce excessive (>0.10" W.C. (25 Pa)) intake air pressure fluctuations. Designs should consider equipment blowers and exhausts when using room air for combustion.

Air intakes must be located to prevent infiltration of chlorine, chlorides, halogens or any other chemicals that are detrimental to the operation of combustion equipment. Common sources of these chemicals are swimming pools, degreasing compounds, water softener salts, plastic processing and refrigerants. This will ensure equipment longevity and maintain warranty validation.

### WARNING!

If the equipment room is in the vicinity of any these types of chemicals, it must be supplied with clean combustion air. The equipment room must also have a slightly positive room air pressure, provided by a powered combustion air supply louver or duct.

Air intakes must not be in the proximity of garages, industrial and medical hood venting, loading docks or refrigerant vent lines. Boilers must not be installed in the proximity of activities that generate dust if that dust can enter the boiler intake. Boilers must be located to prevent moisture and precipitation from entering combustion air inlets.

When a boiler is used, temporarily, to provide heat during ongoing building construction or renovation, accumulated drywall dust, sawdust and similar particles can:

- Accumulate in the unit's combustion air intake and block combustion air flow
- Accumulate over the burner surface and restrict flow of air/fuel mixture

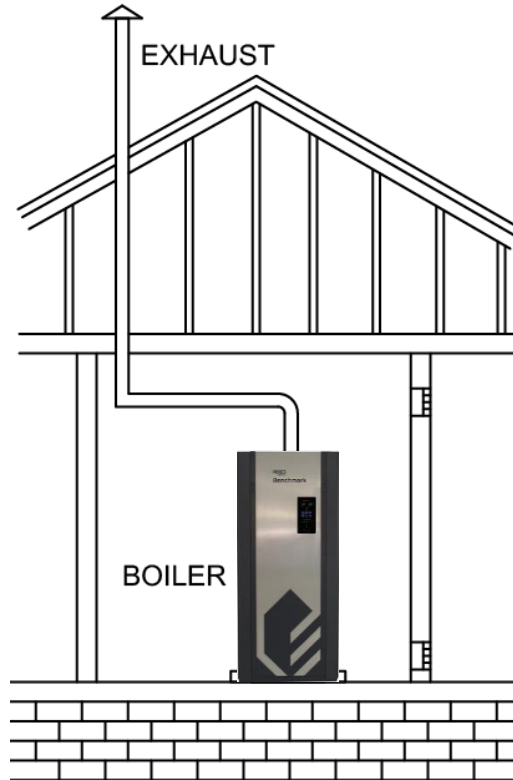
In these situations, AERCO requires that a disposable air intake filter be installed, temporarily, above the boiler combustion air inlet. Air filters may be required year-round in instances in which dust or debris can enter the combustion air tube. Consult the boiler Operations and Maintenance Manual for details.

Combustion air temperatures as low as **-30 °F (-34.4 °C)** can be used without affecting the integrity of the equipment; however, the combustion settings may require adjustment to compensate for site conditions.

## 4.2 Combustion Air From *Within* The Building

Where combustion air will originate from within the building, air must be provided to the equipment room from two permanent openings to an interior room (or rooms). Openings connecting indoor spaces must be sized and located in accordance with the following:

- Each opening must have a minimum free area of **1 inch<sup>2</sup> per 1,000 BTU/hr. (2,200 mm<sup>2</sup>/kW)** of total input rating of all appliances in the space, but not less than **100 inch<sup>2</sup> (0.06 m<sup>2</sup>)**.
- One opening must commence within **12 inches (300 mm)** of the top of the enclosure, and one opening must commence within **12 inches (300 mm)** of the bottom. (See Figure 2).
- For Canadian installations, refer and adhere to the latest publication of CAN/CSA B149.1.



**Figure 2: All Combustion Air from Adjacent Indoor Spaces through Indoor Combustion Air Openings**

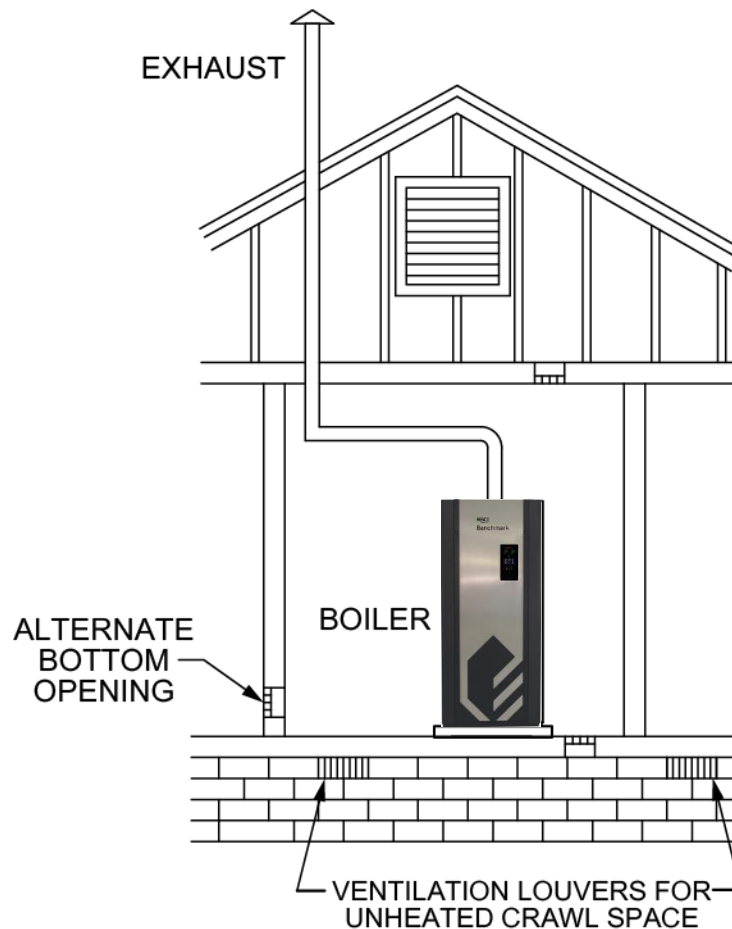
**4.3 Combustion Air From *Outside* The Building**

Outdoor combustion air must be provided through opening(s) to the outdoors in accordance with the methods described below. The minimum dimension of air openings must not be less than **3 inches (76 mm)**. The required size of the openings for combustion air must be based upon the net free area of each opening. When the free area through a louver, grille, or screen is known, it must be used to calculate the opening size required to provide the free area specified. For additional details, consult NFPA 54, or in Canada, CSA B149.1-10, paragraphs 8.4.1 and 8.4.3.

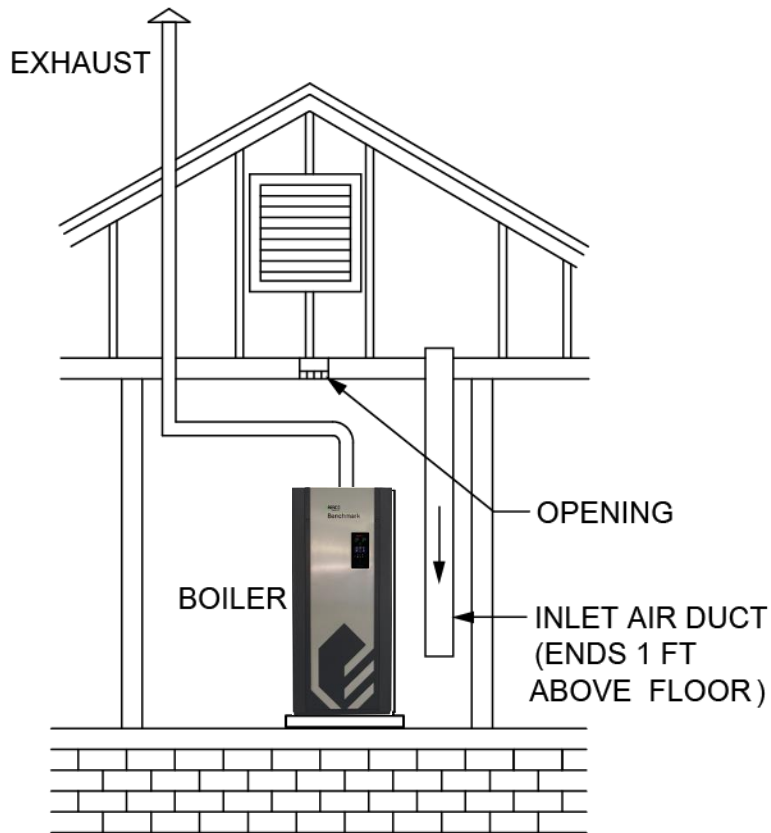
**4.4 Two-Permanent-Openings Method (Usa Only)**

Two permanent openings must be provided; one commencing within **12 inches (304 mm)** of the top of the enclosure and one commencing within **12 inches (304 mm)** of the bottom. The openings must communicate directly — or by ducts — with the outdoors, or spaces that freely communicate with the outdoors, as shown on the following pages:

1. When communicating directly with the outdoors, or when communicating to the outdoors through vertical ducts, each opening must have a minimum free area of **1 inch<sup>2</sup> per 4,000 BTU/hr. (550 mm<sup>2</sup>/kW)** of total input rating of all appliances in the space (see Figures 3 and 4).

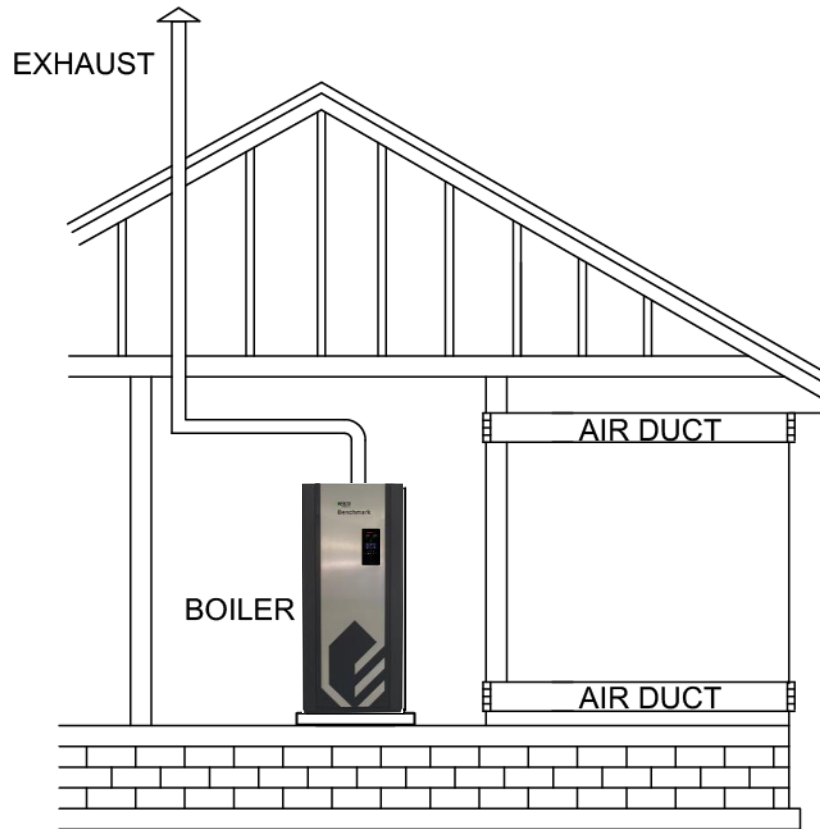


**Figure 3: All Combustion Air from Outdoors - Inlet Air from Ventilated Crawl Space and Outlet Air to Ventilated Attic**



**Figure 4: All Combustion Air from Outdoors - Through Ventilated Attic**

2. When communicating with the outdoors through horizontal ducts, each opening must have a minimum free area of **1 inch<sup>2</sup> per 2,000 BTU/hr. (1100 mm<sup>2</sup>/kW)** of total input rating of all appliances in the space (see Figure 5).



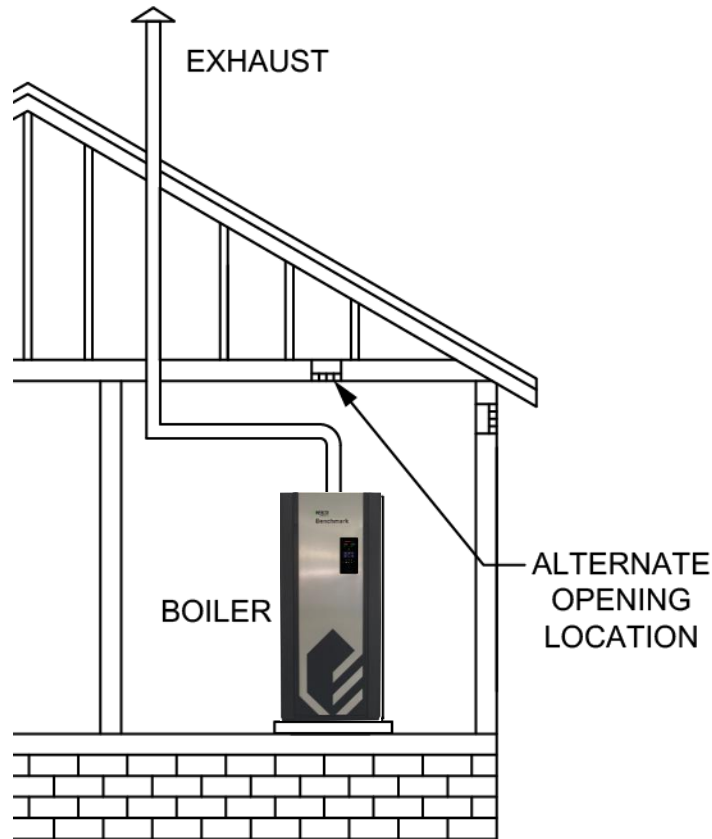
**Figure 5: All Combustion Air from Outdoors Through Horizontal Ducts**

**NOTE:** For Canadian installations, refer and adhere to the latest publication of CAN/CSA B149.1.

**4.5 One Permanent Opening Method**

One permanent opening must be provided, commencing within **12 inches (300 mm)** of the top of the enclosure. The appliance must have clearances of at least **1 inch (25 mm)** from the sides and back of the appliance, and a clearance of 6 inches (150 mm) from the front. The opening must communicate with the outdoors directly or through a vertical or horizontal duct to the outdoors or spaces that freely communicate with the outdoors (as shown in Figure 6) and must have a minimum free area as follows:

- **1 inch<sup>2</sup> per 3,000 BTU/hr. (700 mm<sup>2</sup>/kW)** of the total input rating of all appliances located in the space.



**Figure 6: All Combustion Air from Outdoors Through Single Combustion Air Opening**

**NOTE:** For Canadian installations, refer and adhere to the latest publication of CAN/CSA B149.1.

## 4.6 Opening A Louver Through The Benchmark Boiler

A louver can be opened using the auxiliary relay contacts of the Benchmark boiler. These contacts are provided by a single pole double throw (SPDT) relay that is energized when there is a demand for heat and is de-energized after that demand is satisfied. The relay contacts are rated for 120 VAC at 5 amps, resistive.

**NOTE:** Do NOT power louver directly using the Auxiliary Relay. An external relay (not supplied) must be employed for this purpose. The boiler power cannot support external accessories.

If the louver features a proof-of-open switch, it must be connected to the boiler's delayed interlock. The delayed interlock must be closed for the unit to fire. If the louver requires time to open, a time-delay must be programmed to hold the start sequence of the boiler long enough for the proof-of-open switch to make (Parameter: **Aux Start On Delay** — programmable from 0 to 120 seconds). If the proof-of-open switch does not prove within the programmed time frame, the boiler will shut down.

For wiring connections and further details regarding the auxiliary relay, delayed interlock and the **Aux Start On Delay** parameter, refer to the Benchmark boiler's Operations and Maintenance manual.

If an AERCO Control System (ACS) is being used to manage a multiple boiler installation, the louver must be opened using the System Start Relay of the ACS. Refer to the ACS Operations and Maintenance Manual, GF-131, for wiring connections and further details.

## 4.7 Ducted Combustion Air

The Benchmark is approved for ducted combustion air installations; i.e., it can draw combustion air from the outdoors through a metal or PVC duct connected between the Benchmark unit(s) and the outdoors. This configuration is useful for situations in which room air is insufficient or otherwise unsuitable for combustion.

If room air is unsuitable for combustion, combustion air must be supplied with powered duct fans.

The minimum ducted combustion-air duct sizes for the Benchmark boilers are as follows:

BMK750 = 6-inch diameter (15.2 cm)	BMK3000 = 8-inch diameter (20.3 cm)
BMK1000 = 6-inch diameter (15.2 cm)	BMK4000 = 10-inch diameter (25.4 cm)
BMK1500 = 6-inch diameter (15.2 cm)	BMK5000N = 10-inch diameter (25.4 cm)
BMK2000 = 8-inch diameter (20.3 cm)	BMK5000 = 14-inch diameter (35.6 cm)
BMK2500 = 8-inch diameter (20.3 cm)	BMK6000 = 14-inch diameter (35.6 cm)

In many installations, the combustion air duct can be manifolded for multiple unit applications.

The length and restriction of the combustion air duct directly impacts the size, length and restriction of the discharge venting. The ducted air intake must be located at least **3 feet (0.9 m)** below any vent termination within **10 feet (3.1 m)**.

A screen with mesh size not smaller than **1" x 1" (2.54 mm x 2.54 mm)** must be installed at the inlet of the ducted combustion air duct.

### IMPORTANT NOTES:

1. Please consult your local AERCO representative or the AERCO factory for all applications utilizing common ducted combustion air with common breeching of exhausts.
2. AERCO boilers and AERCO water heaters may share common combustion air and exhaust breeching. other configurations, not depicted in this guide, are possible. if you intend to implement any of these options, please contact your local AERCO representative or the AERCO factory for project specific venting and combustion air configurations.

## 4.8 Exhaust Vent And Combustion Air Systems

The Benchmark supports several venting and combustion air options, and although the application parameters vary, there are basic similarities among all systems. Sections 24.1 and 24.2 of this Guide provide tables that address the pressure drop of most applicable vent and duct fittings and sizes. The losses in the vent exit and air duct entrance are also included.

It should be noted that flow and vent or duct diameter have the most significant effects on overall system pressure drop. When using fittings or terminations not listed in the Tables in Section 24, consult the device manufacturer for actual pressure drop values. If a rectangular duct is to be used, consult the table in Section 24.5 for a round diameter duct size that has the identical pressure drop per length of rectangular duct.

## 4.9 Gross Natural Draft

Flue gases have a lower density (and are lighter) than air and will rise, creating "gross natural draft." Gross natural draft is created when flue gases exit the vent at an elevation above the Benchmark boiler. The amount of draft depends upon the height of the stack and the difference between the flue gas temperature and the surrounding air temperatures (densities). Gross natural draft values for stacks at various heights above the Benchmark unit are presented in Section 24.3. These draft values are based on an installation site at sea level.

Adding the gross natural draft (negative) to the vent and air system pressure drop (positive) determines if the total system will be positive pressure or negative pressure ("net natural draft"). As with most combustion equipment, negative pressure (net natural draft) systems should be treated differently from positive pressure systems when the discharge vents are manifolded. Note that sidewall vent terminations, as well as some vertical terminations, are positive pressure systems.

**Contact your AERCO sales representative or AERCO International for design assistance and approval when designing manifolded exhaust vent systems.**

### CAUTION!

**Do NOT install a non-sealed draft control damper.**



#### 4.10 Acceptable Pressure Ranges

For individually vented units, the exhaust system must be designed so that pressure measured at every point is in the range from **-0.25" W.C. to +0.81" W.C. (-62 Pa to 202 Pa)**. For common vented units, the exhaust system must be designed so that pressure measured at every point is in the range from **-0.25" W.C. to +0.25" W.C. (-62 Pa to 62 Pa)**. Pressures below **-0.25" W.C. (-62 Pa)** (more negative) may cause flame instability. Pressures above **+0.25" W.C. (62 Pa)** for common vented units, or **+0.81 W.C. (202 Pa)** for individually vented units (more positive), will prevent flue gases from exiting.

#### 4.11 Exhaust Fans

If the Benchmark boiler's exhaust system incorporates an exhaust fan, the system designer must size the vent pipe diameters, select the fan and determine the location of the fan sensor to maintain a **-0.25" W.C. to +0.25" W.C. (-62 Pa to 62 Pa)** pressure range at the outlet of each boiler. Also, the designer must ensure that the exhaust fan material is acceptable for use with Category IV appliances.

#### 4.12 Corrections For Altitude

The table in Section 24.4 lists correction factors for installation altitudes above sea level. These factors must be applied to both the natural draft and pressure drops of vent and air ducts. *The pressure drop through vents and combustion air ducts will increase at higher elevations, while the natural draft will decrease.*

#### 4.13 Manifolded Systems

In many instances it may be practical to connect multiple units using a manifolded vent or exhaust configuration. However, when multiple units are connected by a manifolded air intake or exhaust vent, the operation of a given unit can be affected by the others, if the venting or combustion air system is not designed properly. Properly designed common vent and air supply systems can be installed that will prevent "operational interaction" between units.

**Do not use static regain method on common ductwork, but rather, use one duct size for the common run (See Figure 13).**

**Contact your AERCO sales representative or AERCO International for design assistance and review when designing manifolded exhaust and manifolded combustion air systems.**

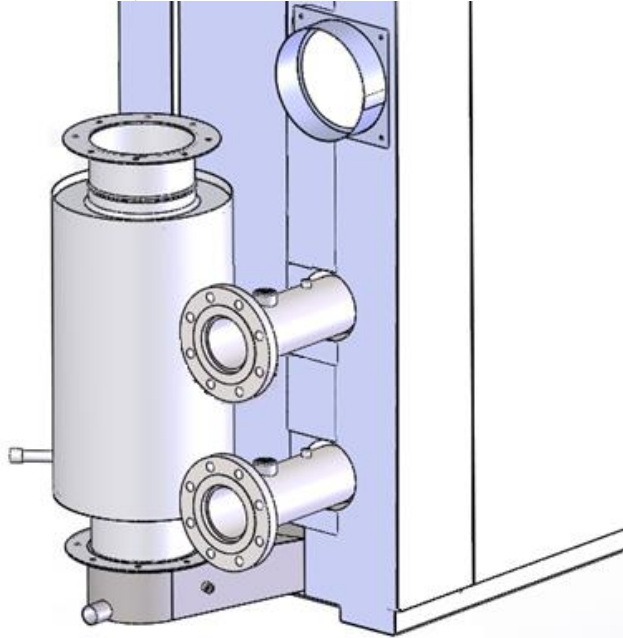
#### 4.14 Elbow Quantity And Separation

The quantity and angle of elbows and the distances between them can influence the system's exhaust and combustion air pressures, as well as its acoustic behavior. Designers should consider minimizing the number of elbows and maximizing the distance between them in the layout design. Use of angles less than 90° is recommended whenever possible. Five or fewer elbows are recommended for individual venting runs; five or fewer are similarly recommended for common sections. In flue and combustion air ducting runs, elbows should remain separated as much as possible. Where close elbows cannot be avoided, factory review is recommended to determine if changes need to be made.

#### 4.15 Exhaust Muffler Guidelines

An exhaust muffler is recommended for Benchmark boilers when installed in a noise-sensitive application and when the exhaust vent ducting is relatively short in length. The following criteria must be used to determine when to include a field-installed muffler in a Benchmark installation:

- The exhaust is **sidewall vented** and the vent is terminated in close proximity to residences, offices, hotel/hospital rooms, classrooms etc.
- OR**
- The **total vertical and horizontal section** of exhaust vent is **less than 25 linear feet (7.6 m)** in length from the last unit, and the vent terminates in close proximity to residences, offices, hotel/hospital rooms, classrooms etc.



