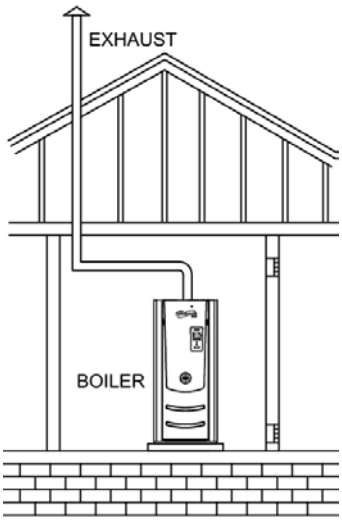
VENTING AND COMBUSTION AIR GUIDE

Natural Gas, Propane Gas, or Dual Fuel Fired Modulating, Condensing Boilers

For models:

BMK 750 to BMK 6000

Benchmark Series
Gas Fired Boilers



Revised: 12/03/2013

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1.1 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, direct 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 – 1d, which illustrate the air inlet, vent connections and condensate removal connections for the BMK 750 (0.75 MMBTU), BMK 1000 (1.0 MMBTU), BMK 1500 (1.5 MMBTU), BMK 2000 (2.0 MMBTU), BMK 2500 (2.5 MMBTU), BMK 3000 (3.0 MMBTU) and BMK 6000 (6.0 MMBTU) models.

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

1.2 Materials and Approvals

The Benchmark boiler is a Category II, III, and IV appliance that requires special attention to exhaust venting and combustion air details. The exhaust vent MUST be UL listed for use with Category II, III, and IV appliances. The BMK 2500 and BMK 3000 can be used with polypropylene venting materials, but NOT PVC or CPVC. The smaller size BMK 750 and BMK 1000 boilers can be used with AL29-4C, VP1738A polypropylene, PVC or CPVC vent materials, due to their lower exhaust operating temperatures. If needed, a PVC Vent Adapter is provided in the Spares Kit included with each BMK 750 and BMK 1000 boiler. The BMK 6000 must use UL-listed vents made of AL29-4C stainless steel. Proper clearances to combustibles must be maintained per UL and the vent manufacturer requirements.

The UL, National Fuel Gas Code (ANSI Z223.1/ NFPA54)[1] 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.

1.3 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 should be at least 4 feet below, 1 foot above or 4 feet removed horizontally from any window, door or gravity air inlet of a building. Such terminations should extend beyond the outside face of the wall by at least 6 inches.