**Figure 7: Flanged AERCO Exhaust Muffler**

For **manifolded exhaust** systems, the total vertical section length includes both horizontal and common vertical; individual boiler vertical connectors are included in the determination as well.

**EXAMPLE:** For an installation that has a **20 foot (6 m)** common vertical, **5 foot (1.5 m)** common horizontal after the last boiler, and each boiler has a **10 foot (3.1 m)** vertical connector, the total section linear length considered is **35 feet (10.7 m)**. Because this length is greater than **25 linear feet (7.6 m)**, a muffler is **not** required.

**Contact your local AERCO sales representative for more information on the AERCO exhaust muffler.**

**4.16 Vent & Combustion Air System Design Requirements**

The minimum exhaust vent and combustion air duct sizes for Benchmark Low NOx boilers models are as follows:

Model	Minimum Diameter	
	Combustion Air Duct	Exhaust Vent Diameter
BMK750	6 inch (15.2 cm)	6 inch (15.2 cm)
BMK1000	6 inch (15.2 cm)	6 inch (15.2 cm)
BMK1500	6 inch (15.2 cm)	6 inch (15.2 cm)
BMK2000	8 inch (20.3 cm)	8 inch (20.3 cm)
BMK2500	8 inch (20.3 cm)	8 inch (20.3 cm)
BMK3000	8 inch (20.3 cm)	8 inch (20.3 cm)
BMK4000 BMK5000N	10 inch (25.4 cm)	12 inch (30.5 cm)
BMK5000 BMK6000	14 inch (35.6 cm)	14 inch (35.6 cm) (<9ppm NO <sub>x</sub> Optional Calibration)
		*12 inch (30.5 cm) optional (Standard <20ppm NO <sub>x</sub> emissions only)

\* Optional **12 inch (30.5 cm)** diameter exhaust venting requires a **12" (30.5 cm)** vent adapter. Consult your local AERCO sales representative or vent manufacturer for more information on the 12" (30.5 cm) adapter.

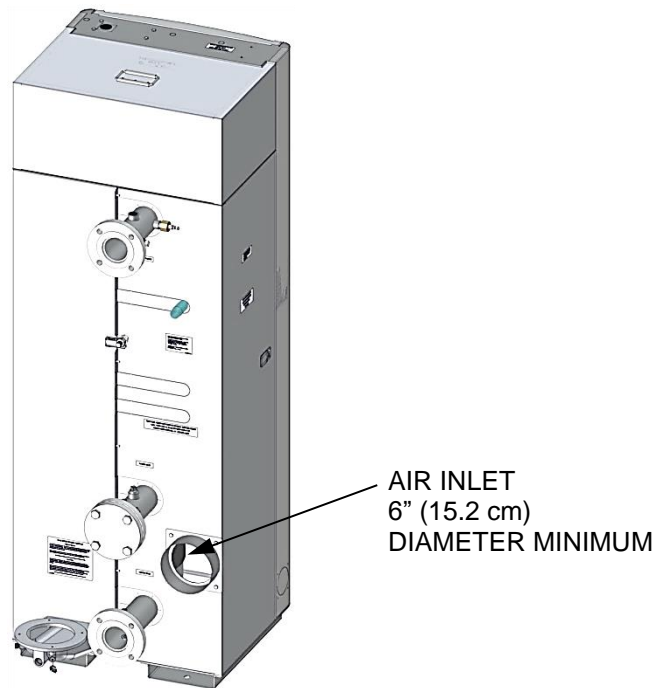
A **1/4-inch (6.35 mm)** NPT combustion test hole is provided on each unit's exhaust manifold connection (see Figures 8a, 8b, 8c and 8d, below). A **24 inch (61 cm)** length of straight vent is required downstream of the exhaust manifold, as illustrated in these figures.

The vent system should always be pitched up **1/4 inch per foot (21 mm per m)** of run towards the vent termination to enable condensate to drain back to the unit for disposal. Low spots in the vent must be avoided. Periodic inspection must be performed to assure correct drainage.

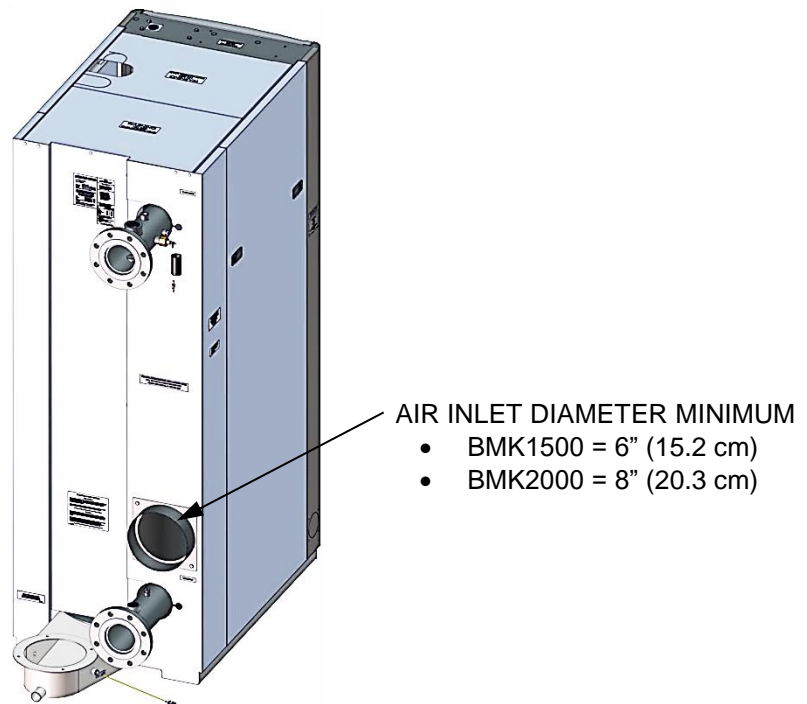
Benchmark vents must not be interconnected to those of other manufacturers' equipment.

Horizontal vent and ductwork must be supported to prevent sagging, in accordance with local code and the vent manufacturer's requirements. Vertical vent and ductwork must be supported to prevent excessive stress on the horizontal runs. The exhaust manifold and inlet air adapter must never be used as weight-supporting elements. The supports must be so arranged and the overall layout designed to assure that stresses on the vent and combustion air connections are minimized.

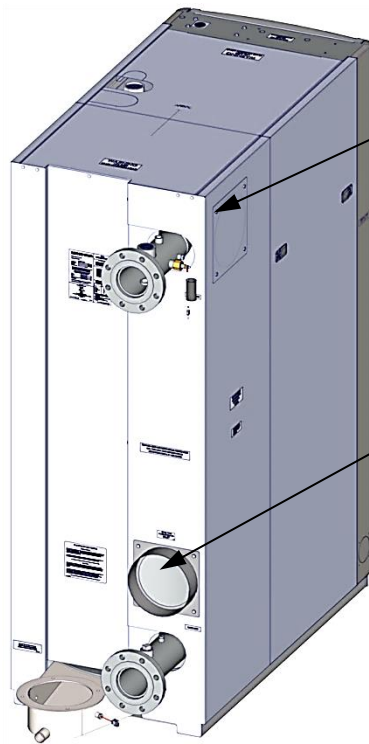
The vents and combustion air ducts may be insulated in accordance with the vent manufacturer's instructions and local codes.



**Figure 8a: Ducted Combustion Connection for BMK750 & BMK1000 Boilers**



**Figure 8b: Ducted Combustion Connection for BMK1500 & BMK2000 Boilers**



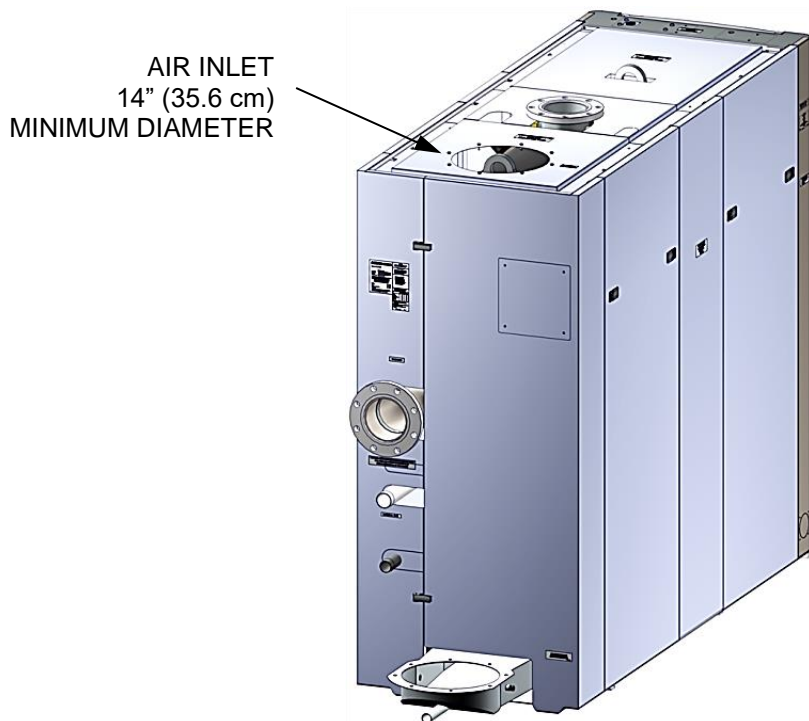
ALTERNATE MINIMUM AIR INLET,  
1 EACH SIDE

- BMK2500 = 8"/10 (20.3/25.4 cm)
- BMK3000 = 8"/10 (20.3/25.4 cm)
- BMK4000 = 14" (35.6 cm)
- BMK5000N = 14" (35.6 cm)

AIR INLET MINIMUM DIAMETER

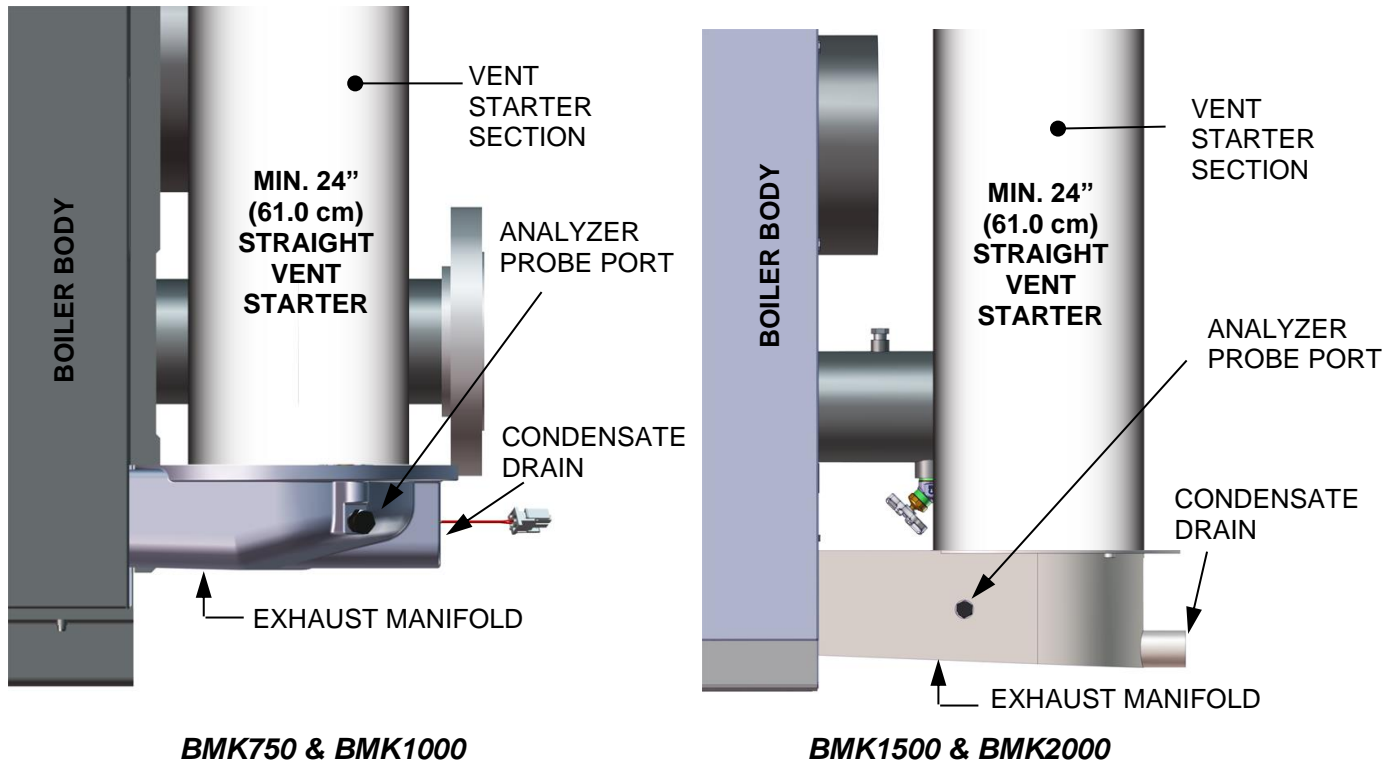
- BMK2500 = 8" (20.3 cm)
- BMK3000 = 8" (20.3 cm)
- BMK4000 = 10" (25.4 cm)
- BMK5000N = 10" (25.4 cm)

**Figure 8c: Ducted Combustion Connection for BMK2500, BMK3000, BMK4000 & BMK5000N Boilers**

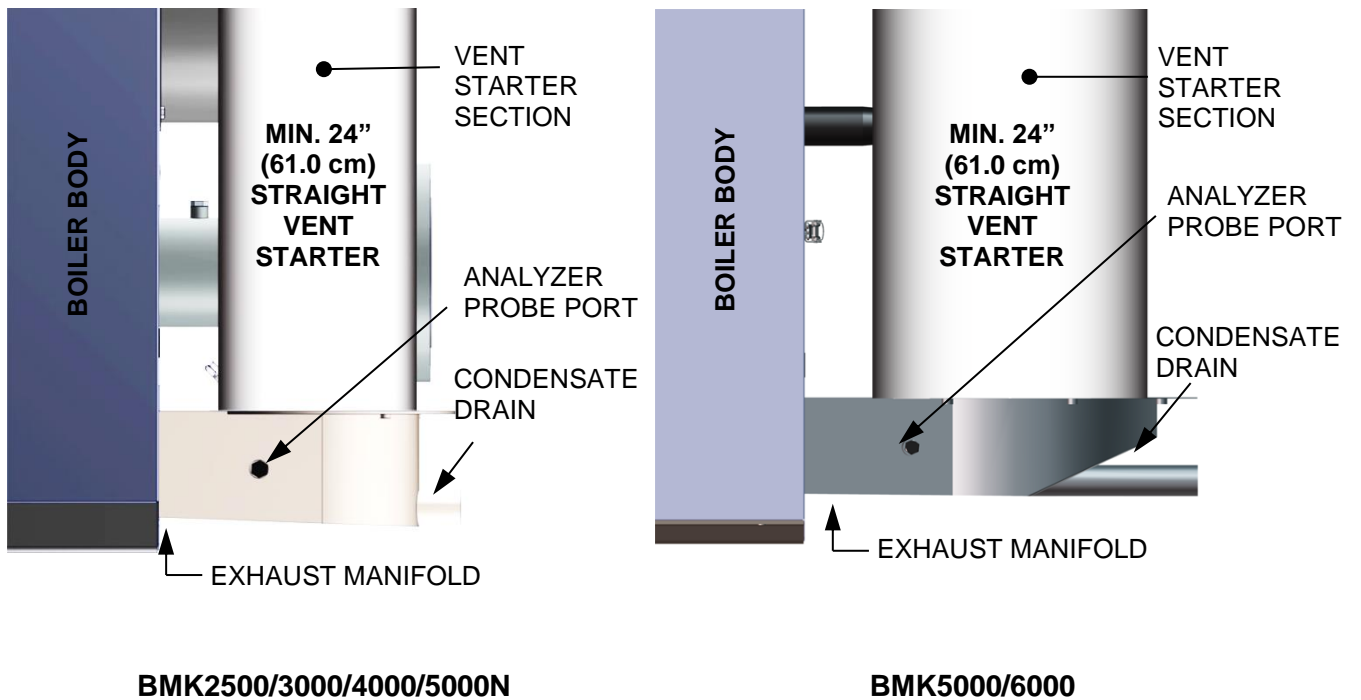


AIR INLET  
14" (35.6 cm)  
MINIMUM DIAMETER

**Figure 8d: Ducted Combustion Connection for BMK5000 & 6000 Boilers**



**Figure 9a: Vent Starter Section – Left Side View**



**Figure 9b: Vent Starter Section – Left Side View**

## 5. CONDENSATE REMOVAL

The exhaust vent system must be pitched back toward the Benchmark unit by a minimum of **1/4 inch per foot (21 mm per m)** of duct length to enable condensate to drain back to the unit for disposal. Low spots in the vent must be avoided to prevent the condensate from collecting.

The condensate trap assembly is located directly below the exhaust manifold. Plastic hose must be connected to the trap assembly and run to drain. Care must be taken to avoid hose kinks and to avoid raising the hose above the trap assembly. Condensate must flow freely to drain. The condensate-to-drain run must not be hard-piped so the trap can be removed periodically for maintenance purposes.

If the condensate must be lifted above the trap assembly to a drain, it must be drained into a sump. From there, a pump can lift the condensate away.

Each unit will produce the following approximate condensate quantities in the full condensing mode:

- BMK750 = 6 gallons (22.7 L) per hour
- BMK1000 = 8 gallons (30.3 L) per hour
- BMK1500 = 9 gallons (34.1 L) per hour
- BMK2000 = 10 gallons (37.9 L) per hour
- BMK2500 = 15 gallons (56.8 L) per hour
- BMK3000 = 20 gallons (75.7 L) per hour
- BMK4000 = 30 gallons (113.6 L) per hour
- BMK5000N = 33 gallons (124.9 L) per hour
- BMK5000 = 33 gallons (124.9 L) per hour
- BMK6000 = 40 gallons (151.4 L) per hour

Condensate drain systems must be sized for full condensing mode.

In multiple boiler applications, it is common to manifold these drains together in a plastic pipe manifold to a floor drain. Condensate manifolds must be large enough to handle the anticipated flow and must be properly secured and protected. Manifolds are generally located behind the boilers so that short runs of plastic tubing into the manifold can be used for the condensate drain. A base drain must be installed at the bottom of vertical common flue piping.

The pH level of the condensate produced by Benchmark boilers ranges between 3.0 and 3.2. The installation must be designed in accordance with local codes that specify acceptable pH limits. If required, any type of commercially available neutralizer may be used.

## 6. INDIVIDUALLY VENTED SYSTEMS

Systems with individual vents may be used with any of the combustion air systems described previously and illustrated in Figures 9a and 9b, above. The maximum combined pressure drop of the vent and combustion air system must not exceed **140 equivalent feet (42.7 m)** of length.

To calculate the pressure drop:

- 1) Calculate the exhaust vent pressure drop.
- 2) Calculate the combustion duct pressure drop.
- 3) Divide the vent pressure drop by the altitude correction factor (CF) listed in the table in Section 24.4 to correct for installations above sea level.
- 4) Determine the natural draft, if any, from the table in Section 24.3 and multiply it by the altitude CF.
- 5) Add the altitude corrected vent pressure drop (positive) and the draft (negative) to get the total vent pressure drop.
- 6) Add the total vent pressure drop to the altitude corrected combustion air duct pressure drop.

The total system pressure drop must not exceed **140 equivalent feet (42.7 m)**.



**6.1 Bmk1500 Example**

Calculate the maximum pressure drop for a single boiler installation at 500 feet (150 m) above sea level having a winter design temperature of 20 °F (-6.7 °C). The duct system consists of:

- 1) A 6-inch (15.2 cm) diameter exhaust vent with two (2) 90° elbows, one (1) 45° elbows, 10 feet (3.05 m) of horizontal run, 20 feet (6.1 m) of vertical run
- 2) A rain cap termination
- 3) A 6-inch (15.2 cm) diameter ducted combustion air duct with two 90° elbows and 15 feet (4.6 m) of run

**CALCULATION:**

**6-inch Diameter Exhaust Vent Pressure**

Two 90° elbows: 2 x 13.11 = 26.22 ft. (7.99 m)  
 One 45° elbow: 1 x 9.98 = 9.98 ft. (3.04 m)  
 30 feet (9.1 m) total run (10 horizontal + 20 vertical):  
 30 x 1.77 = 53.10 ft. (16.18 m)  
 Rain cap exit loss: 1 x 21.95 = 21.95 ft. (6.69 m)  
 Vent drop subtotal: = 111.25 ft. (33.91 m)  
 Altitude correction:  $\frac{110.69}{0.982 \text{ (CF)}}$  = 113.29 ft. (34.53 m)

Natural draft for 20 feet (6.1 m) @ 20 °F (-6.7 °C) outside temperature:  
 = -12.6 ft. (-3.84 m)

Altitude correction: -12.6 x 0.982 CF = -12.37 ft. (-3.77 m)  
**Total vent drop: = 100.92 ft. (30.76 m)**

**6-inch Diameter Combustion Air Duct Pressure**

Two 90° elbows: 2 x 5.84 = 11.68 ft. (3.56 m)  
 15 feet (4.6 m) total run: 15 x 1.06 = 15.9 ft. (4.85 m)  
 Entrance loss: 1 x 8.60 = 8.60 ft. (2.62 m)

Combustion air drop subtotal: = 36.18 ft. (11.03 m)

Altitude correction: =  $\frac{36.18}{0.982 \text{ CF}}$  = 36.84 ft. (11.23 m)

**Combustion air drop total: = 36.84 ft. (11.23 m)**

**System total pressure drop**

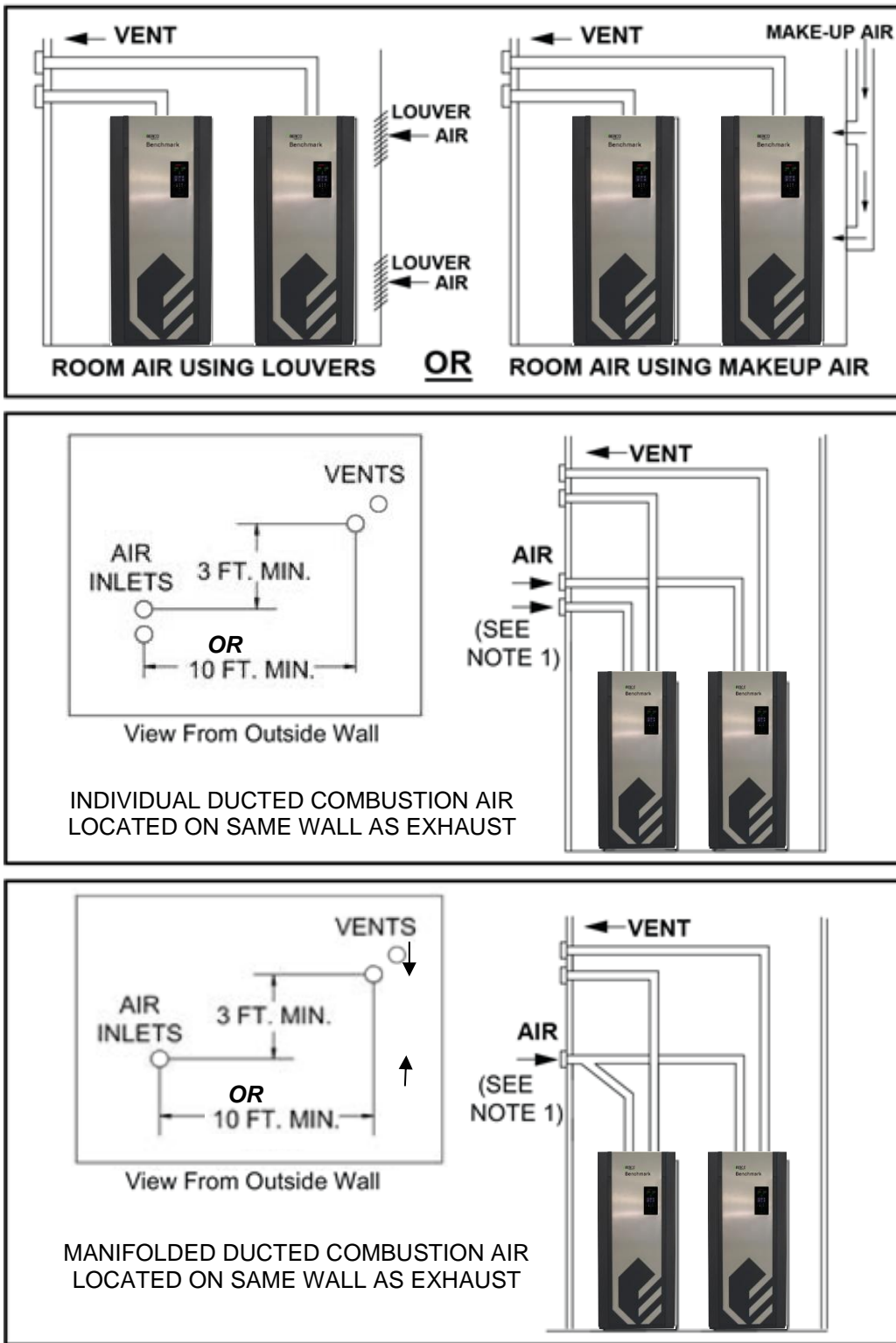
Vent drop + combustion air duct pressure drop  
 = 100.92 + 36.84  
 = 137.76 ft. (41.99 m)

**Conclusion:**

Pressure drop is less than 140 equivalent feet (42.7 m) – **System OK.**

## 7. MANIFOLDED DUCTED COMBUSTION AIR

For systems using manifolded ducted combustion ductwork, use the longest length of common duct and the individual branch to the furthest boiler to calculate the pressure drop.

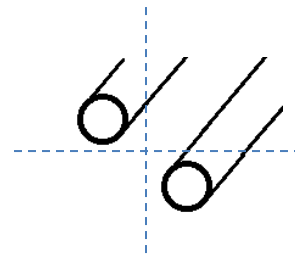
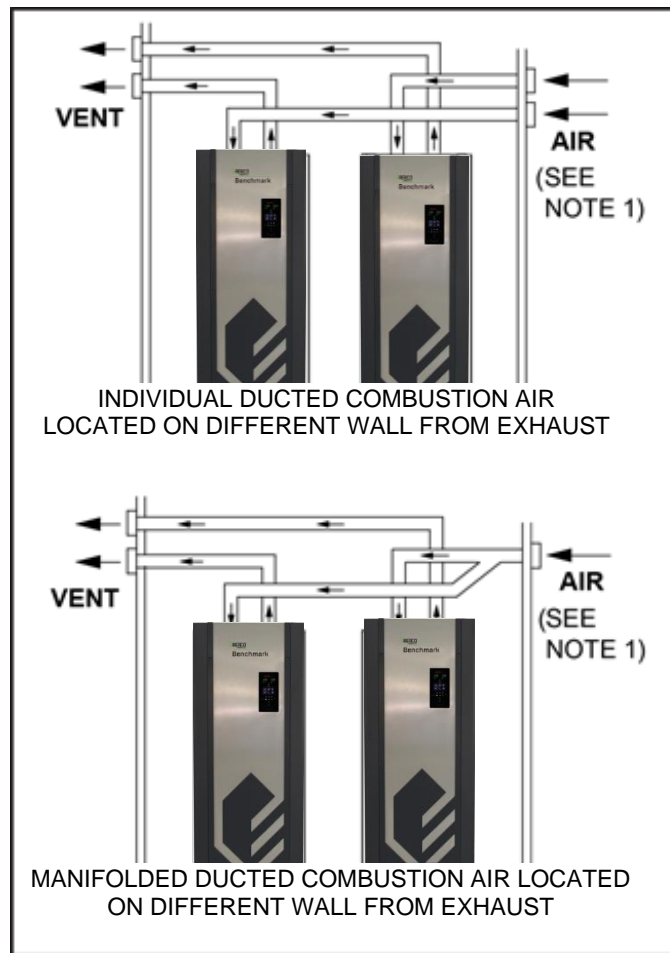


**NOTE:** Do not install flues directly above another flue termination as this can lead to exhaust gas recirculation; refer to NFPA 54 for details on code required vent termination.

**Figure 10a: Individual Vents – Preferred Installations**

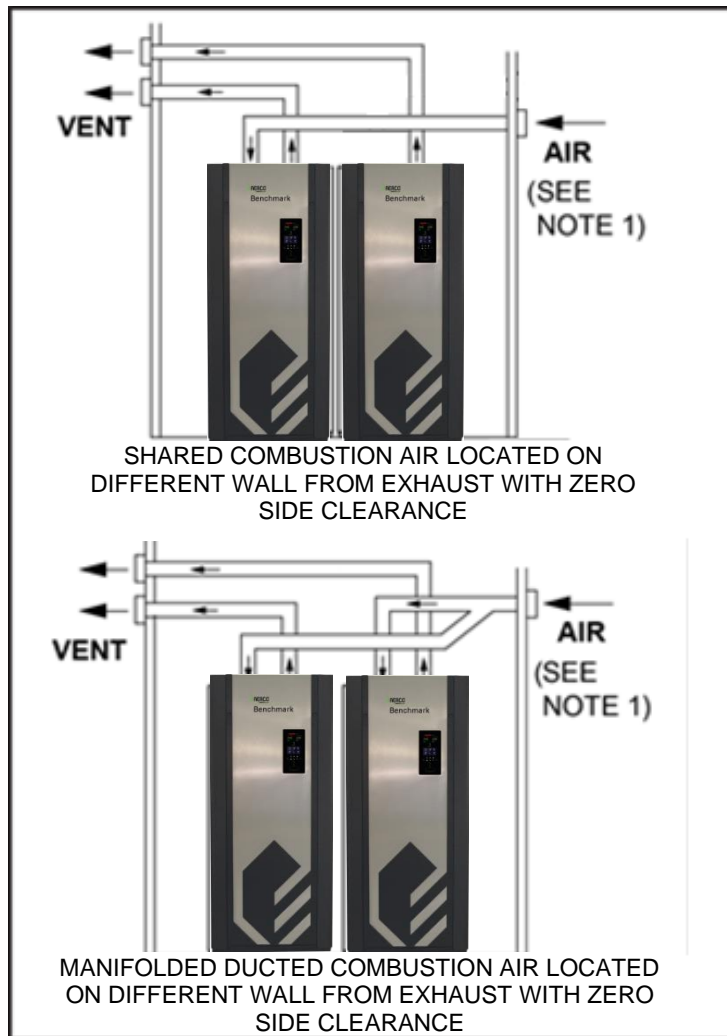
**NOTE:**

- For high wind sites, a tee must be installed at the fresh air inlet. The leg of the tee connects to the combustion air intake.
- On the flue vent side, a tee or exit cone (velocity cone) may be utilized in place of a rain cap for high wind sites.
- The branches of the tee can be in the horizontal or vertical direction, as determined by the system designer and site conditions.
- In cooler climates, flue terminations should be horizontally offset to eliminate ice formation, due to condensate, from blocking the lower exhaust (see diagram below).



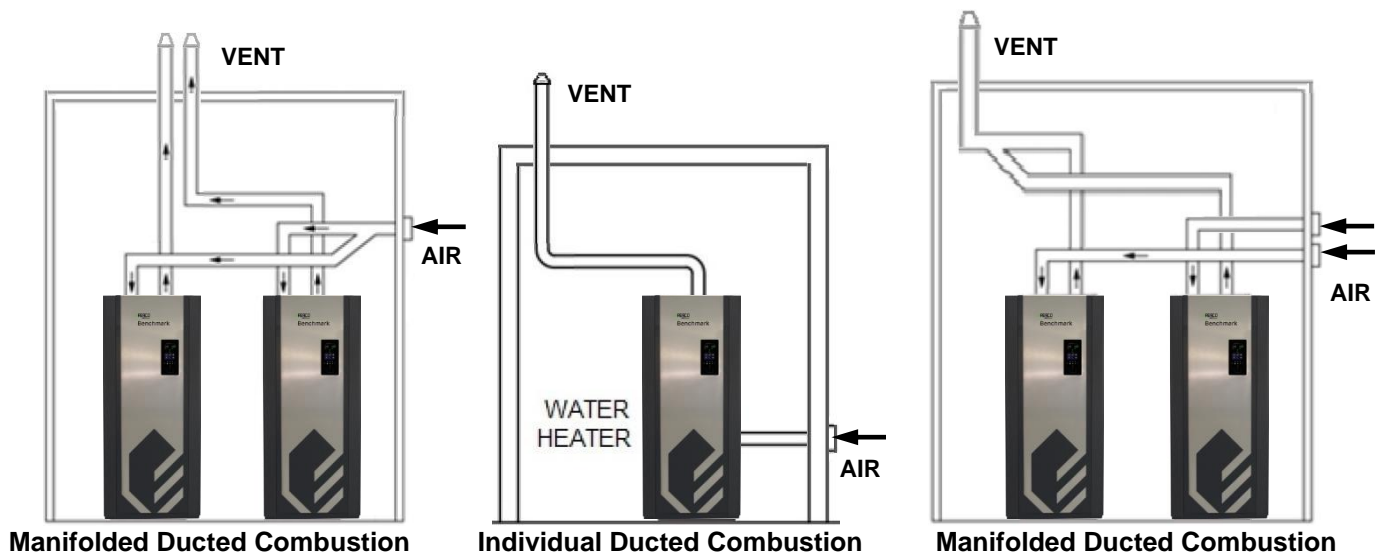
**NOTE:** Do not install flues directly above another flue termination as this can refer to NFPA 54 for details on code required vent termination.

**Figure 10b: Individual Vents – Acceptable Installations**



**NOTE:** The panels should be removed and the internal gap between the units should be sealed using weather tape, rubber strip or other sealant.

**Figure 10c: Individual Vents – ACCEPTABLE Installations**

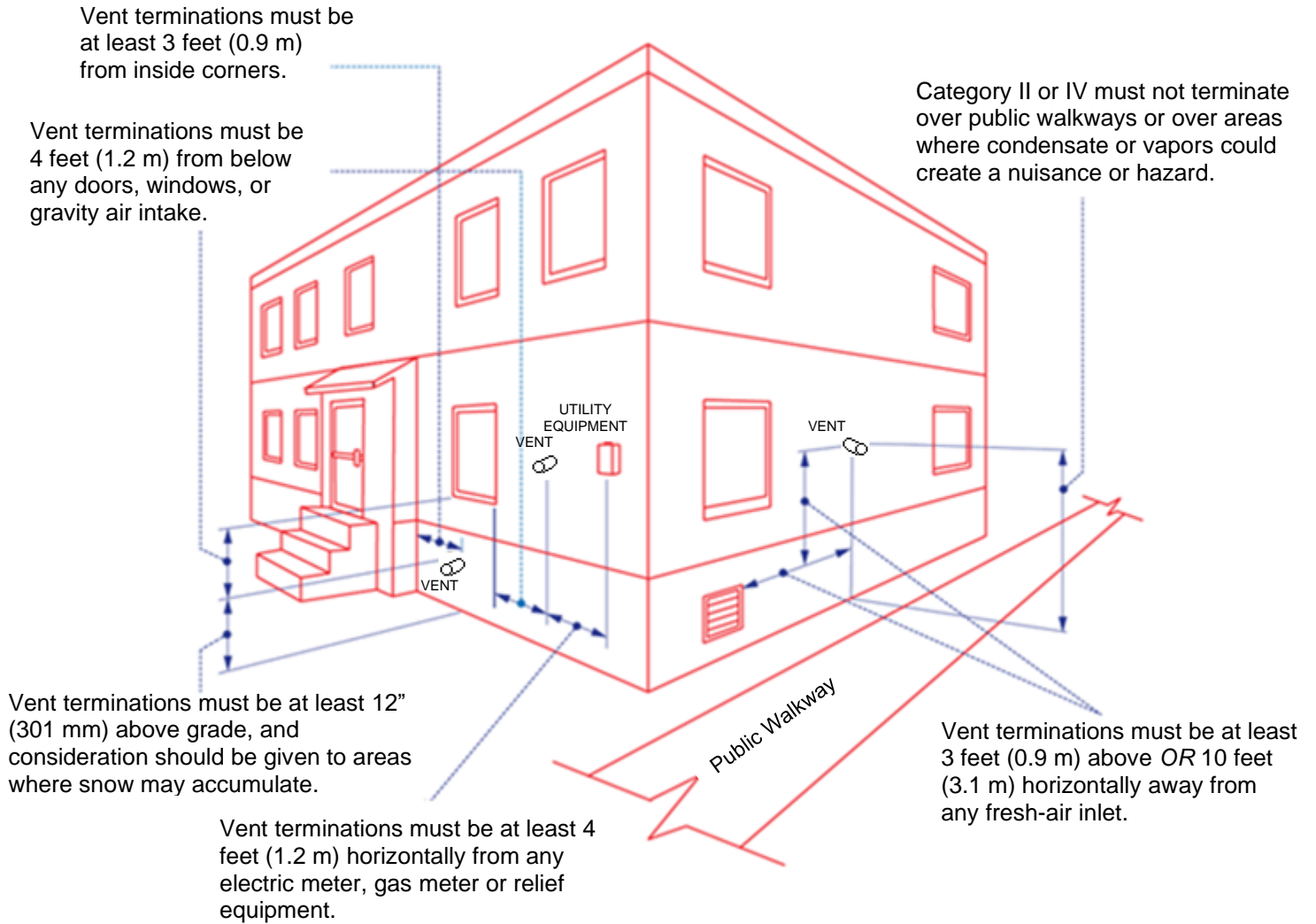


**Figure 10d: Individual Vents – ACCEPTABLE Installations**

**NOTE:** For high wind sites, a tee may be installed at the fresh air inlet. The leg of the tee connects to the combustion air intake. The branches of the tee can be in the horizontal or vertical direction, as determined by the system designer and site conditions.

**IMPORTANT NOTES:**

1. Please consult the AERCO factory for all applications utilizing common ducted combustion air with common breeching of exhausts.
2. AERCO boilers and AERCO water heaters may share common combustion air and exhaust breeching. Other configurations, not depicted in this guide, are possible. If you intend to implement any of these options, please contact your local AERCO representative or the AERCO factory for project specific venting and combustion air configurations.



**NOTE:** Vertical terminations shall extend at least 3 feet (0.9 m) above the highest point where it passes through a roof of a building and at least 2 feet (0.6 m) higher than any portion of the building within a horizontal distance of 10 feet (3.1 m). Termination that extend more than 2 feet (0.6 m) above the roof must be laterally supported

**Figure 10d: Determining Location of Vent Outlet**

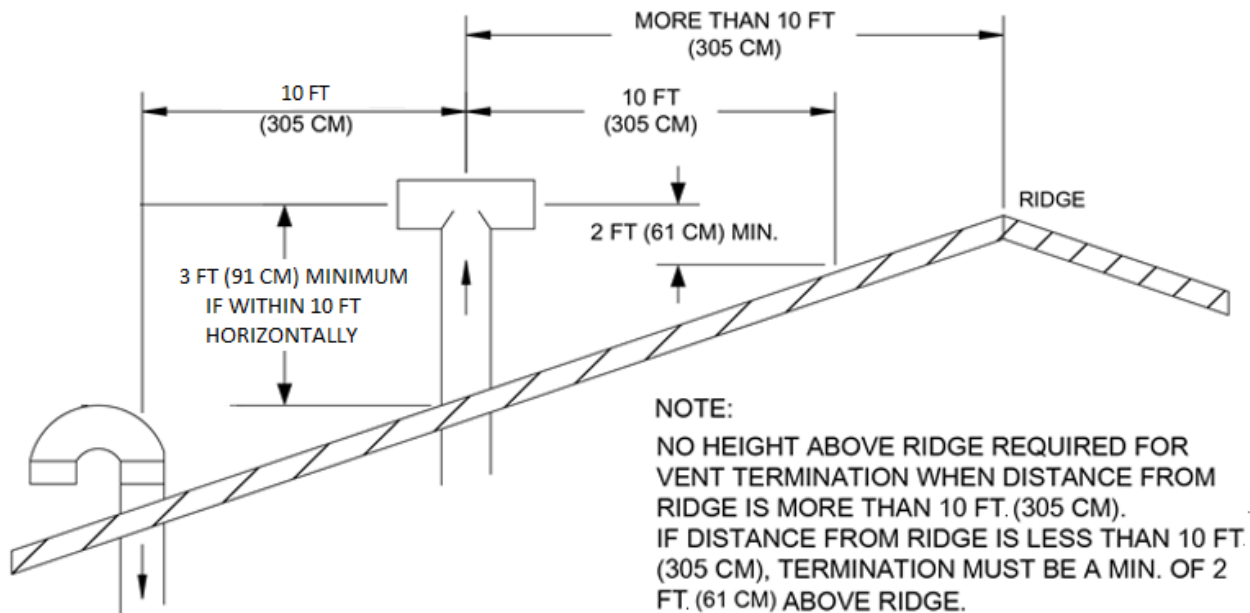
**7.1 Installation Requirements For Vertical Venting**

**WARNING!**

DO NOT INSULATE OR OTHERWISE WRAP VENT PIPE OR FITTINGS. FOLLOW THE VENT PIPE MANUFACTURERS INSTALLATION INSTRUCTIONS FOR VERTICAL VENTING.

The vent termination must be located as follows (refer to Figure 10e):

- a. Combustion air inlet must be 3 ft. (0.9 m) below any vent outlet that is within 10 ft. (3.1 m).
- b. Vertical terminations shall extend at least 3 ft. (0.9 m) above the highest point where it passes through a roof of a building and at least 2 ft. (0.6 m) higher than any portion of the building within a horizontal distance of 10 ft. (3.1 m). Terminations that extend more than 2 ft. above the roof must be laterally supported.
- c. Combustion air inlet must also face away from the vent outlet.
- d. Use vent pipe manufacturer’s vent cap or exit cone (velocity cone), fire stop, support collar, roof flushing and storm collar.
- e. AERCO recommends the use of an exit cone in lieu of a termination rain cap for normal installations and T- termination for high-wind areas.



**Figure 10e: Acceptable Combustion Air Inlet & Vent Outlet Configuration**

**8. COMMON VENT BREECHING (MANIFOLDED)**

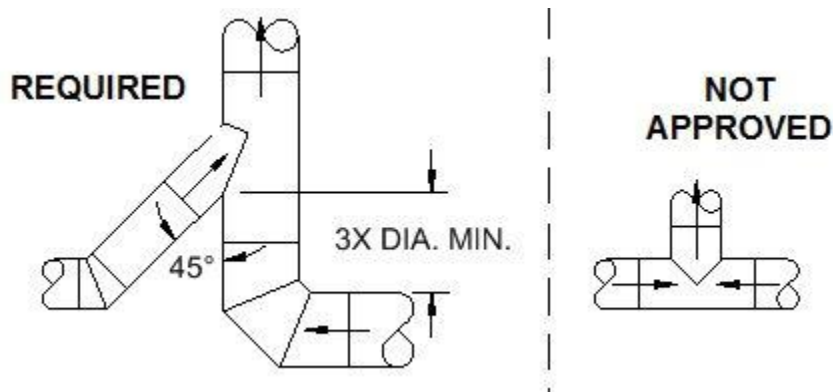
- IMPORTANT NOTES:**
1. AERCO forced draft boilers are designed for application in common vent systems.
  2. Please consult the AERCO factory for all applications utilizing common ducted combustion air with common breeching of exhausts.
  3. AERCO boilers and AERCO water heaters may share common combustion air and exhaust breeching. Other configurations, not depicted in this guide, are possible. If you intend to implement any of these options, please contact your local AERCO representative or the AERCO factory for project specific venting and combustion air configurations and for design assistance and approval when designing manifolded exhaust vent systems.
  4. For applications requiring side wall termination of common venting, please contact AERCO representative.

Connections to common vent breeching or duct work must be accomplished with a 45° elbow in the direction of flow in the main breeching. “Tees” must not be used to accomplish these connections - see Figure 11a. The required minimum common venting vertical vent run should be 10 feet (3.1 m) up to vertical termination after the last boiler is connected to common header.



**Figure 11a: Required Connections to Common Vent Breeching**

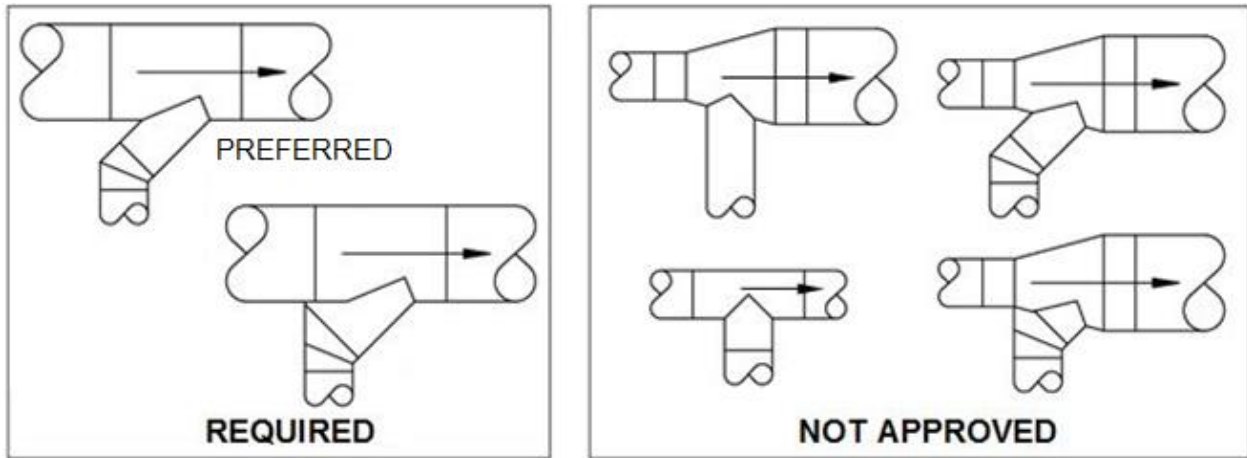
Interconnection of groups of units must *never* be accomplished via a “tee”. As shown in Figure 11b, change the direction with one of the mains and then connect the second three diameters (common section diameter) from this turn via a 45° connection.



**Figure 11b: Required Interconnection of Groups of Units**



Figure 12 illustrates the preferable “transition vent section” when making the 45° connection into a main. The main can also remain at one diameter, as long as it is sized for the total number of units vented and the 45° branch connection is retained. Use of the recommended “transition” assembly will reduce the overall system pressure drop.



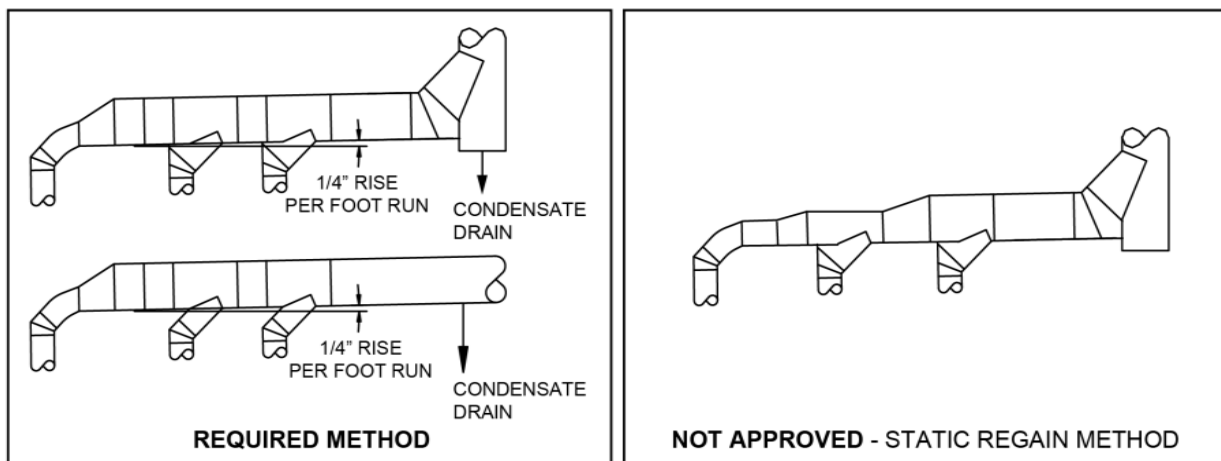
**Figure 12: Required Transition Vent Sections**

The vent system should always be pitched up ¼-inch per foot (21 mm per m) of run towards the vent termination (see Figure 13). This will enable condensate to drain back to the unit for disposal. Low spots in the vent must be avoided. Inspect periodically to ensure correct drainage.