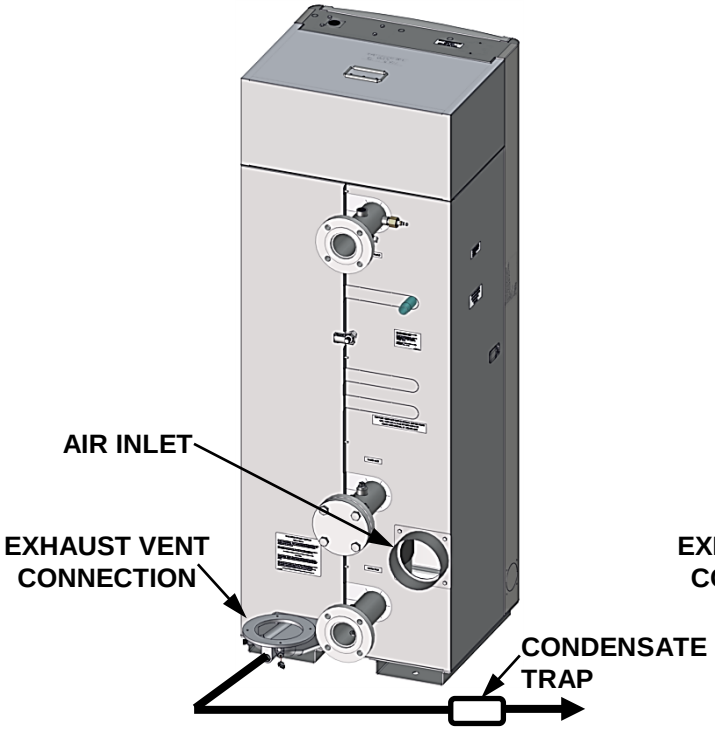


*Figure 1a: **BMK 750/1000***

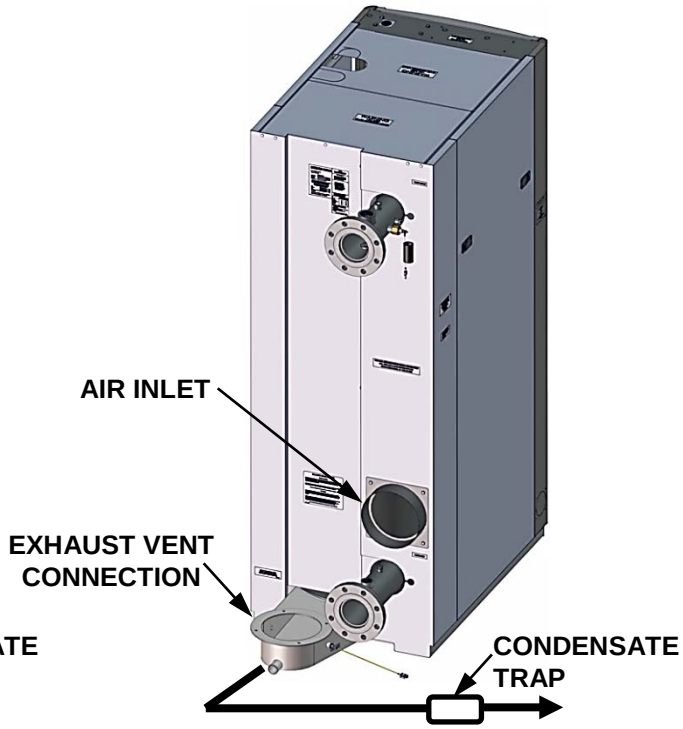


*Figure 1b: **BMK 1500/2000***

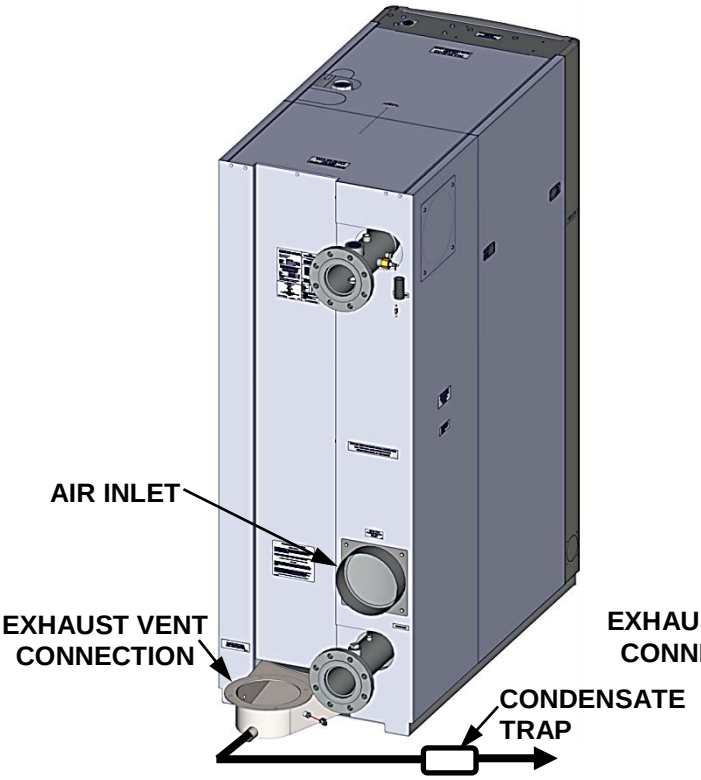


*Figure 1c: **BMK 2500/3000***

*Figure 1d: **BMK 6000***

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

Vents should 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 should not be located in high wind, wind-blocked 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. As a general rule, designs should minimize wind effects.

Wall and roof penetrations should follow all applicable codes and the vent manufacturer's instructions. Vents should 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 should extend at least 3 feet above the roof through properly flashed penetrations, and at least 2 feet above any object within a 10-foot horizontal distance.

Vertical and horizontal discharges should be designed to prevent rain from entering the vent. Large-mesh screens can be applied to protect against the entry of foreign objects but the 'free area' should be at least twice the flue cross-sectional area.

If the vent system is to be connected to an existing stack, the stack must be UL listed for Category II, III, and IV appliances (capable of 480°F, 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 other manufacturer’s equipment.

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

1.4 Combustion Air Supply

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

- BMK 750 165 SCFM
- BMK 1000 200 SCFM
- BMK 1500 325 SCFM
- BMK 2000 500 SCFM
- BMK 2500 600 SCFM
- BMK 3000 700 SCFM
- BMK 6000 1400 SCFM

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.

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.

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

Intakes should be located to prevent infiltration of chlorides, halogens or any other chemicals that would be detrimental to the operation of combustion equipment. Common sources of these compounds are swimming pools, degreasing compounds, salts, plastic processing and refrigerants. When the environment contains these types of chemicals, the air MUST be supplied from the outdoors using direct-vent/ducted-combustion ductwork.

Air intakes must not be located in the proximity of garages, industrial and medical hood venting, loading docks or refrigerant vent lines. Boilers should not be installed in the proximity of activities that generate dust if that dust can enter the boiler intake. Boilers should 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 recommends 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 can be used without affecting the integrity of the equipment; however, the combustion settings may require adjustment to compensate for site conditions.

1.5 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 shall be sized and located in accordance with the following:

- Each opening shall have a minimum free area of 1 inch^2 per 1,000 BTU/hr (2,200 mm^2/kW) of total input rating of all appliances in the space, but not less than 100 inch^2 (0.06 m^2).
- One opening shall commence within 12 inches (300 mm) of the top of the enclosure, and one opening shall commence within 12 inches (300 mm) of the bottom. (See Figure 2).
- The minimum dimension of air openings shall be not less than 3 inches (80 mm).