As shown in Figure 13, the unit at the end of the vent main must be connected via an elbow. An end cap must not be used as it may cause vibration and flue pressure fluctuations.

As discussed previously, the static regain method should not be used for common ductwork, but rather, the one duct size should be used for the common run.

Benchmark vents must never be interconnected to those connected to another manufacturers’ equipment.



**Figure 13: Connection of Unit at End of Vent Main**

**9. PRESSURE DROP AND DRAFT DATA TABLES**

**9.1 Discharge Flue Vent Pressure Drop**

**Table 1-a: Discharge Flue Vent Pressure Drop (Eq. Ft.) for Single BMK750 Boiler**

(Assuming 180 °F (82.2 °C) Water Temperature and 20 °F (11 °C) Rise at Sea Level)

Flue Vent Inch Dia. (cm)	Flue Velocity in Ft./sec (m/sec)	Straight Run in Eq. Ft. / Foot (m/m)	90° elbow Eq. Ft. (m)	45° elbow Eq. Ft. (m)	Exit Loss Horiz. Term. Eq. Ft. (m)	Exit Loss Rain Cap Eq. Ft. (m)
6 (15.2)	16.65 (5.07)	0.45 (0.45)	2.90 (0.88)	2.15 (0.66)	3.59 (1.09)	5.13 (1.56)
8 (20.3)	9.37 (2.86)	0.11 (0.11)	0.74 (0.23)	0.56 (0.17)	1.14 (0.35)	2.11 (0.64)
10 (25.4)	5.99 (1.83)	0.04 (0.04)	0.26 (0.08)	0.20 (0.06)	0.47 (0.14)	0.86 (0.26)
12 (30.5)	4.16 (1.27)	0.02 (0.02)	0.11 (0.03)	0.09 (0.03)	0.22 (0.07)	0.42 (0.13)
14 (35.6)	3.06 (0.93)	0.01 (0.01)	0.06 (0.02)	0.04 (0.01)	0.12 (0.04)	0.23 (0.07)

**Table 1-b: Discharge Flue Vent Pressure Drop (Eq. Ft.) for Single BMK1000 Boiler**

(Assuming 180 °F (82.2 °C) Water Temperature and 20 °F (11 °C) Rise at Sea Level)

Flue Vent Inch Dia. (cm)	Flue Velocity in Ft./sec (m/sec)	Straight Run in Eq. Ft. / Foot (m/m)	90° elbow Eq. Ft. (m)	45° elbow Eq. Ft. (m)	Exit Loss Horiz. Term. Eq. Ft. (m)	Exit Loss Rain Cap Eq. Ft. (m)
6 (15.2)	22.20 (6.77)	0.77 (0.77)	5.15 (1.57)	3.82 (1.16)	6.39 (1.95)	9.12 (2.78)
8 (20.3)	12.49 (3.81)	0.18 (0.18)	1.32 (0.40)	0.99 (0.30)	2.02 (0.62)	3.75 (1.14)
10 (25.4)	7.99 (2.44)	0.06 (0.06)	0.47 (0.14)	0.36 (0.11)	0.83 (0.25)	1.54 (0.47)
12 (30.5)	5.55 (1.69)	0.03 (0.03)	0.20 (0.06)	0.16 (0.05)	0.40 (0.12)	0.74 (0.23)
14 (35.6)	4.08 (1.24)	0.01 (0.01)	0.10 (0.03)	0.08 (0.02)	0.22 (0.07)	0.40 (0.12)

**Table 1-c: Discharge Flue Vent Pressure Drop (Eq. Ft.) for Single BMK1500 Boiler**

(Assuming 180 °F (82.2 °C) Water Temperature and 20 °F (11 °C) Rise at Sea Level)

Flue Vent Inch Dia. (cm)	Flue Velocity in Ft./sec (m/sec)	Straight Run in Eq. Ft. / Foot (m/m)	90° elbow Eq. Ft. (m)	45° elbow Eq. Ft. (m)	Exit Loss Horiz. Term. Eq. Ft. (m)	Exit Loss Rain Cap Eq. Ft. (m)
6 (15.2)	34.43 (10.49)	1.77 (1.77)	13.11 (4.00)	9.98 (3.04)	15.37 (4.68)	21.95 (6.69)
8 (20.3)	19.37 (5.90)	0.40 (0.40)	3.13 (0.95)	2.36 (0.72)	4.86 (1.48)	9.03 (2.75)
10 (25.4)	12.4 (3.78)	0.13 (0.13)	1.06 (0.32)	0.80 (0.24)	1.99 (0.61)	3.70 (1.13)
12 (30.5)	8.62 (2.63)	0.05 (0.05)	0.46 (0.14)	0.35 (0.11)	0.96 (0.29)	1.78 (0.54)
14 (35.6)	6.33 (1.93)	0.03 (0.03)	0.24 (0.07)	0.19 (0.06)	0.52 (0.16)	0.96 (0.29)
16 (40.6)	4.85 (1.48)	0.01 (0.01)	0.14 (0.04)	0.11 (0.03)	0.3 (0.09)	0.56 (0.17)

**Table 1-d: Discharge Venting Pressure Drop for Single BMK2000 Boiler**

(Assuming 180 °F (82.2 °C) Water Temperature and 20 °F (11 °C) Rise at Sea Level)

Flue Vent Inch Dia. (cm)	Flue Velocity in Ft./sec (m/sec)	Straight Run in Eq. Ft. / Foot (m/m)	90° elbow Eq. Ft. (m)	45° elbow Eq. Ft. (m)	Exit Loss Horiz. Term. Eq. Ft. (m)	Exit Loss Rain Cap Eq. Ft. (m)
8 (20.3)	26.35 (8.03)	0.71 (0.71)	5.86 (1.79)	4.42 (1.35)	9.00 (2.74)	16.71 (5.09)
10 (25.4)	16.87 (5.14)	0.23 (0.23)	2.08 (0.63)	1.59 (0.48)	3.69 (1.12)	6.85 (2.09)
12 (30.5)	11.71 (3.57)	0.09 (0.09)	0.91 (0.28)	0.70 (0.21)	1.78 (0.54)	3.30 (1.01)
14 (35.6)	8.60 (2.62)	0.04 (0.04)	0.46 (0.14)	0.35 (0.11)	0.96 (0.29)	1.78 (0.54)
16 (40.6)	6.59 (2.01)	0.02 (0.02)	0.25 (0.08)	0.20 (0.06)	0.56 (0.17)	1.04 (0.32)
18 (45.7)	5.21 (1.59)	0.01 (0.01)	0.15 (0.05)	0.12 (0.04)	0.35 (0.11)	0.65 (0.20)

**Table 1-e: Discharge Venting Pressure Drop for Single BMK2500 Boiler**

(Assuming 180 °F (82.2 °C) Water Temperature and 20 °F (11 °C) Rise at Sea Level)

Flue Vent Inch Dia. (cm)	Flue Velocity in Ft./sec (m/sec)	Straight Run in Eq. Ft. / Foot (m/m)	90° elbow Eq. Ft. (m)	45° elbow Eq. Ft. (m)	Exit Loss Horiz. Term. Eq. Ft. (m)	Exit Loss Rain Cap Eq. Ft. (m)
8 (20.3)	25.62 (7.81)	0.93 (0.93)	5.54 (1.69)	4.17 (1.27)	8.51 (2.59)	15.89 (4.84)
10 (25.4)	16.49 (5.03)	0.30 (0.30)	1.97 (0.60)	1.51 (0.46)	3.48 (1.06)	6.47 (1.97)
12 (30.5)	11.39 (3.47)	0.12 (0.12)	0.86 (0.26)	0.67 (0.20)	1.68 (0.51)	3.12 (0.95)
14 (35.6)	8.37 (2.55)	0.06 (0.06)	0.43 (0.13)	0.34 (0.10)	0.91 (0.28)	1.68 (0.51)
16 (40.6)	6.40 (1.95)	0.03 (0.03)	0.24 (0.07)	0.19 (0.06)	0.53 (0.16)	0.99 (0.30)
18 (45.7)	5.06 (1.54)	0.02 (0.02)	0.14 (0.04)	0.11 (0.03)	0.33 (0.10)	0.62 (0.19)

**Table 1-f: Discharge Flue Vent Pressure Drop (Eq. Ft.) for Single BMK3000 Boiler**

(Assuming 180 °F (82.2 °C) Water Temperature and 20 °F (11 °C) Rise at Sea Level)

Flue Vent Inch Dia. (cm)	Flue Velocity in Ft./sec (m/sec)	Straight Run in Eq. Ft. / Foot (m/m)	90° elbow Eq. Ft. (m)	45° elbow Eq. Ft. (m)	Exit Loss Horiz. Term. Eq. Ft. (m)	Exit Loss Rain Cap Eq. Ft. (m)
8 (20.3)	29.28 (8.92)	1.46 (0.45)	11.98 (3.65)	9.01 (2.75)	18.6 (5.67)	34.54 (10.53)
10 (25.4)	19.13 (5.83)	0.47 (0.14)	4.05 (1.23)	3.04 (0.93)	7.62 (2.32)	14.15 (4.31)
12 (30.5)	13.28 (4.05)	0.19 (0.06)	1.76 (0.54)	1.34 (0.41)	3.67 (1.12)	6.82 (2.08)
14 (35.6)	9.76 (2.97)	0.09 (0.03)	0.92 (0.28)	0.71 (0.22)	1.98 (0.60)	3.68 (1.12)
16 (40.6)	7.47 (2.28)	0.05 (0.02)	0.53 (0.16)	0.42 (0.13)	1.16 (0.35)	2.16 (0.66)
18 (45.7)	5.90 (1.80)	0.03 (0.01)	0.33 (0.16)	0.26 (0.08)	0.73 (0.22)	1.35 (0.41)

**Table 1-g: Discharge Flue Vent Pressure Drop (Eq. Ft.) for Single BMK4000 Boiler**

(Assuming 180 °F (82.2 °C) Water Temperature and 20 °F (11 °C) Rise at Sea Level)

Flue Vent Inch Dia. (cm)	Flue Velocity in Ft./sec (m/sec)	Straight Run in Eq. Ft. / Foot (m/m)	90° elbow Eq. Ft. (m)	45° elbow Eq. Ft. (m)	Exit Loss Horiz. Term. Eq. Ft. (m)	Exit Loss Rain Cap Eq. Ft. (m)
12 (30.5)	24.41 (7.44)	0.38 (0.38)	3.95 (1.2)	3.06 (0.93)	7.74 (2.36)	14.34 (4.37)
14 (35.6)	17.93 (5.47)	0.18 (0.18)	1.98 (0.6)	1.54 (0.47)	4.18 (1.27)	7.74 (2.36)
16 (40.6)	13.72 (4.18)	0.09 (0.09)	1.09 (0.33)	0.85 (0.26)	2.45 (0.75)	4.53 (1.38)
18 (45.7)	10.84 (3.3)	0.05 (0.05)	0.65 (0.2)	0.51 (0.16)	1.53 (0.47)	2.83 (0.86)
20 (6.1)	8.78 (2.68)	0.03 (0.03)	0.41 (0.12)	0.32 (0.1)	1 (0.3)	1.85 (0.56)

**Table 1-h: Discharge Flue Vent Pressure Drop (Eq. Ft.) for Single BMK5000N Boiler**

(Assuming 180 °F (82.2 °C) Water Temperature and 20 °F (11 °C) Rise at Sea Level)

Flue Vent Inch Dia. (cm)	Flue Velocity in Ft./sec (m/sec)	Straight Run in Eq. Ft. / Foot (m/m)	90° elbow Eq. Ft. (m)	45° elbow Eq. Ft. (m)	Exit Loss Horiz. Term. Eq. Ft. (m)	Exit Loss Rain Cap Eq. Ft. (m)
12 (30.5)	30.54 (9.31)	0.58 (0.58)	6.18 (1.88)	4.78 (1.46)	12.12 (3.69)	22.45 (6.84)
14 (35.6)	22.43 (6.84)	0.27 (0.27)	3.09 (0.94)	2.41 (0.73)	6.54 (1.99)	12.11 (3.69)
16 (40.6)	17.17 (5.23)	0.14 (0.14)	1.71 (0.52)	1.33 (0.41)	3.83 (1.17)	7.1 (2.16)
18 (45.7)	13.56 (4.13)	0.08 (0.08)	1.01 (0.31)	0.79 (0.24)	2.39 (0.73)	4.43 (1.35)
20 (6.1)	10.98 (3.35)	0.05 (0.05)	0.63 (0.19)	0.5 (0.15)	1.57 (0.48)	2.9 (0.88)

**Table 1-i: Discharge Flue Vent Pressure Drop (Eq. Ft.) for Single BMK5000/6000 Boiler**

(Assuming 180 °F (82.2 °C) Water Temperature and 20 °F (11 °C) Rise at Sea Level)

Flue Vent Inch Dia. (cm)	Flue Velocity in Ft./sec (m/sec)	Straight Run in Eq. Ft. / Foot (m/m)	90° elbow Eq. Ft. (m)	45° elbow Eq. Ft. (m)	Exit Loss Horiz. Term. Eq. Ft. (m)	Exit Loss Rain Cap Eq. Ft. (m)
12 (30.5)	30.59 (9.32)	0.64 (0.64)	6.20 (1.89)	4.80 (1.46)	12.13 (3.7)	22.53 (6.87)
14 (35.6)	22.48 (6.85)	0.29 (0.29)	3.11 (0.95)	2.42 (0.74)	6.55 (2.0)	12.16 (3.71)
16 (40.6)	17.21 (5.25)	0.15 (0.15)	1.72 (0.52)	1.34 (0.41)	3.84 (1.17)	7.13 (2.17)
18 (45.7)	13.60 (4.15)	0.08 (0.08)	1.02 (0.31)	0.79 (0.24)	2.40 (0.73)	4.45 (1.36)
20 (6.1)	11.01 (3.36)	0.05 (0.05)	0.64 (0.2)	0.50 (0.15)	1.57 (0.48)	2.92 (0.89)

**9.2 Ducted Combustion Air Duct Pressure Drop**

**Table 2-a: Ducted Combustion Air Duct Pressure Drop in Eq. Ft. (m) for BMK750 Boiler**

Inlet Duct & No. Boilers	Duct Section Type	Outside Air Temperature in °F (°C)								
		-30 °F (-34.4)	-15 °F (-26.1)	0 °F (-17.8)	20 °F (-6.7)	40 °F (4.4)	60 °F (15.6)	80 °F (26.7)	100 °F (37.8)	120 °F (48.9)
6" Duct Single Boiler	Straight Run	0.27 (0.27)	0.27 (0.27)	0.28 (0.28)	0.29 (0.29)	0.30 (0.30)	0.31 (0.31)	0.32 (0.32)	0.33 (0.33)	0.34 (0.34)
	90° Elbow	1.18 (0.36)	1.23 (0.375)	1.29 (0.393)	1.38 (0.421)	1.47 (0.448)	1.57 (0.479)	1.68 (0.512)	1.79 (0.546)	1.91 (0.582)
	45° Elbow	0.87 (0.265)	0.91 (0.277)	0.96 (0.293)	1.02 (0.311)	1.09 (0.332)	1.16 (0.354)	1.24 (0.378)	1.32 (0.402)	1.41 (0.43)
	Ent. Loss	1.83 (0.558)	1.92 (0.585)	2.02 (0.616)	2.15 (0.655)	2.29 (0.698)	2.45 (0.747)	2.61 (0.796)	2.79 (0.85)	2.97 (0.905)
8" Duct Single Boiler	Straight Run	0.07 (0.07)	0.07 (0.07)	0.07 (0.07)	0.07 (0.07)	0.07 (0.07)	0.08 (0.08)	0.08 (0.08)	0.08 (0.08)	0.08 (0.08)
	90° Elbow	0.30 (0.091)	0.31 (0.094)	0.33 (0.101)	0.35 (0.107)	0.38 (0.116)	0.40 (0.122)	0.43 (0.131)	0.46 (0.14)	0.49 (0.149)
	45° Elbow	0.23 (0.07)	0.24 (0.073)	0.25 (0.076)	0.27 (0.082)	0.28 (0.085)	0.30 (0.091)	0.32 (0.098)	0.34 (0.104)	0.37 (0.113)
	Ent. Loss	0.58 (0.177)	0.61 (0.186)	0.64 (0.195)	0.68 (0.207)	0.73 (0.223)	0.77 (0.235)	0.83 (0.253)	0.88 (0.268)	0.94 (0.287)
8" Duct Two Boilers	Straight Run	0.20 (0.20)	0.21 (0.21)	0.22 (0.22)	0.23 (0.23)	0.25 (0.25)	0.26 (0.26)	0.28 (0.28)	0.30 (0.30)	0.32 (0.32)
	90° Elbow	1.20 (0.366)	1.26 (0.384)	1.32 (0.402)	1.41 (0.43)	1.5 (0.457)	1.6 (0.488)	1.71 (0.521)	1.83 (0.558)	1.95 (0.594)
	45° Elbow	0.90 (0.274)	0.95 (0.29)	1.00 (0.305)	1.06 (0.323)	1.13 (0.344)	1.21 (0.369)	1.29 (0.393)	1.38 (0.421)	1.47 (0.448)
	Ent. Loss	2.32 (0.707)	2.43 (0.741)	2.55 (0.777)	2.72 (0.829)	2.90 (0.884)	3.10 (0.945)	3.31 (1.009)	3.53 (1.076)	3.76 (1.146)
10" Duct Two Boilers	Straight Run	0.07 (0.07)	0.07 (0.07)	0.07 (0.07)	0.08 (0.08)	0.08 (0.08)	0.09 (0.09)	0.09 (0.09)	0.10 (0.10)	0.11 (0.11)
	90° Elbow	0.43 (0.131)	0.45 (0.137)	0.47 (0.143)	0.5 (0.152)	0.53 (0.162)	0.57 (0.174)	0.61 (0.186)	0.65 (0.198)	0.69 (0.21)
	45° Elbow	0.33 (0.101)	0.34 (0.104)	0.36 (0.11)	0.38 (0.116)	0.41 (0.125)	0.44 (0.134)	0.47 (0.143)	0.50 (0.152)	0.53 (0.162)
	Ent. Loss	0.95 (0.29)	1.00 (0.305)	1.05 (0.32)	1.11 (0.338)	1.19 (0.363)	1.27 (0.387)	1.35 (0.411)	1.44 (0.439)	1.54 (0.469)
10" Duct Three Boilers	Straight Run	0.14 (0.14)	0.15 (0.15)	0.15 (0.15)	0.16 (0.16)	0.17 (0.17)	0.19 (0.19)	0.2 (0.20)	0.21 (0.21)	0.23 (0.23)
	90° Elbow	0.96 (0.293)	1.01 (0.308)	1.06 (0.323)	1.13 (0.344)	1.20 (0.366)	1.28 (0.39)	1.37 (0.418)	1.46 (0.445)	1.56 (0.475)
	45° Elbow	0.74 (0.226)	0.77 (0.235)	0.81 (0.247)	0.86 (0.262)	0.92 (0.28)	0.98 (0.299)	1.05 (0.32)	1.12 (0.341)	1.19 (0.363)
	Ent. Loss	2.14 (0.652)	2.24 (0.683)	2.35 (0.716)	2.51 (0.765)	2.68 (0.817)	2.86 (0.872)	3.05 (0.93)	3.25 (0.991)	3.47 (1.058)

**Table 2-a: Ducted Combustion Air Duct Pressure Drop in Eq. Ft. (m) for BMK750 Boiler – Continued**

Inlet Duct & No. Boilers	Duct Section Type	Outside Air Temperature in °F (°C)								
		-30 °F (-34.4)	-15 °F (-26.1)	0 °F (-17.8)	20 °F (-6.7)	40 °F (4.4)	60 °F (15.6)	80 °F (26.7)	100 °F (37.8)	120 °F (48.9)
12" Duct Three Boilers	Straight Run	0.06 (0.06)	0.06 (0.06)	0.06 (0.06)	0.07 (0.07)	0.07 (0.07)	0.08 (0.08)	0.08 (0.08)	0.09 (0.09)	0.09 (0.09)
	90° Elbow	0.42 (0.128)	0.44 (0.134)	0.46 (0.14)	0.49 (0.149)	0.53 (0.162)	0.56 (0.171)	0.6 (0.183)	0.64 (0.195)	0.68 (0.207)
	45° Elbow	0.32 (0.098)	0.34 (0.104)	0.36 (0.11)	0.38 (0.116)	0.41 (0.125)	0.43 (0.131)	0.46 (0.14)	0.49 (0.149)	0.53 (0.162)
	Ent. Loss	1.03 (0.314)	1.08 (0.329)	1.13 (0.344)	1.21 (0.369)	1.29 (0.393)	1.38 (0.421)	1.47 (0.448)	1.57 (0.479)	1.67 (0.509)
12" Duct Four Boilers	Straight Run	0.10 (0.10)	0.10 (0.10)	0.11 (0.11)	0.11 (0.11)	0.12 (0.12)	0.13 (0.13)	0.14 (0.14)	0.15 (0.15)	0.16 (0.16)
	90° Elbow	0.74 (0.226)	0.78 (0.238)	0.82 (0.25)	0.87 (0.265)	0.93 (0.283)	1.00 (0.305)	1.06 (0.323)	1.13 (0.344)	1.21 (0.369)
	45° Elbow	0.58 (0.177)	0.60 (0.183)	0.63 (0.192)	0.68 (0.207)	0.72 (0.219)	0.77 (0.235)	0.82 (0.25)	0.88 (0.268)	0.94 (0.287)
	Ent. Loss	1.83 (0.558)	1.92 (0.585)	2.02 (0.616)	2.15 (0.655)	2.29 (0.698)	2.45 (0.747)	2.61 (0.796)	2.79 (0.85)	2.97 (0.905)
14" Duct Four Boilers	Straight Run	0.05 (0.05)	0.05 (0.05)	0.05 (0.05)	0.05 (0.05)	0.06 (0.06)	0.06 (0.06)	0.06 (0.06)	0.07 (0.07)	0.07 (0.07)
	90° Elbow	0.37 (0.113)	0.39 (0.119)	0.41 (0.125)	0.44 (0.134)	0.47 (0.143)	0.5 (0.152)	0.53 (0.162)	0.57 (0.174)	0.61 (0.186)
	45° Elbow	0.29 (0.088)	0.30 (0.091)	0.32 (0.098)	0.34 (0.104)	0.36 (0.11)	0.39 (0.119)	0.41 (0.125)	0.44 (0.134)	0.47 (0.143)
	Ent. Loss	0.99 (0.302)	1.04 (0.317)	1.09 (0.332)	1.16 (0.354)	1.24 (0.378)	1.32 (0.402)	1.41 (0.43)	1.50 (0.457)	1.60 (0.488)

- NOTES:**
- 1) Calculation assumes 165 SCFM (4.67 m<sup>3</sup>/min) per boiler at full fire rate
  - 2) Units for "Straight Run" pressure drop values are equivalent feet per foot (eq. m / m)
  - 3) Units for "Elbows" and "Ent. Loss" are equivalent feet per item (eq. m / item)

**Table 2-b: Ducted Combustion Air Duct Pressure Drop in Eq. Ft. (m) for BMK1000 Boiler**

Inlet Duct & No. Boilers	Duct Section Type	Outside Air Temperature in °F (°C)								
		-30 °F (-34.4)	-15 °F (-26.1)	0 °F (-17.8)	20 °F (-6.7)	40 °F (4.4)	60 °F (15.6)	80 °F (26.7)	100 °F (37.8)	120 °F (48.9)
6" Duct Single Boiler	Straight Run	0.46 (0.46)	0.47 (0.47)	0.48 (0.48)	0.50 (0.50)	0.51 (0.51)	0.53 (0.53)	0.54 (0.54)	0.56 (0.56)	0.58 (0.58)
	90° Elbow	2.09 (0.637)	2.19 (0.668)	2.30 (0.701)	2.45 (0.747)	2.62 (0.799)	2.79 (0.85)	2.98 (0.908)	3.18 (0.969)	3.39 (1.033)
	45° Elbow	1.55 (0.472)	1.62 (0.494)	1.70 (0.518)	1.82 (0.555)	1.94 (0.591)	2.07 (0.631)	2.21 (0.674)	2.35 (0.716)	2.51 (0.765)
	Ent. Loss	3.26 (0.994)	3.42 (1.042)	3.58 (1.091)	3.82 (1.164)	4.08 (1.244)	4.35 (1.326)	4.64 (1.414)	4.95 (1.509)	5.29 (1.612)
8" Duct Single Boiler	Straight Run	0.11 (0.11)	0.11 (0.11)	0.12 (0.12)	0.12 (0.12)	0.12 (0.12)	0.13 (0.13)	0.13 (0.13)	0.14 (0.14)	0.14 (0.14)
	90° Elbow	0.53 (0.162)	0.56 (0.171)	0.59 (0.18)	0.63 (0.192)	0.67 (0.204)	0.71 (0.216)	0.76 (0.232)	0.81 (0.247)	0.87 (0.265)
	45° Elbow	0.4 (0.122)	0.42 (0.128)	0.44 (0.134)	0.47 (0.143)	0.50 (0.152)	0.54 (0.165)	0.57 (0.174)	0.61 (0.186)	0.65 (0.198)
	Ent. Loss	1.03 (0.314)	1.08 (0.329)	1.13 (0.344)	1.21 (0.369)	1.29 (0.393)	1.38 (0.421)	1.47 (0.448)	1.57 (0.479)	1.67 (0.509)
8" Duct Two Boilers	Straight Run	0.34 (0.34)	0.36 (0.36)	0.37 (0.37)	0.40 (0.40)	0.42 (0.42)	0.45 (0.45)	0.48 (0.48)	0.51 (0.51)	0.55 (0.55)
	90° Elbow	2.13 (0.649)	2.24 (0.683)	2.35 (0.716)	2.51 (0.765)	2.67 (0.814)	2.85 (0.869)	3.04 (0.927)	3.25 (0.991)	3.47 (1.058)
	45° Elbow	1.61 (0.491)	1.69 (0.515)	1.77 (0.539)	1.89 (0.576)	2.02 (0.616)	2.15 (0.655)	2.29 (0.698)	2.45 (0.747)	2.61 (0.796)
	Ent. Loss	4.12 (1.256)	4.32 (1.317)	4.54 (1.384)	4.84 (1.475)	5.16 (1.573)	5.51 (1.679)	5.88 (1.792)	6.27 (1.911)	6.69 (2.039)
10" Duct Two Boilers	Straight Run	0.11 (0.11)	0.12 (0.12)	0.12 (0.12)	0.13 (0.13)	0.14 (0.14)	0.15 (0.15)	0.16 (0.16)	0.17 (0.17)	0.18 (0.18)
	90° Elbow	0.76 (0.232)	0.80 (0.244)	0.84 (0.256)	0.89 (0.271)	0.95 (0.29)	1.01 (0.308)	1.08 (0.329)	1.15 (0.351)	1.23 (0.375)
	45° Elbow	0.58 (0.177)	0.61 (0.186)	0.64 (0.195)	0.68 (0.207)	0.73 (0.223)	0.78 (0.238)	0.83 (0.253)	0.88 (0.268)	0.94 (0.287)
	Ent. Loss	1.69 (0.515)	1.77 (0.539)	1.86 (0.567)	1.98 (0.604)	2.11 (0.643)	2.26 (0.689)	2.41 (0.735)	2.57 (0.783)	2.74 (0.835)
10" Duct Three Boilers	Straight Run	0.24 (0.24)	0.25 (0.25)	0.26 (0.26)	0.28 (0.28)	0.30 (0.30)	0.32 (0.32)	0.34 (0.34)	0.36 (0.36)	0.38 (0.38)
	90° Elbow	1.71 (0.521)	1.79 (0.546)	1.88 (0.573)	2.00 (0.61)	2.14 (0.652)	2.28 (0.695)	2.43 (0.741)	2.60 (0.792)	2.77 (0.844)
	45° Elbow	1.31 (0.399)	1.37 (0.418)	1.44 (0.439)	1.53 (0.466)	1.64 (0.5)	1.75 (0.533)	1.86 (0.567)	1.99 (0.607)	2.12 (0.646)
	Ent. Loss	3.80 (1.158)	3.98 (1.213)	4.18 (1.274)	4.46 (1.359)	4.76 (1.451)	5.08 (1.548)	5.42 (1.652)	5.78 (1.762)	6.16 (1.878)

**Table 2-b: Ducted Combustion Air Duct Pressure Drop in Eq. Ft. (m) for BMK1000 Boiler – Continued**

Inlet Duct & No. Boilers	Duct Section Type	Outside Air Temperature in °F (°C)								
		-30 °F (-34.4)	-15 °F (-26.1)	0 °F (-17.8)	20 °F (-6.7)	40 °F (4.4)	60 °F (15.6)	80 °F (26.7)	100 °F (37.8)	120 °F (48.9)
12" Duct Three Boilers	Straight Run	0.10 (0.10)	0.1 (0.10)	0.11 (0.11)	0.11 (0.11)	0.12 (0.12)	0.13 (0.13)	0.14 (0.14)	0.15 (0.15)	0.16 (0.16)
	90° Elbow	0.74 (0.226)	0.78 (0.238)	0.82 (0.25)	0.87 (0.265)	0.93 (0.283)	1 (0.305)	1.06 (0.323)	1.13 (0.344)	1.21 (0.369)
	45° Elbow	0.58 (0.177)	0.60 (0.183)	0.63 (0.192)	0.68 (0.207)	0.72 (0.219)	0.77 (0.235)	0.82 (0.25)	0.88 (0.268)	0.94 (0.287)
	Ent. Loss	1.83 (0.558)	1.92 (0.585)	2.02 (0.616)	2.15 (0.655)	2.29 (0.698)	2.45 (0.747)	2.61 (0.796)	2.79 (0.85)	2.97 (0.905)
12" Duct Four Boilers	Straight Run	0.16 (0.16)	0.17 (0.17)	0.18 (0.18)	0.19 (0.19)	0.21 (0.21)	0.22 (0.22)	0.23 (0.23)	0.25 (0.25)	0.26 (0.26)
	90° Elbow	1.32 (0.402)	1.39 (0.424)	1.46 (0.445)	1.56 (0.475)	1.66 (0.506)	1.77 (0.539)	1.89 (0.576)	2.02 (0.616)	2.15 (0.655)
	45° Elbow	1.02 (0.311)	1.08 (0.329)	1.13 (0.344)	1.20 (0.366)	1.28 (0.39)	1.37 (0.418)	1.46 (0.445)	1.56 (0.475)	1.66 (0.506)
	Ent. Loss	3.26 (0.994)	3.42 (1.042)	3.58 (1.091)	3.82 (1.164)	4.08 (1.244)	4.35 (1.326)	4.64 (1.414)	4.95 (1.509)	5.29 (1.612)
14" Duct Four Boilers	Straight Run	0.08 (0.08)	0.08 (0.08)	0.08 (0.08)	0.09 (0.09)	0.10 (0.10)	0.10 (0.10)	0.11 (0.11)	0.12 (0.12)	0.12 (0.12)
	90° Elbow	0.66 (0.201)	0.70 (0.213)	0.73 (0.223)	0.78 (0.238)	0.83 (0.253)	0.89 (0.271)	0.95 (0.29)	1.01 (0.308)	1.08 (0.329)
	45° Elbow	0.52 (0.158)	0.54 (0.165)	0.57 (0.174)	0.61 (0.186)	0.65 (0.198)	0.69 (0.21)	0.74 (0.226)	0.79 (0.241)	0.84 (0.256)
	Ent. Loss	1.76 (0.536)	1.84 (0.561)	1.93 (0.588)	2.06 (0.628)	2.20 (0.671)	2.35 (0.716)	2.51 (0.765)	2.67 (0.814)	2.85 (0.869)

- NOTES:**
- 1) Calculation assumes 200 SCFM (5.66 m<sup>3</sup>/min) per boiler at full fire rate
  - 2) Units for "Straight Run" pressure drop values are equivalent feet per foot (eq. m / m)
  - 3) Units for "Elbows" and "Ent. Loss" are equivalent feet per item (eq. m / item)



**Table 2-c: Ducted Combustion Air Duct Pressure Drop in Eq. Ft. (m) for BMK1500 Boiler**

Inlet Duct & No. Boilers	Duct Section Type	Outside Air Temperature in °F (°C)								
		-30 °F (-34.4)	-15 °F (-26.1)	0 °F (-17.8)	20 °F (-6.7)	40 °F (4.4)	60 °F (15.6)	80 °F (26.7)	100 °F (37.8)	120 °F (48.9)
6" Duct Single Boiler	Straight Run	0.98 (0.98)	1.00 (1.00)	1.02 (1.02)	1.06 (1.06)	1.09 (1.09)	1.13 (1.13)	1.16 (1.16)	1.20 (1.20)	1.24 (1.24)
	90° Elbow	4.97 (1.515)	5.21 (1.588)	5.47 (1.667)	5.84 (1.78)	6.23 (1.899)	6.64 (2.024)	7.09 (2.161)	7.56 (2.304)	8.07 (2.46)
	45° Elbow	3.78 (1.152)	3.97 (1.21)	4.17 (1.271)	4.44 (1.353)	4.74 (1.445)	5.06 (1.542)	5.4 (1.646)	5.76 (1.756)	6.14 (1.871)
	Ent. Loss	7.33 (2.234)	7.69 (2.344)	8.07 (2.46)	8.60 (2.621)	9.18 (2.798)	9.79 (2.984)	10.45 (3.185)	11.15 (3.399)	11.89 (3.624)
8" Duct Single Boiler	Straight Run	0.23 (0.23)	0.24 (0.24)	0.24 (0.24)	0.25 (0.25)	0.26 (0.26)	0.27 (0.27)	0.28 (0.28)	0.29 (0.29)	0.30 (0.30)
	90° Elbow	1.19 (0.363)	1.25 (0.381)	1.31 (0.399)	1.39 (0.424)	1.49 (0.454)	1.59 (0.485)	1.69 (0.515)	1.81 (0.552)	1.93 (0.588)
	45° Elbow	0.89 (0.271)	0.94 (0.287)	0.98 (0.299)	1.05 (0.32)	1.12 (0.341)	1.19 (0.363)	1.27 (0.387)	1.36 (0.415)	1.45 (0.442)
	Ent. Loss	2.32 (0.707)	2.43 (0.741)	2.55 (0.777)	2.72 (0.829)	2.90 (0.884)	3.10 (0.945)	3.31 (1.009)	3.53 (1.076)	3.76 (1.146)
10" Duct Two Boilers	Straight Run	0.24 (0.24)	0.25 (0.25)	0.26 (0.26)	0.28 (0.28)	0.30 (0.30)	0.32 (0.32)	0.34 (0.34)	0.36 (0.36)	0.38 (0.38)
	90° Elbow	1.60 (0.488)	1.68 (0.512)	1.77 (0.539)	1.88 (0.573)	2.01 (0.613)	2.14 (0.652)	2.29 (0.698)	2.44 (0.744)	2.60 (0.792)
	45° Elbow	1.21 (0.369)	1.27 (0.387)	1.33 (0.405)	1.42 (0.433)	1.51 (0.46)	1.61 (0.491)	1.72 (0.524)	1.84 (0.561)	1.96 (0.597)
	Ent. Loss	3.80 (1.158)	3.98 (1.213)	4.18 (1.274)	4.46 (1.359)	4.76 (1.451)	5.08 (1.548)	5.42 (1.652)	5.78 (1.762)	6.16 (1.878)
12" Duct Two Boilers	Straight Run	0.10 (0.10)	0.10 (0.10)	0.11 (0.11)	0.11 (0.11)	0.12 (0.12)	0.13 (0.13)	0.14 (0.14)	0.15 (0.15)	0.16 (0.16)
	90° Elbow	0.70 (0.213)	0.73 (0.223)	0.77 (0.235)	0.82 (0.25)	0.88 (0.268)	0.93 (0.283)	1.00 (0.305)	1.06 (0.323)	1.13 (0.344)
	45° Elbow	0.53 (0.162)	0.56 (0.171)	0.59 (0.18)	0.62 (0.189)	0.67 (0.204)	0.71 (0.216)	0.76 (0.232)	0.81 (0.247)	0.86 (0.262)
	Ent. Loss	1.83 (0.558)	1.92 (0.585)	2.02 (0.616)	2.15 (0.655)	2.29 (0.698)	2.45 (0.747)	2.61 (0.796)	2.79 (0.85)	2.97 (0.905)
12" Duct Three Boilers	Straight Run	0.20 (0.20)	0.21 (0.21)	0.22 (0.22)	0.24 (0.24)	0.26 (0.26)	0.27 (0.27)	0.29 (0.29)	0.31 (0.31)	0.33 (0.33)
	90° Elbow	1.57 (0.479)	1.65 (0.503)	1.73 (0.527)	1.85 (0.564)	1.97 (0.6)	2.10 (0.64)	2.24 (0.683)	2.39 (0.728)	2.55 (0.777)
	45° Elbow	1.20 (0.366)	1.26 (0.384)	1.32 (0.402)	1.41 (0.43)	1.50 (0.457)	1.60 (0.488)	1.71 (0.521)	1.82 (0.555)	1.94 (0.591)
	Ent. Loss	4.12 (1.256)	4.32 (1.317)	4.54 (1.384)	4.84 (1.475)	5.16 (1.573)	5.51 (1.679)	5.88 (1.792)	6.27 (1.911)	6.69 (2.039)

**Table 2-c: Ducted Combustion Air Duct Pressure Drop in Eq. Ft. (m) for BMK1500 Boiler – Continued**

Inlet Duct & No. Boilers	Duct Section Type	Outside Air Temperature in °F (°C)								
		-30 °F (-34.4)	-15 °F (-26.1)	0 °F (-17.8)	20 °F (-6.7)	40 °F (4.4)	60 °F (15.6)	80 °F (26.7)	100 °F (37.8)	120 °F (48.9)
14" Duct  Three Boilers	Straight Run	0.09 (0.09)	0.10 (0.10)	0.10 (0.10)	0.11 (0.11)	0.12 (0.12)	0.13 (0.13)	0.14 (0.14)	0.14 (0.14)	0.15 (0.15)
	90° Elbow	0.82 (0.25)	0.86 (0.262)	0.9 (0.274)	0.96 (0.293)	1.02 (0.311)	1.09 (0.332)	1.17 (0.357)	1.24 (0.378)	1.33 (0.405)
	45° Elbow	0.63 (0.192)	0.66 (0.201)	0.70 (0.213)	0.74 (0.226)	0.79 (0.241)	0.85 (0.259)	0.90 (0.274)	0.96 (0.293)	1.03 (0.314)
	Ent. Loss	2.22 (0.677)	2.33 (0.71)	2.45 (0.747)	2.61 (0.796)	2.79 (0.85)	2.97 (0.905)	3.17 (0.966)	3.38 (1.03)	3.61 (1.100)
14" Duct  Four Boilers	Straight Run	0.16 (0.16)	0.17 (0.17)	0.18 (0.18)	0.19 (0.19)	0.2 (0.20)	0.22 (0.22)	0.23 (0.23)	0.25 (0.25)	0.26 (0.26)
	90° Elbow	1.45 (0.442)	1.53 (0.466)	1.60 (0.488)	1.71 (0.521)	1.82 (0.555)	1.94 (0.591)	2.07 (0.631)	2.21 (0.674)	2.36 (0.719)
	45° Elbow	1.12 (0.341)	1.18 (0.36)	1.24 (0.378)	1.32 (0.402)	1.41 (0.43)	1.50 (0.457)	1.60 (0.488)	1.71 (0.521)	1.83 (0.558)
	Ent. Loss	3.95 (1.204)	4.15 (1.265)	4.35 (1.326)	4.64 (1.414)	4.95 (1.509)	5.29 (1.612)	5.64 (1.719)	6.02 (1.835)	6.42 (1.957)
16" Duct  Four Boilers	Straight Run	0.08 (0.08)	0.09 (0.09)	0.09 (0.09)	0.10 (0.10)	0.10 (0.10)	0.11 (0.11)	0.12 (0.12)	0.13 (0.13)	0.13 (0.13)
	90° Elbow	0.84 (0.256)	0.88 (0.268)	0.93 (0.283)	0.99 (0.302)	1.06 (0.323)	1.13 (0.344)	1.20 (0.366)	1.28 (0.39)	1.37 (0.418)
	45° Elbow	0.66 (0.201)	0.69 (0.21)	0.73 (0.223)	0.78 (0.238)	0.83 (0.253)	0.88 (0.268)	0.94 (0.287)	1 (0.305)	1.07 (0.326)
	Ent. Loss	2.32 (0.707)	2.43 (0.741)	2.55 (0.777)	2.72 (0.829)	2.9 (0.884)	3.10 (0.945)	3.31 (1.009)	3.53 (1.076)	3.76 (1.146)

- NOTES:** 1) Calculation assumes 300 SCFM (8.49 m<sup>3</sup>/min) per boiler at full fire rate  
 2) Units for "Straight Run" pressure drop values are equivalent feet per foot (eq. m / m)  
 3) Units for "Elbows" and "Ent. Loss" are equivalent feet per item (eq. m / item)

**Table 2-d: Ducted Combustion Air Duct Pressure Drop in Eq. Ft. (m) for BMK2000 Boiler**

Inlet Duct & No. Boilers	Duct Section Type	Outside Air Temperature in °F (°C)								
		-30 °F (-34.4)	-15 °F (-26.1)	0 °F (-17.8)	20 °F (-6.7)	40 °F (4.4)	60 °F (15.6)	80 °F (26.7)	100 °F (37.8)	120 °F (48.9)
8" Duct Single Boiler	Straight Run	0.40 (0.40)	0.41 (0.41)	0.42 (0.42)	0.43 (0.43)	0.44 (0.44)	0.46 (0.46)	0.47 (0.47)	0.49 (0.49)	0.50 (0.50)
	90° Elbow	2.13 (0.649)	2.24 (0.683)	2.35 (0.716)	2.51 (0.765)	2.67 (0.814)	2.85 (0.869)	3.04 (0.927)	3.25 (0.991)	3.47 (1.058)
	45° Elbow	1.61 (0.491)	1.69 (0.515)	1.77 (0.539)	1.89 (0.576)	2.02 (0.616)	2.15 (0.655)	2.29 (0.698)	2.45 (0.747)	2.61 (0.796)
	Ent. Loss	4.12 (1.256)	4.32 (1.317)	4.54 (1.384)	4.84 (1.475)	5.16 (1.573)	5.51 (1.679)	5.88 (1.792)	6.27 (1.911)	6.69 (2.039)
10" Duct Single Boiler	Straight Run	0.13 (0.13)	0.13 (0.13)	0.14 (0.14)	0.14 (0.14)	0.15 (0.15)	0.15 (0.15)	0.16 (0.16)	0.16 (0.16)	0.17 (0.17)
	90° Elbow	0.76 (0.232)	0.80 (0.244)	0.84 (0.256)	0.89 (0.271)	0.95 (0.29)	1.01 (0.308)	1.08 (0.329)	1.15 (0.351)	1.23 (0.375)
	45° Elbow	0.58 (0.177)	0.61 (0.186)	0.64 (0.195)	0.68 (0.207)	0.73 (0.223)	0.78 (0.238)	0.83 (0.253)	0.88 (0.268)	0.94 (0.287)
	Ent. Loss	1.69 (0.515)	1.77 (0.539)	1.86 (0.567)	1.98 (0.604)	2.11 (0.643)	2.26 (0.689)	2.41 (0.735)	2.57 (0.783)	2.74 (0.835)
12" Duct Two Boilers	Straight Run	0.16 (0.16)	0.17 (0.17)	0.18 (0.18)	0.19 (0.19)	0.21 (0.21)	0.22 (0.22)	0.23 (0.23)	0.25 (0.25)	0.26 (0.26)
	90° Elbow	1.32 (0.402)	1.39 (0.424)	1.46 (0.445)	1.56 (0.475)	1.66 (0.506)	1.77 (0.539)	1.89 (0.576)	2.02 (0.616)	2.15 (0.655)
	45° Elbow	1.02 (0.311)	1.08 (0.329)	1.13 (0.344)	1.20 (0.366)	1.28 (0.39)	1.37 (0.418)	1.46 (0.445)	1.56 (0.475)	1.66 (0.506)
	Ent. Loss	3.26 (0.994)	3.42 (1.042)	3.58 (1.091)	3.82 (1.164)	4.08 (1.244)	4.35 (1.326)	4.64 (1.414)	4.95 (1.509)	5.29 (1.612)
14" Duct Two Boilers	Straight Run	0.08 (0.08)	0.08 (0.08)	0.08 (0.08)	0.09 (0.09)	0.10 (0.10)	0.10 (0.10)	0.11 (0.11)	0.12 (0.12)	0.12 (0.12)
	90° Elbow	0.66 (0.201)	0.70 (0.213)	0.73 (0.223)	0.78 (0.238)	0.83 (0.253)	0.89 (0.271)	0.95 (0.29)	1.01 (0.308)	1.08 (0.329)
	45° Elbow	0.52 (0.158)	0.54 (0.165)	0.57 (0.174)	0.61 (0.186)	0.65 (0.198)	0.69 (0.21)	0.74 (0.226)	0.79 (0.241)	0.84 (0.256)
	Ent. Loss	1.76 (0.536)	1.84 (0.561)	1.93 (0.588)	2.06 (0.628)	2.2 (0.671)	2.35 (0.716)	2.51 (0.765)	2.67 (0.814)	2.85 (0.869)
16" Duct Three Boilers	Straight Run	0.08 (0.08)	0.09 (0.09)	0.09 (0.09)	0.10 (0.10)	0.10 (0.10)	0.11 (0.11)	0.12 (0.12)	0.13 (0.13)	0.13 (0.13)
	90° Elbow	0.82 (0.25)	0.86 (0.262)	0.91 (0.277)	0.97 (0.296)	1.03 (0.314)	1.10 (0.335)	1.18 (0.36)	1.25 (0.381)	1.34 (0.408)
	45° Elbow	0.64 (0.195)	0.67 (0.204)	0.71 (0.216)	0.76 (0.232)	0.81 (0.247)	0.86 (0.262)	0.92 (0.28)	0.98 (0.299)	1.04 (0.317)
	Ent. Loss	2.32 (0.707)	2.43 (0.741)	2.55 (0.777)	2.72 (0.829)	2.90 (0.884)	3.10 (0.945)	3.31 (1.009)	3.53 (1.076)	3.76 (1.146)

**Table 2-d: Ducted Combustion Air Duct Pressure Drop in Eq. Ft. (m) for BMK2000 Boiler – Continued**

Inlet Duct & No. Boilers	Duct Section Type	Outside Air Temperature in °F (°C)								
		-30 °F (-34.4)	-15 °F (-26.1)	0 °F (-17.8)	20 °F (-6.7)	40 °F (4.4)	60 °F (15.6)	80 °F (26.7)	100 °F (37.8)	120 °F (48.9)
18" Duct  Three Boilers	Straight Run	0.05 (0.05)	0.05 (0.05)	0.05 (0.05)	0.05 (0.05)	0.06 (0.06)	0.06 (0.06)	0.07 (0.07)	0.07 (0.07)	0.08 (0.08)
	90° Elbow	0.49 (0.149)	0.51 (0.155)	0.54 (0.165)	0.57 (0.174)	0.61 (0.186)	0.65 (0.198)	0.7 (0.213)	0.74 (0.226)	0.79 (0.241)
	45° Elbow	0.38 (0.116)	0.4 (0.122)	0.42 (0.128)	0.45 (0.137)	0.48 (0.146)	0.51 (0.155)	0.54 (0.165)	0.58 (0.177)	0.62 (0.189)
	Ent. Loss	1.45 (0.442)	1.52 (0.463)	1.59 (0.485)	1.70 (0.518)	1.81 (0.552)	1.93 (0.588)	2.06 (0.628)	2.20 (0.671)	2.35 (0.716)
18" Duct  Four Boilers	Straight Run	0.08 (0.08)	0.08 (0.08)	0.09 (0.09)	0.09 (0.09)	0.10 (0.10)	0.11 (0.11)	0.11 (0.11)	0.12 (0.12)	0.13 (0.13)
	90° Elbow	0.87 (0.265)	0.91 (0.277)	0.96 (0.293)	1.02 (0.311)	1.09 (0.332)	1.16 (0.354)	1.24 (0.378)	1.32 (0.402)	1.41 (0.43)
	45° Elbow	0.68 (0.207)	0.71 (0.216)	0.75 (0.229)	0.80 (0.244)	0.85 (0.259)	0.91 (0.277)	0.97 (0.296)	1.03 (0.314)	1.10 (0.335)
	Ent. Loss	2.57 (0.783)	2.70 (0.823)	2.83 (0.863)	3.02 (0.92)	3.22 (0.981)	3.44 (1.049)	3.67 (1.119)	3.91 (1.192)	4.18 (1.274)
20" Duct  Four Boilers	Straight Run	0.05 (0.05)	0.05 (0.05)	0.05 (0.05)	0.06 (0.06)	0.06 (0.06)	0.06 (0.06)	0.07 (0.07)	0.07 (0.07)	0.08 (0.08)
	90° Elbow	0.55 (0.168)	0.57 (0.174)	0.60 (0.183)	0.64 (0.195)	0.68 (0.207)	0.73 (0.223)	0.78 (0.238)	0.83 (0.253)	0.88 (0.268)
	45° Elbow	0.43 (0.131)	0.45 (0.137)	0.47 (0.143)	0.5 (0.152)	0.53 (0.162)	0.57 (0.174)	0.61 (0.186)	0.65 (0.198)	0.69 (0.21)
	Ent. Loss	1.69 (0.515)	1.77 (0.539)	1.86 (0.567)	1.98 (0.604)	2.11 (0.643)	2.26 (0.689)	2.41 (0.735)	2.57 (0.783)	2.74 (0.835)

- NOTES:** 1) Calculation assumes 500 SCFM (14.16 m<sup>3</sup>/min) per boiler at full fire rate  
 2) Units for "Straight Run" pressure drop values are equivalent feet per foot (eq. m / m)  
 3) Units for "Elbows" and "Ent. Loss" are equivalent feet per item (eq. m / item)

**Table 2-e: Ducted Combustion Air Duct Pressure Drop in Eq. Ft. (m) for BMK2500 Boiler**

		Outside Air Temperature in °F (°C)								
Inlet Duct & No. Boilers	Duct Section Type	-30 °F (-34.4)	-15 °F (-26.1)	0 °F (-17.8)	20 °F (-6.7)	40 °F (4.4)	60 °F (15.6)	80 °F (26.7)	100 °F (37.8)	120 °F (48.9)
8" Duct Single Boiler	Straight Run	0.71 (0.71)	0.73 (0.73)	0.74 (0.74)	0.76 (0.76)	0.78 (0.78)	0.81 (0.81)	0.83 (0.83)	0.86 (0.86)	0.88 (0.88)
	90° Elbow	3.96 (1.21)	4.15 (1.27)	4.36 (1.33)	4.65 (1.42)	4.96 (1.51)	5.29 (1.61)	5.64 (1.72)	6.03 (1.84)	6.43 (1.96)
	45° Elbow	2.98 (0.91)	3.13 (0.95)	3.28 (1.00)	3.50 (1.07)	3.73 (1.14)	3.98 (1.21)	4.24 (1.29)	4.53 (1.38)	4.83 (1.47)
	Ent. Loss	7.73 (2.35)	8.11 (2.47)	8.51 (2.59)	9.08 (2.77)	9.68 (2.95)	10.33 (3.15)	11.02 (3.36)	11.76 (3.58)	12.54 (3.82)
10" Duct Single Boiler	Straight Run	0.23 (0.23)	0.23 (0.23)	0.24 (0.24)	0.25 (0.25)	0.26 (0.26)	0.27 (0.27)	0.27 (0.27)	0.28 (0.28)	0.28 (0.28)
	90° Elbow	1.33 (0.41)	1.40 (0.43)	1.48 (0.45)	1.57 (0.48)	1.68 (0.51)	1.78 (0.54)	1.91 (0.58)	2.03 (0.62)	2.17 (0.66)
	45° Elbow	1.01 (0.31)	1.06 (0.32)	1.11 (0.34)	1.18 (0.36)	1.26 (0.38)	1.34 (0.41)	1.43 (0.44)	1.53 (0.47)	1.63 (0.50)
	Ent. Loss	3.17 (0.97)	3.32 (1.01)	3.48 (1.06)	3.72 (1.13)	3.97 (1.21)	4.23 (1.29)	4.52 (1.38)	4.82 (1.47)	5.13 (1.57)
12" Duct Two Boilers	Straight Run	0.29 (0.29)	0.31 (0.31)	0.32 (0.32)	0.34 (0.34)	0.36 (0.36)	0.38 (0.38)	0.41 (0.41)	0.43 (0.43)	0.46 (0.46)
	90° Elbow	2.33 (0.71)	2.44 (0.74)	2.57 (0.78)	2.73 (0.83)	2.92 (0.89)	3.12 (0.95)	3.33 (1.01)	3.54 (1.08)	3.78 (1.15)
	45° Elbow	1.78 (0.54)	1.86 (0.57)	1.95 (0.59)	2.08 (0.64)	2.23 (0.68)	2.38 (0.72)	2.53 (0.77)	2.70 (0.82)	2.88 (0.88)
	Ent. Loss	6.11 (1.86)	6.41 (1.95)	6.73 (2.05)	7.17 (2.18)	7.65 (2.33)	8.16 (2.49)	8.71 (2.65)	9.29 (2.83)	9.91 (3.02)
14" Duct Two Boilers	Straight Run	0.13 (0.13)	0.14 (0.14)	0.15 (0.15)	0.16 (0.16)	0.17 (0.17)	0.18 (0.18)	0.19 (0.19)	0.20 (0.20)	0.21 (0.21)
	90° Elbow	1.21 (0.37)	1.28 (0.39)	1.33 (0.41)	1.43 (0.43)	1.52 (0.46)	1.62 (0.49)	1.73 (0.53)	1.84 (0.56)	1.97 (0.60)
	45° Elbow	0.93 (0.28)	0.98 (0.30)	1.03 (0.32)	1.10 (0.34)	1.18 (0.36)	1.25 (0.38)	1.33 (0.41)	1.43 (0.43)	1.53 (0.47)
	Ent. Loss	3.29 (1.00)	3.46 (1.05)	3.63 (1.11)	3.87 (1.18)	4.13 (1.26)	4.41 (1.34)	4.70 (1.43)	5.02 (1.53)	5.35 (1.63)
16" Duct Three Boilers	Straight Run	0.15 (0.15)	0.16 (0.16)	0.16 (0.16)	0.18 (0.18)	0.18 (0.18)	0.19 (0.19)	0.21 (0.21)	0.23 (0.23)	0.23 (0.23)
	90° Elbow	1.58 (0.48)	1.66 (0.51)	1.74 (0.53)	1.86 (0.57)	1.98 (0.60)	2.12 (0.65)	2.26 (0.69)	2.41 (0.73)	2.57 (0.78)
	45° Elbow	1.24 (0.38)	1.30 (0.40)	1.37 (0.42)	1.45 (0.44)	1.55 (0.47)	1.66 (0.51)	1.77 (0.54)	1.88 (0.57)	2.01 (0.61)
	Ent. Loss	4.34 (1.32)	4.56 (1.39)	4.78 (1.46)	5.10 (1.55)	5.44 (1.66)	5.81 (1.77)	6.20 (1.89)	6.62 (2.02)	7.06 (2.15)

**Table 2-e: Ducted Combustion Air Duct Pressure Drop in Eq. Ft. (m) for BMK2500 Boiler – Continued**

Inlet Duct & No. Boilers	Duct Section Type	Outside Air Temperature in °F (°C)								
		-30 °F (-34.4)	-15 °F (-26.1)	0 °F (-17.8)	20 °F (-6.7)	40 °F (4.4)	60 °F (15.6)	80 °F (26.7)	100 °F (37.8)	120 °F (48.9)
18" Duct Three Boilers	Straight Run	0.08 (0.08)	0.08 (0.08)	0.09 (0.09)	0.09 (0.09)	0.10 (0.10)	0.11 (0.11)	0.12 (0.12)	0.13 (0.13)	0.13 (0.13)
	90° Elbow	0.97 (0.29)	1.02 (0.31)	1.07 (0.33)	1.14 (0.35)	1.22 (0.37)	1.30 (0.40)	1.38 (0.42)	1.48 (0.45)	1.58 (0.48)
	45° Elbow	0.77 (0.23)	0.80 (0.24)	0.84 (0.26)	0.90 (0.27)	0.96 (0.29)	1.03 (0.31)	1.09 (0.33)	1.17 (0.36)	1.24 (0.38)
	Ent. Loss	2.72 (0.83)	2.85 (0.87)	2.98 (0.91)	3.18 (0.97)	3.40 (1.04)	3.63 (1.10)	3.87 (1.18)	4.13 (1.26)	4.41 (1.34)
18" Duct Four Boilers	Straight Run	0.14 (0.14)	0.15 (0.15)	0.16 (0.16)	0.17 (0.17)	0.18 (0.18)	0.18 (0.18)	0.20 (0.20)	0.21 (0.21)	0.23 (0.23)
	90° Elbow	1.73 (0.53)	1.81 (0.55)	1.90 (0.58)	2.03 (0.62)	2.16 (0.66)	2.31 (0.70)	2.46 (0.75)	2.63 (0.80)	2.80 (0.85)
	45° Elbow	1.36 (0.41)	1.43 (0.43)	1.50 (0.46)	1.60 (0.49)	1.70 (0.52)	1.82 (0.55)	1.94 (0.59)	2.07 (0.63)	2.21 (0.67)
	Ent. Loss	4.83 (1.47)	5.06 (1.54)	5.31 (1.62)	5.67 (1.73)	6.04 (1.84)	6.45 (1.97)	6.88 (2.10)	7.34 (2.24)	7.83 (2.39)
20" Duct Four Boilers	Straight Run	0.08 (0.08)	0.09 (0.09)	0.09 (0.09)	0.10 (0.10)	0.10 (0.10)	0.11 (0.11)	0.12 (0.12)	0.13 (0.13)	0.13 (0.13)
	90° Elbow	1.08 (0.33)	1.14 (0.35)	1.20 (0.37)	1.28 (0.39)	1.36 (0.41)	1.45 (0.44)	1.55 (0.47)	1.65 (0.50)	1.77 (0.54)
	45° Elbow	0.86 (0.26)	0.90 (0.27)	0.94 (0.29)	1.01 (0.31)	1.08 (0.33)	1.14 (0.35)	1.22 (0.37)	1.30 (0.40)	1.39 (0.42)
	Ent. Loss	3.17 (0.97)	3.32 (1.01)	3.48 (1.06)	3.72 (1.13)	3.97 (1.21)	4.23 (1.29)	4.52 (1.38)	4.82 (1.47)	5.13 (1.56)

- NOTES:** 1) Calculation assumes 600 SCFM (16.99 m<sup>3</sup>/min) per boiler at full fire rate  
 2) Units for "Straight Run" pressure drop values are equivalent feet per foot (eq. m / m)  
 3) Units for "Elbows" and "Ent. Loss" are equivalent feet per item (eq. m / item)

**Table 2-f: Ducted Combustion Air Duct Pressure Drop in Eq. Ft. (m) for BMK3000 Boiler**

		Outside Air Temperature in °F (°C)								
Inlet Duct & No. Boilers	Duct Section Type	-30 °F (-34.4)	-15 °F (-26.1)	0 °F (-17.8)	20 °F (-6.7)	40 °F (4.4)	60 °F (15.6)	80 °F (26.7)	100 °F (37.8)	120 °F (48.9)
8" Duct Single Boiler	Straight Run	0.85 (0.85)	0.87 (0.87)	0.89 (0.89)	0.91 (0.91)	0.94 (0.94)	0.97 (0.97)	1.00 (1.00)	1.03 (1.03)	1.06 (1.06)
	90° Elbow	4.75 (1.448)	4.98 (1.518)	5.23 (1.594)	5.58 (1.701)	5.95 (1.814)	6.35 (1.935)	6.77 (2.063)	7.23 (2.204)	7.71 (2.35)
	45° Elbow	3.57 (1.088)	3.75 (1.143)	3.93 (1.198)	4.2 (1.28)	4.48 (1.366)	4.78 (1.457)	5.09 (1.551)	5.44 (1.658)	5.8 (1.768)
	Ent. Loss	9.27 (2.825)	9.73 (2.966)	10.21 (3.112)	10.89 (3.319)	11.62 (3.542)	12.39 (3.776)	13.22 (4.029)	14.11 (4.301)	15.05 (4.587)
10" Duct Single Boiler	Straight Run	0.28 (0.28)	0.28 (0.28)	0.29 (0.29)	0.3 (0.30)	0.31 (0.31)	0.32 (0.32)	0.32 (0.32)	0.33 (0.33)	0.34 (0.34)
	90° Elbow	1.6 (0.488)	1.68 (0.512)	1.77 (0.539)	1.88 (0.573)	2.01 (0.613)	2.14 (0.652)	2.29 (0.698)	2.44 (0.744)	2.6 (0.792)
	45° Elbow	1.21 (0.369)	1.27 (0.387)	1.33 (0.405)	1.42 (0.433)	1.51 (0.46)	1.61 (0.491)	1.72 (0.524)	1.84 (0.561)	1.96 (0.597)
	Ent. Loss	3.8 (1.158)	3.98 (1.213)	4.18 (1.274)	4.46 (1.359)	4.76 (1.451)	5.08 (1.548)	5.42 (1.652)	5.78 (1.762)	6.16 (1.878)
12" Duct Two Boilers	Straight Run	0.35 (0.35)	0.37 (0.37)	0.38 (0.38)	0.41 (0.41)	0.43 (0.43)	0.46 (0.46)	0.49 (0.49)	0.52 (0.52)	0.55 (0.55)
	90° Elbow	2.8 (0.853)	2.93 (0.893)	3.08 (0.939)	3.28 (1)	3.5 (1.067)	3.74 (1.14)	3.99 (1.216)	4.25 (1.295)	4.54 (1.384)
	45° Elbow	2.13 (0.649)	2.23 (0.68)	2.34 (0.713)	2.5 (0.762)	2.67 (0.814)	2.85 (0.869)	3.04 (0.927)	3.24 (0.988)	3.46 (1.055)
	Ent. Loss	7.33 (2.234)	7.69 (2.344)	8.07 (2.46)	8.6 (2.621)	9.18 (2.798)	9.79 (2.984)	10.45 (3.185)	11.15 (3.399)	11.89 (3.624)
14" Duct Two Boilers	Straight Run	0.16 (0.16)	0.17 (0.17)	0.18 (0.18)	0.19 (0.19)	0.2 (0.20)	0.21 (0.21)	0.23 (0.23)	0.24 (0.24)	0.25 (0.25)
	90° Elbow	1.45 (0.442)	1.53 (0.466)	1.6 (0.488)	1.71 (0.521)	1.82 (0.555)	1.94 (0.591)	2.07 (0.631)	2.21 (0.674)	2.36 (0.719)
	45° Elbow	1.12 (0.341)	1.18 (0.36)	1.24 (0.378)	1.32 (0.402)	1.41 (0.43)	1.5 (0.457)	1.6 (0.488)	1.71 (0.521)	1.83 (0.558)
	Ent. Loss	3.95 (1.204)	4.15 (1.265)	4.35 (1.326)	4.64 (1.414)	4.95 (1.509)	5.29 (1.612)	5.64 (1.719)	6.02 (1.835)	6.42 (1.957)
16" Duct Three Boilers	Straight Run	0.18 (0.18)	0.19 (0.19)	0.19 (0.19)	0.21 (0.21)	0.22 (0.22)	0.23 (0.23)	0.25 (0.25)	0.27 (0.27)	0.28 (0.28)
	90° Elbow	1.90 (0.579)	1.99 (0.607)	2.09 (0.637)	2.23 (0.68)	2.38 (0.725)	2.54 (0.774)	2.71 (0.826)	2.89 (0.881)	3.08 (0.939)
	45° Elbow	1.49 (0.454)	1.56 (0.475)	1.64 (0.5)	1.74 (0.53)	1.86 (0.567)	1.99 (0.607)	2.12 (0.646)	2.26 (0.689)	2.41 (0.735)
	Ent. Loss	5.21 (1.588)	5.47 (1.667)	5.74 (1.75)	6.12 (1.865)	6.53 (1.99)	6.97 (2.124)	7.44 (2.268)	7.94 (2.42)	8.47 (2.582)

**Table 2-f: Ducted Combustion Air Duct Pressure Drop in Eq. Ft. (m) for BMK3000 Boiler – Continued**

Inlet Duct & No. Boilers	Duct Section Type	Outside Air Temperature in °F (°C)								
		-30 °F (-34.4)	-15 °F (-26.1)	0 °F (-17.8)	20 °F (-6.7)	40 °F (4.4)	60 °F (15.6)	80 °F (26.7)	100 °F (37.8)	120 °F (48.9)
18" Duct  Three Boilers	Straight Run	0.10 (0.10)	0.10 (0.10)	0.11 (0.11)	0.11 (0.11)	0.12 (0.12)	0.13 (0.13)	0.14 (0.14)	0.15 (0.15)	0.16 (0.16)
	90° Elbow	1.16 (0.354)	1.22 (0.372)	1.28 (0.39)	1.37 (0.418)	1.46 (0.445)	1.56 (0.475)	1.66 (0.506)	1.77 (0.539)	1.89 (0.576)
	45° Elbow	0.92 (0.28)	0.96 (0.293)	1.01 (0.308)	1.08 (0.329)	1.15 (0.351)	1.23 (0.375)	1.31 (0.399)	1.4 (0.427)	1.49 (0.454)
	Ent. Loss	3.26 (0.994)	3.42 (1.042)	3.58 (1.091)	3.82 (1.164)	4.08 (1.244)	4.35 (1.326)	4.64 (1.414)	4.95 (1.509)	5.29 (1.612)
18" Duct  Four Boilers	Straight Run	0.17 (0.17)	0.18 (0.18)	0.19 (0.19)	0.2 (0.20)	0.21 (0.21)	0.22 (0.22)	0.24 (0.24)	0.25 (0.25)	0.27 (0.27)
	90° Elbow	2.07 (0.631)	2.17 (0.661)	2.28 (0.695)	2.43 (0.741)	2.59 (0.789)	2.77 (0.844)	2.95 (0.899)	3.15 (0.96)	3.36 (1.024)
	45° Elbow	1.63 (0.497)	1.71 (0.521)	1.80 (0.549)	1.92 (0.585)	2.04 (0.622)	2.18 (0.664)	2.33 (0.71)	2.48 (0.756)	2.65 (0.808)
	Ent. Loss	5.79 (1.765)	6.07 (1.85)	6.37 (1.942)	6.8 (2.073)	7.25 (2.21)	7.74 (2.359)	8.25 (2.515)	8.81 (2.685)	9.40 (2.865)
20" Duct  Four Boilers	Straight Run	0.10 (0.10)	0.11 (0.11)	0.11 (0.11)	0.12 (0.12)	0.12 (0.12)	0.13 (0.13)	0.14 (0.14)	0.15 (0.15)	0.16 (0.16)
	90° Elbow	1.3 (0.396)	1.37 (0.418)	1.44 (0.439)	1.53 (0.466)	1.63 (0.497)	1.74 (0.53)	1.86 (0.567)	1.98 (0.604)	2.12 (0.646)
	45° Elbow	1.03 (0.314)	1.08 (0.329)	1.13 (0.344)	1.21 (0.369)	1.29 (0.393)	1.37 (0.418)	1.46 (0.445)	1.56 (0.475)	1.67 (0.509)
	Ent. Loss	3.8 (1.158)	3.98 (1.213)	4.18 (1.274)	4.46 (1.359)	4.76 (1.451)	5.08 (1.548)	5.42 (1.652)	5.78 (1.762)	6.16 (1.878)

- NOTES:** 1) Calculation assumes 700 SCFM (19.82 m<sup>3</sup>/min) per boiler at full fire rate  
 2) Units for "Straight Run" pressure drop values are equivalent feet per foot (eq. m / m)  
 3) Units for "Elbows" and "Ent. Loss" are equivalent feet per item (eq. m / item)



**Table 2-g: Ducted Combustion Air Duct Pressure Drop in Eq. Ft. (m) for BMK4000 Boiler**

Inlet Duct & No. Boilers	Duct Section Type	Outside Air Temperature in °F (°C)						
		-15 °F (-26.1)	0 °F (-17.8)	20 °F (-6.7)	40 °F (4.4)	60 °F (15.6)	80 °F (26.7)	100 °F (37.8)
10" Duct Single Boiler	Straight Run	0.69 (0.69)	0.71 (0.71)	0.73 (0.73)	0.76 (0.76)	0.78 (0.78)	0.81 (0.81)	0.83 (0.83)
	90° Elbow	4.56 (1.39)	4.79 (1.46)	5.11 (1.56)	5.45 (1.66)	5.82 (1.77)	6.21 (1.89)	6.62 (2.02)
	45° Elbow	3.5 (1.07)	3.67 (1.12)	3.92 (1.19)	4.17 (1.27)	4.45 (1.36)	4.75 (1.45)	5.08 (1.55)
	Ent. Loss	10.15 (3.09)	10.65 (3.25)	11.36 (3.46)	12.11 (3.69)	12.93 (3.94)	13.8 (4.21)	14.73 (4.49)
12" Duct Single Boiler	Straight Run	0.24 (0.24)	0.25 (0.25)	0.27 (0.27)	0.29 (0.29)	0.31 (0.31)	0.33 (0.33)	0.35 (0.35)
	90° Elbow	1.99 (0.61)	2.09 (0.64)	2.23 (0.68)	2.38 (0.73)	2.54 (0.77)	2.71 (0.83)	2.89 (0.88)
	45° Elbow	1.54 (0.47)	1.62 (0.49)	1.72 (0.52)	1.84 (0.56)	1.96 (0.6)	2.1 (0.64)	2.23 (0.68)
	Ent. Loss	4.89 (1.49)	5.14 (1.57)	5.48 (1.67)	5.84 (1.78)	6.23 (1.9)	6.65 (2.03)	7.1 (2.16)
16" Duct Two Boilers	Straight Run	0.21 (0.21)	0.22 (0.22)	0.24 (0.24)	0.25 (0.25)	0.27 (0.27)	0.29 (0.29)	0.31 (0.31)
	90° Elbow	2.21 (0.67)	2.32 (0.71)	2.46 (0.75)	2.64 (0.8)	2.81 (0.86)	3 (0.91)	3.2 (0.98)
	45° Elbow	1.72 (0.52)	1.81 (0.55)	1.93 (0.59)	2.05 (0.62)	2.2 (0.67)	2.34 (0.71)	2.5 (0.76)
	Ent. Loss	6.2 (1.89)	6.5 (1.98)	6.93 (2.11)	7.39 (2.25)	7.89 (2.4)	8.42 (2.57)	8.98 (2.74)
18" Duct Two Boilers	Straight Run	0.12 (0.12)	0.12 (0.12)	0.13 (0.13)	0.14 (0.14)	0.15 (0.15)	0.16 (0.16)	0.17 (0.17)
	90° Elbow	1.31 (0.4)	1.38 (0.42)	1.46 (0.45)	1.56 (0.48)	1.67 (0.51)	1.78 (0.54)	1.9 (0.58)
	45° Elbow	1.02 (0.31)	1.07 (0.33)	1.15 (0.35)	1.22 (0.37)	1.31 (0.4)	1.39 (0.42)	1.48 (0.45)
	Ent. Loss	3.87 (1.18)	4.06 (1.24)	4.33 (1.32)	4.62 (1.41)	4.93 (1.5)	5.26 (1.6)	5.61 (1.71)
20" Duct Three Boilers	Straight Run	0.15 (0.15)	0.16 (0.16)	0.17 (0.17)	0.18 (0.18)	0.19 (0.19)	0.2 (0.2)	0.22 (0.22)
	90° Elbow	1.84 (0.56)	1.94 (0.59)	2.06 (0.63)	2.21 (0.67)	2.35 (0.72)	2.51 (0.77)	2.67 (0.81)
	45° Elbow	1.44 (0.44)	1.51 (0.46)	1.61 (0.49)	1.72 (0.52)	1.83 (0.56)	1.95 (0.59)	2.09 (0.64)
	Ent. Loss	5.71 (1.74)	5.99 (1.83)	6.39 (1.95)	6.82 (2.08)	7.27 (2.22)	7.76 (2.37)	8.28 (2.52)

**Table 2-g: Ducted Combustion Air Duct Pressure Drop in Eq. Ft. (m) for BMK4000 Boiler – Continued**

Inlet Duct & No. Boilers	Duct Section Type	Outside Air Temperature in °F (°C)						
		-15 °F (-26.1)	0 °F (-17.8)	20 °F (-6.7)	40 °F (4.4)	60 °F (15.6)	80 °F (26.7)	100 °F (37.8)
22" Duct Three Boilers	Straight Run	0.09 (0.09)	0.1 (0.1)	0.1 (0.1)	0.11 (0.11)	0.12 (0.12)	0.13 (0.13)	0.14 (0.14)
	90° Elbow	1.21 (0.37)	1.27 (0.39)	1.35 (0.41)	1.44 (0.44)	1.54 (0.47)	1.63 (0.5)	1.74 (0.53)
	45° Elbow	0.94 (0.29)	0.99 (0.3)	1.05 (0.32)	1.12 (0.34)	1.2 (0.37)	1.28 (0.39)	1.37 (0.42)
	Ent. Loss	3.9 (1.19)	4.09 (1.25)	4.37 (1.33)	4.66 (1.42)	4.97 (1.51)	5.29 (1.61)	5.66 (1.73)
22" Duct Four Boilers	Straight Run	0.16 (0.16)	0.17 (0.17)	0.18 (0.18)	0.19 (0.19)	0.2 (0.2)	0.22 (0.22)	0.23 (0.23)
	90° Elbow	2.15 (0.66)	2.24 (0.68)	2.4 (0.73)	2.56 (0.78)	2.73 (0.83)	2.92 (0.89)	3.11 (0.95)
	45° Elbow	1.67 (0.51)	1.76 (0.54)	1.87 (0.57)	2 (0.61)	2.12 (0.65)	2.27 (0.69)	2.43 (0.74)
	Ent. Loss	6.93 (2.11)	7.27 (2.22)	7.76 (2.37)	8.28 (2.52)	8.83 (2.69)	9.42 (2.87)	10.05 (3.06)
24" Duct Four Boilers	Straight Run	0.1 (0.1)	0.11 (0.11)	0.12 (0.12)	0.12 (0.12)	0.13 (0.13)	0.14 (0.14)	0.15 (0.15)
	90° Elbow	1.45 (0.44)	1.53 (0.47)	1.62 (0.49)	1.73 (0.53)	1.84 (0.56)	1.96 (0.6)	2.1 (0.64)
	45° Elbow	1.12 (0.34)	1.18 (0.36)	1.26 (0.38)	1.34 (0.41)	1.44 (0.44)	1.54 (0.47)	1.63 (0.5)
	Ent. Loss	4.89 (1.49)	5.14 (1.57)	5.48 (1.67)	5.84 (1.78)	6.23 (1.9)	6.65 (2.03)	7.1 (2.16)

- NOTES:** 1) Calculation assumes 867 SCFM (24.55 m<sup>3</sup>/min) per boiler at full fire rate  
 2) Units for "Straight Run" pressure drop values are equivalent feet per foot (eq. m / m)  
 3) Units for "Elbows" and "Ent. Loss" are equivalent feet per item (eq. m / item)

**Table 2-h: Ducted Combustion Air Duct Pressure Drop in Eq. Ft. (m) for BMK5000N Boiler**

		Outside Air Temperature in °F (°C)						
Inlet Duct & No. Boilers	Duct Section Type	-15 °F (-26.1)	0 °F (-17.8)	20 °F (-6.7)	40 °F (4.4)	60 °F (15.6)	80 °F (26.7)	100 °F (37.8)
10" Duct Single Boiler	Straight Run	1.06 (1.06)	1.08 (1.08)	1.12 (1.12)	1.16 (1.16)	1.19 (1.19)	1.23 (1.23)	1.27 (1.27)
	90° Elbow	7.14 (2.18)	7.49 (2.28)	7.99 (2.44)	8.53 (2.6)	9.09 (2.77)	9.7 (2.96)	10.36 (3.16)
	45° Elbow	5.47 (1.67)	5.73 (1.75)	6.11 (1.86)	6.53 (1.99)	6.97 (2.12)	7.43 (2.26)	7.93 (2.42)
	Ent. Loss	15.87 (4.84)	16.65 (5.07)	17.76 (5.41)	18.95 (5.78)	20.22 (6.16)	21.57 (6.57)	23.01 (7.01)
12" Duct Single Boiler	Straight Run	0.37 (0.37)	0.39 (0.39)	0.41 (0.41)	0.44 (0.44)	0.47 (0.47)	0.5 (0.5)	0.53 (0.53)
	90° Elbow	3.11 (0.95)	3.27 (1)	3.49 (1.06)	3.72 (1.13)	3.97 (1.21)	4.23 (1.29)	4.51 (1.37)
	45° Elbow	2.42 (0.74)	2.53 (0.77)	2.7 (0.82)	2.88 (0.88)	3.07 (0.94)	3.27 (1)	3.49 (1.06)
	Ent. Loss	7.65 (2.33)	8.03 (2.45)	8.56 (2.61)	9.14 (2.79)	9.75 (2.97)	10.41 (3.17)	11.1 (3.38)
18" Duct Two Boilers	Straight Run	0.18 (0.18)	0.19 (0.19)	0.2 (0.2)	0.21 (0.21)	0.23 (0.23)	0.24 (0.24)	0.26 (0.26)
	90° Elbow	2.05 (0.62)	2.15 (0.66)	2.29 (0.7)	2.44 (0.74)	2.61 (0.8)	2.78 (0.85)	2.96 (0.9)
	45° Elbow	1.6 (0.49)	1.67 (0.51)	1.79 (0.55)	1.9 (0.58)	2.04 (0.62)	2.17 (0.66)	2.32 (0.71)
	Ent. Loss	6.05 (1.84)	6.34 (1.93)	6.77 (2.06)	7.22 (2.2)	7.7 (2.35)	8.22 (2.51)	8.77 (2.67)
20" Duct Two Boilers	Straight Run	0.11 (0.11)	0.11 (0.11)	0.12 (0.12)	0.13 (0.13)	0.14 (0.14)	0.14 (0.14)	0.15 (0.15)
	90° Elbow	1.28 (0.39)	1.34 (0.41)	1.44 (0.44)	1.54 (0.47)	1.63 (0.5)	1.74 (0.53)	1.85 (0.56)
	45° Elbow	1 (0.3)	1.05 (0.32)	1.12 (0.34)	1.2 (0.37)	1.27 (0.39)	1.35 (0.41)	1.45 (0.44)
	Ent. Loss	3.97 (1.21)	4.16 (1.27)	4.44 (1.35)	4.73 (1.44)	5.05 (1.54)	5.39 (1.64)	5.76 (1.76)
22" Duct Three Boilers	Straight Run	0.14 (0.14)	0.15 (0.15)	0.16 (0.16)	0.17 (0.17)	0.18 (0.18)	0.19 (0.19)	0.21 (0.21)
	90° Elbow	1.89 (0.58)	1.98 (0.6)	2.11 (0.64)	2.26 (0.69)	2.4 (0.73)	2.56 (0.78)	2.73 (0.83)
	45° Elbow	1.46 (0.45)	1.54 (0.47)	1.65 (0.5)	1.76 (0.54)	1.87 (0.57)	2 (0.61)	2.14 (0.65)
	Ent. Loss	6.1 (1.86)	6.39 (1.95)	6.82 (2.08)	7.28 (2.22)	7.77 (2.37)	8.28 (2.52)	8.85 (2.7)

**Table 2-h: Ducted Combustion Air Duct Pressure Drop in Eq. Ft. (m) for BMK5000N Boiler – Continued**

Inlet Duct & No. Boilers	Duct Section Type	Outside Air Temperature in °F (°C)						
		-15 °F (-26.1)	0 °F (-17.8)	20 °F (-6.7)	40 °F (4.4)	60 °F (15.6)	80 °F (26.7)	100 °F (37.8)
24" Duct Three Boilers	Straight Run	0.09 (0.09)	0.1 (0.1)	0.1 (0.1)	0.11 (0.11)	0.12 (0.12)	0.12 (0.12)	0.13 (0.13)
	90° Elbow	1.27 (0.39)	1.34 (0.41)	1.43 (0.44)	1.53 (0.47)	1.62 (0.49)	1.73 (0.53)	1.84 (0.56)
	45° Elbow	0.99 (0.3)	1.04 (0.32)	1.11 (0.34)	1.18 (0.36)	1.27 (0.39)	1.34 (0.41)	1.44 (0.44)
	Ent. Loss	4.31 (1.31)	4.51 (1.37)	4.82 (1.47)	5.14 (1.57)	5.48 (1.67)	5.86 (1.79)	6.25 (1.9)
24" Duct Four Boilers	Straight Run	0.16 (0.16)	0.17 (0.17)	0.18 (0.18)	0.19 (0.19)	0.2 (0.2)	0.22 (0.22)	0.23 (0.23)
	90° Elbow	2.27 (0.69)	2.38 (0.73)	2.54 (0.77)	2.71 (0.83)	2.88 (0.88)	3.07 (0.94)	3.28 (1)
	45° Elbow	1.76 (0.54)	1.85 (0.56)	1.98 (0.6)	2.11 (0.64)	2.24 (0.68)	2.39 (0.73)	2.56 (0.78)
	Ent. Loss	7.65 (2.33)	8.03 (2.45)	8.56 (2.61)	9.14 (2.79)	9.75 (2.97)	10.41 (3.17)	11.1 (3.38)
26" Duct Four Boilers	Straight Run	0.11 (0.11)	0.11 (0.11)	0.12 (0.12)	0.13 (0.13)	0.14 (0.14)	0.14 (0.14)	0.15 (0.15)
	90° Elbow	1.57 (0.48)	1.65 (0.5)	1.76 (0.54)	1.88 (0.57)	2 (0.61)	2.14 (0.65)	2.28 (0.69)
	45° Elbow	1.22 (0.37)	1.28 (0.39)	1.37 (0.42)	1.46 (0.45)	1.56 (0.48)	1.66 (0.51)	1.77 (0.54)
	Ent. Loss	5.55 (1.69)	5.83 (1.78)	6.22 (1.9)	6.64 (2.02)	7.08 (2.16)	7.55 (2.3)	8.05 (2.45)

- NOTES:** 1) Calculation assumes 1084 SCFM (30.7 m<sup>3</sup>/min) per boiler at full fire rate  
 2) Units for "Straight Run" pressure drop values are equivalent feet per foot (eq. m / m)  
 3) Units for "Elbows" and "Ent. Loss" are equivalent feet per item (eq. m / item)

**Table 2-i: Ducted Combustion Air Duct Pressure Drop in Eq. Ft. (m) for BMK5000/6000 Boiler**

Inlet Duct & No. Boilers	Duct Section Type	Outside Air Temperature in °F (°C)								
		-30 °F (-34.4)	-15 °F (-26.1)	0 °F (-17.8)	20 °F (-6.7)	40 °F (4.4)	60 °F (15.6)	80 °F (26.7)	100 °F (37.8)	120 °F (48.9)
14" Duct Single Boiler	Straight Run	0.16 (0.16)	0.17 (0.17)	0.18 (0.18)	0.19 (0.19)	0.20 (0.20)	0.22 (0.22)	0.23 (0.23)	0.25 (0.25)	0.26 (0.26)
	90° Elbow	1.49 (0.454)	1.57 (0.479)	1.64 (0.5)	1.75 (0.533)	1.87 (0.57)	2.00 (0.61)	2.13 (0.649)	2.27 (0.692)	2.42 (0.738)
	45° Elbow	1.16 (0.354)	1.22 (0.372)	1.28 (0.39)	1.36 (0.415)	1.46 (0.445)	1.55 (0.472)	1.66 (0.506)	1.77 (0.539)	1.89 (0.576)
	Ent. Loss	3.95 (1.204)	4.15 (1.265)	4.35 (1.326)	4.64 (1.414)	4.95 (1.509)	5.29 (1.612)	5.64 (1.719)	6.02 (1.835)	6.42 (1.957)
16" Duct Single Boiler	Straight Run	0.08 (0.08)	0.09 (0.09)	0.09 (0.09)	0.10 (0.10)	0.10 (0.10)	0.11 (0.11)	0.12 (0.12)	0.13 (0.13)	0.13 (0.13)
	90° Elbow	0.82 (0.25)	0.86 (0.262)	0.91 (0.277)	0.97 (0.296)	1.03 (0.314)	1.10 (0.335)	1.18 (0.36)	1.25 (0.381)	1.34 (0.408)
	45° Elbow	0.64 (0.195)	0.67 (0.204)	0.71 (0.216)	0.76 (0.232)	0.81 (0.247)	0.86 (0.262)	0.92 (0.28)	0.98 (0.299)	1.04 (0.317)
	Ent. Loss	2.32 (0.707)	2.43 (0.741)	2.55 (0.777)	2.72 (0.829)	2.90 (0.884)	3.10 (0.945)	3.31 (1.009)	3.53 (1.076)	3.76 (1.146)
18" Duct Two Boilers	Straight Run	0.17 (0.17)	0.18 (0.18)	0.19 (0.19)	0.20 (0.20)	0.21 (0.21)	0.23 (0.23)	0.24 (0.24)	0.26 (0.26)	0.28 (0.28)
	90° Elbow	1.96 (0.597)	2.05 (0.625)	2.15 (0.655)	2.30 (0.701)	2.45 (0.747)	2.62 (0.799)	2.79 (0.85)	2.98 (0.908)	3.18 (0.969)
	45° Elbow	1.53 (0.466)	1.60 (0.488)	1.68 (0.512)	1.79 (0.546)	1.91 (0.582)	2.04 (0.622)	2.18 (0.664)	2.32 (0.707)	2.48 (0.756)
	Ent. Loss	5.79 (1.765)	6.07 (1.85)	6.37 (1.942)	6.80 (2.073)	7.25 (2.21)	7.74 (2.359)	8.25 (2.515)	8.81 (2.685)	9.4 (2.865)
20" Duct Two Boilers	Straight Run	0.10 (0.10)	0.11 (0.11)	0.11 (0.11)	0.12 (0.12)	0.13 (0.13)	0.13 (0.13)	0.14 (0.14)	0.15 (0.15)	0.16 (0.16)
	90° Elbow	1.23 (0.375)	1.29 (0.393)	1.35 (0.411)	1.44 (0.439)	1.54 (0.469)	1.64 (0.5)	1.75 (0.533)	1.87 (0.57)	1.99 (0.607)
	45° Elbow	0.96 (0.293)	1.00 (0.305)	1.05 (0.32)	1.12 (0.341)	1.2 (0.366)	1.28 (0.39)	1.36 (0.415)	1.46 (0.445)	1.55 (0.472)
	Ent. Loss	3.8 (1.158)	3.98 (1.213)	4.18 (1.274)	4.46 (1.359)	4.76 (1.451)	5.08 (1.548)	5.42 (1.652)	5.78 (1.762)	6.16 (1.878)
22" Duct Three Boilers	Straight Run	0.13 (0.13)	0.14 (0.14)	0.15 (0.15)	0.16 (0.16)	0.17 (0.17)	0.18 (0.18)	0.19 (0.19)	0.20 (0.20)	0.22 (0.22)
	90° Elbow	1.8 (0.549)	1.89 (0.576)	1.99 (0.607)	2.12 (0.646)	2.26 (0.689)	2.41 (0.735)	2.57 (0.783)	2.75 (0.838)	2.93 (0.893)
	45° Elbow	1.41 (0.43)	1.47 (0.448)	1.55 (0.472)	1.65 (0.503)	1.76 (0.536)	1.88 (0.573)	2.00 (0.61)	2.14 (0.652)	2.28 (0.695)
	Ent. Loss	5.84 (1.78)	6.12 (1.865)	6.43 (1.96)	6.85 (2.088)	7.31 (2.228)	7.8 (2.377)	8.32 (2.536)	8.88 (2.707)	9.47 (2.886)

**Table 2-i: Ducted Combustion Air Duct Pressure Drop in Eq. Ft. (m) for BMK5000/6000 Boiler – Continued**

Inlet Duct & No. Boilers	Duct Section Type	Outside Air Temperature in °F (°C)								
		-30 °F (-34.4)	-15 °F (-26.1)	0 °F (-17.8)	20 °F (-6.7)	40 °F (4.4)	60 °F (15.6)	80 °F (26.7)	100 °F (37.8)	120 °F (48.9)
24" Duct Three Boilers	Straight Run	0.09 (0.09)	0.09 (0.09)	0.10 (0.10)	0.10 (0.10)	0.11 (0.11)	0.12 (0.12)	0.12 (0.12)	0.13 (0.13)	0.14 (0.14)
	90° Elbow	1.22 (0.372)	1.28 (0.39)	1.34 (0.408)	1.43 (0.436)	1.53 (0.466)	1.63 (0.497)	1.74 (0.53)	1.85 (0.564)	1.98 (0.604)
	45° Elbow	0.95 (0.29)	1.00 (0.305)	1.04 (0.317)	1.11 (0.338)	1.19 (0.363)	1.27 (0.387)	1.35 (0.411)	1.44 (0.439)	1.54 (0.469)
	Ent. Loss	4.12 (1.256)	4.32 (1.317)	4.54 (1.384)	4.84 (1.475)	5.16 (1.573)	5.51 (1.679)	5.88 (1.792)	6.27 (1.911)	6.69 (2.039)
24" Duct Four Boilers	Straight Run	0.15 (0.15)	0.16 (0.16)	0.17 (0.17)	0.18 (0.18)	0.19 (0.19)	0.20 (0.20)	0.21 (0.21)	0.23 (0.23)	0.24 (0.24)
	90° Elbow	2.17 (0.661)	2.27 (0.692)	2.39 (0.728)	2.54 (0.774)	2.71 (0.826)	2.9 (0.884)	3.09 (0.942)	3.3 (1.006)	3.52 (1.073)
	45° Elbow	1.69 (0.515)	1.77 (0.539)	1.86 (0.567)	1.98 (0.604)	2.11 (0.643)	2.25 (0.686)	2.40 (0.732)	2.57 (0.783)	2.74 (0.835)
	Ent. Loss	7.33 (2.234)	7.69 (2.344)	8.07 (2.46)	8.60 (2.621)	9.18 (2.798)	9.79 (2.984)	10.45 (3.185)	11.15 (3.399)	11.89 (3.624)
26" Duct Four Boilers	Straight Run	0.10 (0.10)	0.11 (0.11)	0.11 (0.11)	0.12 (0.12)	0.13 (0.13)	0.13 (0.13)	0.14 (0.14)	0.15 (0.15)	0.16 (0.16)
	90° Elbow	1.50 (0.457)	1.57 (0.479)	1.65 (0.503)	1.76 (0.536)	1.88 (0.573)	2.01 (0.613)	2.14 (0.652)	2.28 (0.695)	2.44 (0.744)
	45° Elbow	1.17 (0.357)	1.23 (0.375)	1.29 (0.393)	1.37 (0.418)	1.46 (0.445)	1.56 (0.475)	1.67 (0.509)	1.78 (0.543)	1.90 (0.579)
	Ent. Loss	5.32 (1.622)	5.58 (1.701)	5.86 (1.786)	6.25 (1.905)	6.66 (2.03)	7.11 (2.167)	7.59 (2.313)	5.78 (1.762)	8.63 (2.63)

- NOTES:** 1) Calculation assumes 1200 SCFM (33.98 m<sup>3</sup>/min) per boiler at full fire rate  
 2) Units for "Straight Run" pressure drop values are equivalent feet per foot (eq. m / m)  
 3) Units for "Elbows" and "Ent. Loss" are equivalent feet per item (eq. m / item)

**9.3 Gross Natural Draft**

**Table 3-a- Part 1: Gross Natural Draft for BMK1000 & BMK750 Low NOx Boilers – in Inch W.C.**

Stack Height in Feet	Outside Air Temperature								
	-30 °F	-15 °F	0 °F	20 °F	40 °F	60 °F	80 °F	100 °F	120 °F
5	0.024	0.022	0.021	0.018	0.016	0.014	0.011	0.009	0.007
10	0.048	0.045	0.041	0.037	0.032	0.028	0.023	0.018	0.014
15	0.072	0.067	0.062	0.055	0.048	0.041	0.034	0.028	0.021
20	0.096	0.089	0.083	0.073	0.064	0.055	0.046	0.037	0.028
25	0.120	0.112	0.103	0.092	0.080	0.069	0.057	0.046	0.034
30	0.144	0.134	0.124	0.110	0.096	0.083	0.069	0.055	0.041
35	0.168	0.156	0.144	0.128	0.112	0.096	0.080	0.064	0.048
40	0.193	0.179	0.165	0.147	0.128	0.110	0.092	0.073	0.055
45	0.217	0.201	0.186	0.165	0.144	0.124	0.103	0.083	0.062
50	0.241	0.223	0.206	0.183	0.160	0.138	0.115	0.092	0.069
75	0.361	0.335	0.309	0.275	0.241	0.206	0.172	0.138	0.103
100	0.481	0.447	0.413	0.367	0.321	0.275	0.229	0.183	0.138
125	0.602	0.559	0.516	0.458	0.401	0.344	0.287	0.229	0.172
150	0.722	0.670	0.619	0.550	0.481	0.413	0.344	0.275	0.206
175	0.842	0.782	0.722	0.642	0.562	0.481	0.401	0.321	0.241
200	0.963	0.894	0.825	0.734	0.642	0.550	0.458	0.367	0.275

**Table 3-a- Part 1: Gross Natural Draft for BMK1000 & BMK750 Low NOx Boilers – in Pascals**

Stack Height in Meters	Outside Air Temperature								
	-34.4 °C	-26.1 °C	-17.8 °C	-6.7 °C	4.4 °C	15.6 °C	26.7 °C	37.8 °C	48.9 °C
1.52	6.0	5.5	5.2	4.5	4.0	3.5	2.7	2.2	1.7
3.05	12.0	11.2	10.2	9.2	8.0	7.0	5.7	4.5	3.5
4.57	17.9	16.7	15.4	13.7	12.0	10.2	8.5	7.0	5.2
6.1	23.9	22.2	20.7	18.2	15.9	13.7	11.5	9.2	7.0
7.62	29.9	27.9	25.7	22.9	19.9	17.2	14.2	11.5	8.5
9.14	35.9	33.4	30.9	27.4	23.9	20.7	17.2	13.7	10.2
10.67	41.8	38.9	35.9	31.9	27.9	23.9	19.9	15.9	12.0
12.19	48.1	44.6	41.1	36.6	31.9	27.4	22.9	18.2	13.7
13.72	54.1	50.1	46.3	41.1	35.9	30.9	25.7	20.7	15.4
15.24	60.0	55.5	51.3	45.6	39.9	34.4	28.6	22.9	17.2
22.86	89.9	83.4	77.0	68.5	60.0	51.3	42.8	34.4	25.7
30.48	119.8	111.3	102.9	91.4	80.0	68.5	57.0	45.6	34.4
38.1	150.0	139.2	128.5	114.1	99.9	85.7	71.5	57.0	42.8
45.72	179.8	166.9	154.2	137.0	119.8	102.9	85.7	68.5	51.3
53.34	209.7	194.8	179.8	159.9	140.0	119.8	99.9	80.0	60.0
60.96	239.9	222.7	205.5	182.8	159.9	137.0	114.1	91.4	68.5

**Table 3-a-Part 2: Gross Natural Draft for BMK1000 & BMK750 Low NOx Boilers – in Eq. Ft.**

Stack Height in Feet	Outside Air Temperature – Fahrenheit								
	-30 °F	-15 °F	0 °F	20 °F	40 °F	60 °F	80 °F	100 °F	120 °F
5	4.1	3.8	3.5	3.2	2.8	2.4	2.0	1.6	1.2
10	8.3	7.7	7.1	6.3	5.5	4.7	3.9	3.2	2.4
15	12.4	11.5	10.6	9.5	8.3	7.1	5.9	4.7	3.5
20	16.6	15.4	14.2	12.6	11.0	9.5	7.9	6.3	4.7
25	20.7	19.2	17.7	15.8	13.8	11.8	9.9	7.9	5.9
30	24.8	23.1	21.3	18.9	16.6	14.2	11.8	9.5	7.1
35	29.0	26.9	24.8	22.1	19.3	16.6	13.8	11.0	8.3
40	33.1	30.8	28.4	25.2	22.1	18.9	15.8	12.6	9.5
45	37.3	34.6	31.9	28.4	24.8	21.3	17.7	14.2	10.6
50	41.4	38.4	35.5	31.5	27.6	23.7	19.7	15.8	11.8
75	62.1	57.7	53.2	47.3	41.4	35.5	29.6	23.7	17.7
100	82.8	76.9	71.0	63.1	55.2	47.3	39.4	31.5	23.7
125	103.5	96.1	88.7	78.9	69.0	59.1	49.3	39.4	29.6
150	124.2	115.3	106.4	94.6	82.8	71.0	59.1	47.3	35.5
175	144.9	134.5	124.2	110.4	96.6	82.8	69.0	55.2	41.4
200	165.6	153.8	141.9	126.2	110.4	94.6	78.9	63.1	47.3

Note: Based on 160 °F to 180 °F Boiler Water

**Table 3-a-Part 2: Gross Natural Draft for BMK1000 & BMK750 Low NOx Boilers – In Eq. Meters**

Stack Height in Meters	Outside Air Temperature – Celsius								
	-34.4 °C	-26.1 °C	-17.8 °C	-6.7 °C	4.4 °C	15.6 °C	26.7 °C	37.8 °C	48.9 °C
1.52	1.2	1.2	1.1	1.0	0.9	0.7	0.6	0.5	0.4
3.05	2.5	2.3	2.2	1.9	1.7	1.4	1.2	1.0	0.7
4.57	3.8	3.5	3.2	2.9	2.5	2.2	1.8	1.4	1.1
6.10	5.1	4.7	4.3	3.8	3.4	2.9	2.4	1.9	1.4
7.62	6.3	5.9	5.4	4.8	4.2	3.6	3.0	2.4	1.8
9.14	7.6	7.0	6.5	5.8	5.1	4.3	3.6	2.9	2.2
10.67	8.8	8.2	7.6	6.7	5.9	5.1	4.2	3.4	2.5
12.19	10.1	9.4	8.7	7.7	6.7	5.8	4.8	3.8	2.9
13.72	11.4	10.5	9.7	8.7	7.6	6.5	5.4	4.3	3.2
15.24	12.6	11.7	10.8	9.6	8.4	7.2	6.0	4.8	3.6
22.86	18.9	17.6	16.2	14.4	12.6	10.8	9.0	7.2	5.4
30.48	25.2	23.4	21.6	19.2	16.8	14.4	12.0	9.6	7.2
38.10	31.5	29.3	27.0	24.0	21.0	18.0	15.0	12.0	9.0
45.72	37.9	35.1	32.4	28.8	25.2	21.6	18.0	14.4	10.8
53.34	44.2	41.0	37.9	33.6	29.4	25.2	21.0	16.8	12.6
60.96	50.5	46.9	43.3	38.5	33.6	28.8	24.0	19.2	14.4

Note: Based on 71 °C to 82 °C Boiler Water



**Table 3-b-Part 1: Gross Natural Draft for BMK1500, BMK2000, BMK2500, BMK3000 Low NOx Boilers – in Inch W.C.**

Stack Height in Feet	Outside Air Temperature – Fahrenheit								
	-30°F	-15°F	0°F	20°F	40°F	60°F	80°F	100°F	120°F
5	0.024	0.022	0.021	0.018	0.016	0.014	0.011	0.009	0.007
10	0.048	0.045	0.041	0.037	0.032	0.028	0.023	0.018	0.014
15	0.072	0.067	0.062	0.055	0.048	0.041	0.034	0.028	0.021
20	0.096	0.089	0.083	0.073	0.064	0.055	0.046	0.037	0.028
25	0.120	0.112	0.103	0.092	0.080	0.069	0.057	0.046	0.034
30	0.144	0.134	0.124	0.110	0.096	0.083	0.069	0.055	0.041
35	0.168	0.156	0.144	0.128	0.112	0.096	0.080	0.064	0.048
40	0.193	0.179	0.165	0.147	0.128	0.110	0.092	0.073	0.055
45	0.217	0.201	0.186	0.165	0.144	0.124	0.103	0.083	0.062
50	0.241	0.223	0.206	0.183	0.160	0.138	0.115	0.092	0.069
75	0.361	0.335	0.309	0.275	0.241	0.206	0.172	0.138	0.103
100	0.481	0.447	0.413	0.367	0.321	0.275	0.229	0.183	0.138
125	0.602	0.559	0.516	0.458	0.401	0.344	0.287	0.229	0.172
150	0.722	0.670	0.619	0.550	0.481	0.413	0.344	0.275	0.206
175	0.842	0.782	0.722	0.642	0.562	0.481	0.401	0.321	0.241
200	0.963	0.894	0.825	0.734	0.642	0.550	0.458	0.367	0.275

**Table 3-b-Part 1: Gross Natural Draft for BMK1500, BMK2000, BMK2500, BMK3000 Low NOx Boilers – in Pascals**

Stack Height in Meters	Outside Air Temperature – Celsius								
	-34.4 °C	-26.1 °C	-17.8 °C	-6.7 °C	4.4 °C	15.6 °C	26.7 °C	37.8 °C	48.9 °C
1.52	6.0	5.5	5.2	4.5	4.0	3.5	2.7	2.2	1.7
3.05	12.0	11.2	10.2	9.2	8.0	7.0	5.7	4.5	3.5
4.57	17.9	16.7	15.4	13.7	12.0	10.2	8.5	7.0	5.2
6.10	23.9	22.2	20.7	18.2	15.9	13.7	11.5	9.2	7.0
7.62	29.9	27.9	25.7	22.9	19.9	17.2	14.2	11.5	8.5
9.14	35.9	33.4	30.9	27.4	23.9	20.7	17.2	13.7	10.2
10.67	41.8	38.9	35.9	31.9	27.9	23.9	19.9	15.9	12.0
12.19	48.1	44.6	41.1	36.6	31.9	27.4	22.9	18.2	13.7
13.72	54.1	50.1	46.3	41.1	35.9	30.9	25.7	20.7	15.4
15.24	60.0	55.5	51.3	45.6	39.9	34.4	28.6	22.9	17.2
22.86	89.9	83.4	77.0	68.5	60.0	51.3	42.8	34.4	25.7
30.48	119.8	111.3	102.9	91.4	80.0	68.5	57.0	45.6	34.4
38.10	150.0	139.2	128.5	114.1	99.9	85.7	71.5	57.0	42.8
45.72	179.8	166.9	154.2	137.0	119.8	102.9	85.7	68.5	51.3
53.34	209.7	194.8	179.8	159.9	140.0	119.8	99.9	80.0	60.0
60.96	239.9	222.7	205.5	182.8	159.9	137.0	114.1	91.4	68.5

**Table 3-b-Part 2: Gross Natural Draft for BMK1500, BMK2000, BMK2500, BMK3000 Low NOx Boilers – In Eq. Ft.**

Stack Height in Feet	Outside Air Temperature (°F)								
	-30°F	-15°F	0°F	20°F	40°F	60°F	80°F	100°F	120°F
5	4.1	3.8	3.5	3.2	2.8	2.4	2.0	1.6	1.2
10	8.3	7.7	7.1	6.3	5.5	4.7	3.9	3.2	2.4
15	12.4	11.5	10.6	9.5	8.3	7.1	5.9	4.7	3.5
20	16.6	15.4	14.2	12.6	11.0	9.5	7.9	6.3	4.7
25	20.7	19.2	17.7	15.8	13.8	11.8	9.9	7.9	5.9
30	24.8	23.1	21.3	18.9	16.6	14.2	11.8	9.5	7.1
35	29.0	26.9	24.8	22.1	19.3	16.6	13.8	11.0	8.3
40	33.1	30.8	28.4	25.2	22.1	18.9	15.8	12.6	9.5
45	37.3	34.6	31.9	28.4	24.8	21.3	17.7	14.2	10.6
50	41.4	38.4	35.5	31.5	27.6	23.7	19.7	15.8	11.8
75	62.1	57.7	53.2	47.3	41.4	35.5	29.6	23.7	17.7
100	82.8	76.9	71.0	63.1	55.2	47.3	39.4	31.5	23.7
125	103.5	96.1	88.7	78.9	69.0	59.1	49.3	39.4	29.6
150	124.2	115.3	106.4	94.6	82.8	71.0	59.1	47.3	35.5
175	144.9	134.5	124.2	110.4	96.6	82.8	69.0	55.2	41.4
200	165.6	153.8	141.9	126.2	110.4	94.6	78.9	63.1	47.3

Note: Based on 160 °F to 180 °F

**Table 3-b-Part 2: Gross Natural Draft for BMK1500, BMK2000, BMK2500, BMK3000 Low NOx Boilers – in Eq. Meters**

Stack Height in Meters	Outside Air Temperature – Celsius								
	-34.4 °C	-26.1 °C	-17.8 °C	-6.7 °C	4.4 °C	15.6 °C	26.7 °C	37.8 °C	48.9 °C
1.52	1.2	1.2	1.1	1.0	0.9	0.7	0.6	0.5	0.4
3.05	2.5	2.3	2.2	1.9	1.7	1.4	1.2	1.0	0.7
4.57	3.8	3.5	3.2	2.9	2.5	2.2	1.8	1.4	1.1
6.10	5.1	4.7	4.3	3.8	3.4	2.9	2.4	1.9	1.4
7.62	6.3	5.9	5.4	4.8	4.2	3.6	3.0	2.4	1.8
9.14	7.6	7.0	6.5	5.8	5.1	4.3	3.6	2.9	2.2
10.67	8.8	8.2	7.6	6.7	5.9	5.1	4.2	3.4	2.5
12.19	10.1	9.4	8.7	7.7	6.7	5.8	4.8	3.8	2.9
13.72	11.4	10.5	9.7	8.7	7.6	6.5	5.4	4.3	3.2
15.24	12.6	11.7	10.8	9.6	8.4	7.2	6.0	4.8	3.6
22.86	18.9	17.6	16.2	14.4	12.6	10.8	9.0	7.2	5.4
30.48	25.2	23.4	21.6	19.2	16.8	14.4	12.0	9.6	7.2
38.10	31.5	29.3	27.0	24.0	21.0	18.0	15.0	12.0	9.0
45.72	37.9	35.1	32.4	28.8	25.2	21.6	18.0	14.4	10.8
53.34	44.2	41.0	37.9	33.6	29.4	25.2	21.0	16.8	12.6
60.96	50.5	46.9	43.3	38.5	33.6	28.8	24.0	19.2	14.4

Note: Based on 71 °C to 82 °C Boiler Water

**Table 3-c-Part 1: Gross Natural Draft for BMK5000/6000 Low NOx Boilers – in Inch W.C.**

Stack Height in Feet	Outside Air Design Temperature (°F)								
	-30 °F	-15 °F	0 °F	20 °F	40 °F	60 °F	80 °F	100 °F	120 °F
5	0.024	0.022	0.021	0.018	0.016	0.014	0.011	0.009	0.007
10	0.048	0.045	0.041	0.037	0.032	0.028	0.023	0.018	0.014
15	0.072	0.067	0.062	0.055	0.048	0.041	0.034	0.028	0.021
20	0.096	0.089	0.083	0.073	0.064	0.055	0.046	0.037	0.028
25	0.120	0.112	0.103	0.092	0.080	0.069	0.057	0.046	0.034
30	0.144	0.134	0.124	0.110	0.096	0.083	0.069	0.055	0.041
35	0.168	0.156	0.144	0.128	0.112	0.096	0.080	0.064	0.048
40	0.193	0.179	0.165	0.147	0.128	0.110	0.092	0.073	0.055
45	0.217	0.201	0.186	0.165	0.144	0.124	0.103	0.083	0.062
50	0.241	0.223	0.206	0.183	0.160	0.138	0.115	0.092	0.069
75	0.361	0.335	0.309	0.275	0.241	0.206	0.172	0.138	0.103
100	0.481	0.447	0.413	0.367	0.321	0.275	0.229	0.183	0.138
125	0.602	0.559	0.516	0.458	0.401	0.344	0.287	0.229	0.172
150	0.722	0.670	0.619	0.550	0.481	0.413	0.344	0.275	0.206
175	0.842	0.782	0.722	0.642	0.562	0.481	0.401	0.321	0.241
200	0.963	0.894	0.825	0.734	0.642	0.550	0.458	0.367	0.275

**Table 3-c-Part 1: Gross Natural Draft for BMK5000/6000 Low NOx Boilers – in Pascals**

Stack Height in Meters	Outside Air Temperature – Celsius								
	-34.4 °C	-26.1 °C	-17.8 °C	-6.7 °C	4.4 °C	15.6 °C	26.7 °C	37.8 °C	48.9 °C
1.52	6.0	5.5	5.2	4.5	4.0	3.5	2.7	2.2	1.7
3.05	12.0	11.2	10.2	9.2	8.0	7.0	5.7	4.5	3.5
4.57	17.9	16.7	15.4	13.7	12.0	10.2	8.5	7.0	5.2
6.10	23.9	22.2	20.7	18.2	15.9	13.7	11.5	9.2	7.0
7.62	29.9	27.9	25.7	22.9	19.9	17.2	14.2	11.5	8.5
9.14	35.9	33.4	30.9	27.4	23.9	20.7	17.2	13.7	10.2
10.67	41.8	38.9	35.9	31.9	27.9	23.9	19.9	15.9	12.0
12.19	48.1	44.6	41.1	36.6	31.9	27.4	22.9	18.2	13.7
13.72	54.1	50.1	46.3	41.1	35.9	30.9	25.7	20.7	15.4
15.24	60.0	55.5	51.3	45.6	39.9	34.4	28.6	22.9	17.2
22.86	89.9	83.4	77.0	68.5	60.0	51.3	42.8	34.4	25.7
30.48	119.8	111.3	102.9	91.4	80.0	68.5	57.0	45.6	34.4
38.10	150.0	139.2	128.5	114.1	99.9	85.7	71.5	57.0	42.8
45.72	179.8	166.9	154.2	137.0	119.8	102.9	85.7	68.5	51.3
53.34	209.7	194.8	179.8	159.9	140.0	119.8	99.9	80.0	60.0
60.96	239.9	222.7	205.5	182.8	159.9	137.0	114.1	91.4	68.5

**Table 3-c-Part 2: Gross Natural Draft for BMK5000/6000 Low NOx Boilers – in Eq. Ft.**

Stack Height in Feet	Outside Air Temperature (°F)								
	-30 °F	-15 °F	0 °F	20 °F	40 °F	60 °F	80 °F	100 °F	120 °F
5	4.1	3.8	3.5	3.2	2.8	2.4	2.0	1.6	1.2
10	8.3	7.7	7.1	6.3	5.5	4.7	3.9	3.2	2.4
15	12.4	11.5	10.6	9.5	8.3	7.1	5.9	4.7	3.5
20	16.6	15.4	14.2	12.6	11.0	9.5	7.9	6.3	4.7
25	20.7	19.2	17.7	15.8	13.8	11.8	9.9	7.9	5.9
30	24.8	23.1	21.3	18.9	16.6	14.2	11.8	9.5	7.1
35	29.0	26.9	24.8	22.1	19.3	16.6	13.8	11.0	8.3
40	33.1	30.8	28.4	25.2	22.1	18.9	15.8	12.6	9.5
45	37.3	34.6	31.9	28.4	24.8	21.3	17.7	14.2	10.6
50	41.4	38.4	35.5	31.5	27.6	23.7	19.7	15.8	11.8
75	62.1	57.7	53.2	47.3	41.4	35.5	29.6	23.7	17.7
100	82.8	76.9	71.0	63.1	55.2	47.3	39.4	31.5	23.7
125	103.5	96.1	88.7	78.9	69.0	59.1	49.3	39.4	29.6
150	124.2	115.3	106.4	94.6	82.8	71.0	59.1	47.3	35.5
175	144.9	134.5	124.2	110.4	96.6	82.8	69.0	55.2	41.4
200	165.6	153.8	141.9	126.2	110.4	94.6	78.9	63.1	47.3

Note: Based on 160 °F to 180 °F Boiler Water

**Table 3-c-Part 2: Gross Natural Draft for BMK5000/6000 Low NOx Boilers – in Eq. Meters**

Stack Height in Meters	Outside Air Temperature – Celsius								
	-34.4 °C	-26.1 °C	-17.8 °C	-6.7 °C	4.4 °C	15.6 °C	26.7 °C	37.8 °C	48.9 °C
1.52	1.2	1.2	1.1	1.0	0.9	0.7	0.6	0.5	0.4
3.05	2.5	2.3	2.2	1.9	1.7	1.4	1.2	1.0	0.7
4.57	3.8	3.5	3.2	2.9	2.5	2.2	1.8	1.4	1.1
6.10	5.1	4.7	4.3	3.8	3.4	2.9	2.4	1.9	1.4
7.62	6.3	5.9	5.4	4.8	4.2	3.6	3.0	2.4	1.8
9.14	7.6	7.0	6.5	5.8	5.1	4.3	3.6	2.9	2.2
10.67	8.8	8.2	7.6	6.7	5.9	5.1	4.2	3.4	2.5
12.19	10.1	9.4	8.7	7.7	6.7	5.8	4.8	3.8	2.9
13.72	11.4	10.5	9.7	8.7	7.6	6.5	5.4	4.3	3.2
15.24	12.6	11.7	10.8	9.6	8.4	7.2	6.0	4.8	3.6
22.86	18.9	17.6	16.2	14.4	12.6	10.8	9.0	7.2	5.4
30.48	25.2	23.4	21.6	19.2	16.8	14.4	12.0	9.6	7.2
38.10	31.5	29.3	27.0	24.0	21.0	18.0	15.0	12.0	9.0
45.72	37.9	35.1	32.4	28.8	25.2	21.6	18.0	14.4	10.8
53.34	44.2	41.0	37.9	33.6	29.4	25.2	21.0	16.8	12.6
60.96	50.5	46.9	43.3	38.5	33.6	28.8	24.0	19.2	14.4

Note: Based on 71 °C to 82 °C Boiler Water

**9.4 Altitude Correction**

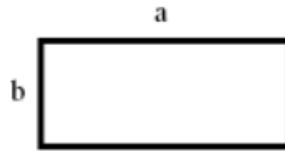
**Table 4:  
Altitude Correction**

Site Elevation Above Sea Level		Altitude Correction Factor (CF)
Feet	Meters	
0	0	1
500	152.4	0.982
1000	304.8	0.964
1500	457.2	0.947
2000	609.6	0.930
2500	762.0	0.913
3000	914.4	0.896
3500	1066.8	0.880
4000	1219.2	0.864
4500	1371.6	0.848
5000	1524.0	0.832
5500	1676.4	0.817
6000	1828.8	0.801
6500	1981.2	0.787
7000	2133.6	0.772
7500	2286.0	0.758
8000	2438.4	0.743
8500	2590.8	0.729
9000	2743.2	0.715
9500	2895.6	0.701
10000	3048.0	0.688

**9.5 Round Vs Square Duct**

**Table 5: Round Duct of Identical Pressure Drop to Rectangular Duct**

$$\text{Formula: } d_e = 1.3 (a \times b)^{0.625} / (a + b)^{0.25}$$



**In Inches**

Adjacent Side of Duct in inches	Side of Rectangular Duct in Inches									
	6	8	10	12	14	16	18	20	22	24
6	6.6									
8	7.6	8.7								
10	8.4	9.8	10.9							
12	9.1	10.7	12	13.1						
14	9.8	11.5	12.9	14.2	15.3					
16	10.4	12.2	13.7	15.1	16.4	17.5				
18	11	12.9	14.5	16	17.3	18.5	19.7			
20	11.5	13.5	15.2	16.8	18.2	19.5	20.7	21.9		
22	12	14.1	15.9	17.6	19.1	20.4	21.7	22.9	24	
24	12.4	14.6	16.5	18.3	19.9	21.3	22.7	23.9	25.1	26.2

**In Centimeters**

Adjacent Side of Duct in cm	Side of Rectangular Duct in Centimeters									
	15.24	20.32	25.4	30.48	35.56	40.64	45.72	50.8	55.88	60.96
15.24	16.76									
20.32	19.30	22.10								
25.4	21.34	24.89	27.69							
30.48	23.11	27.18	30.48	33.27						
35.56	24.89	29.21	32.77	36.07	38.86					
40.64	26.42	30.99	34.80	38.35	41.66	44.45				
45.72	27.94	32.77	36.83	40.64	43.94	46.99	50.04			
50.8	29.21	34.29	38.61	42.67	46.23	49.53	52.58	55.63		
55.88	30.48	35.81	40.39	44.70	48.51	51.82	55.12	58.17	60.96	
60.96	31.50	37.08	41.91	46.48	50.55	54.10	57.66	60.71	63.75	66.55

**Reference:**

1. *National Fuel Gas Code, 2006 edition*, American National Standards Institute, Inc (ANSI Z223.1-2006) and *National Fire Protection Association (NFPA54-2006)*
2. CSA B149.1 (For Canada installations)



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