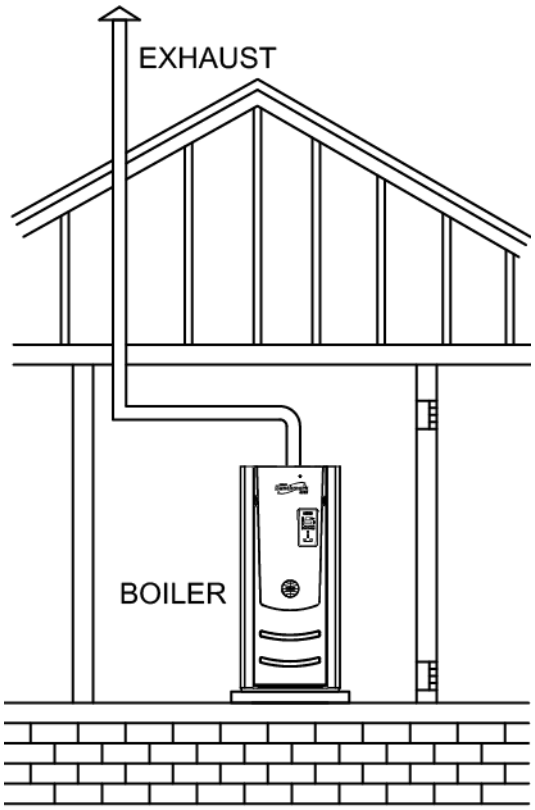


Figure 2: All Combustion Air from Adjacent Indoor Spaces through Indoor Combustion Air Openings

1.6 Combustion Air from OUTSIDE the Building

Outdoor combustion air shall be provided through opening(s) to the outdoors in accordance with the methods described below. The minimum dimension of air openings shall not be less than 3 inches (80 mm). The required size of the openings for combustion air shall be based upon the net free area of each opening. When the free area through a louver, grille, or screen is known, it shall 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.

1.7 Two-Permanent-Openings Method (USA Only)

Two permanent openings shall be provided; one commencing within 12 inches (300 mm) of the top of the enclosure and one commencing within 12 inches (300 mm) of the bottom. The openings shall communicate directly — or by ducts — with the outdoors, or spaces that freely communicate with the outdoors, as show on the following pages:

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

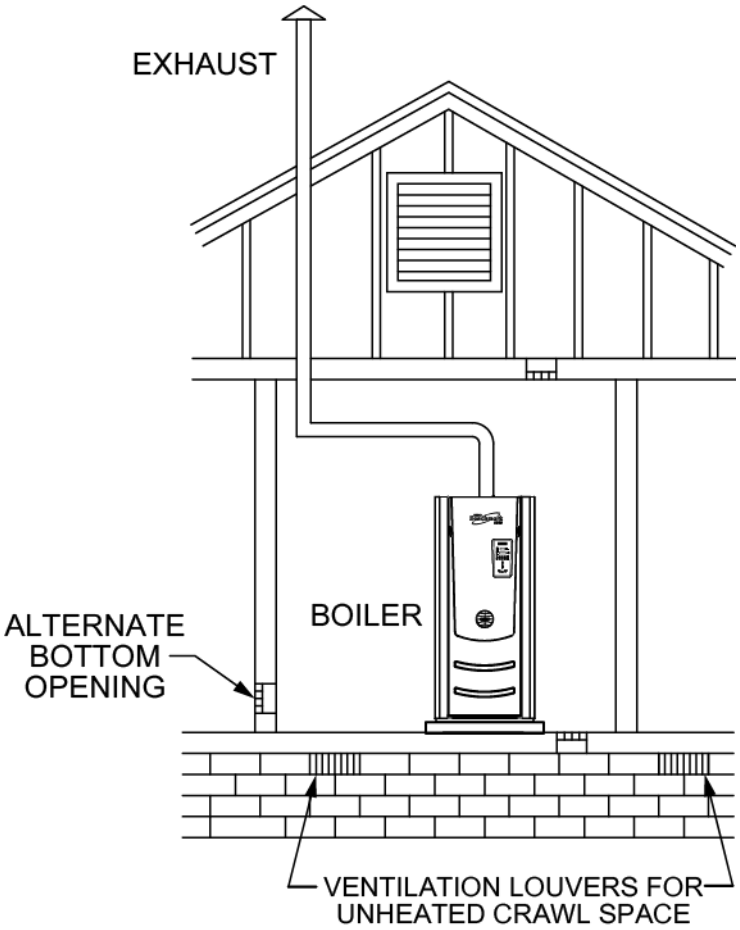


Figure 3: All Combustion Air From Outdoors - Inlet Air From Ventilated Crawl Space and Outlet Air to Ventilated Attic

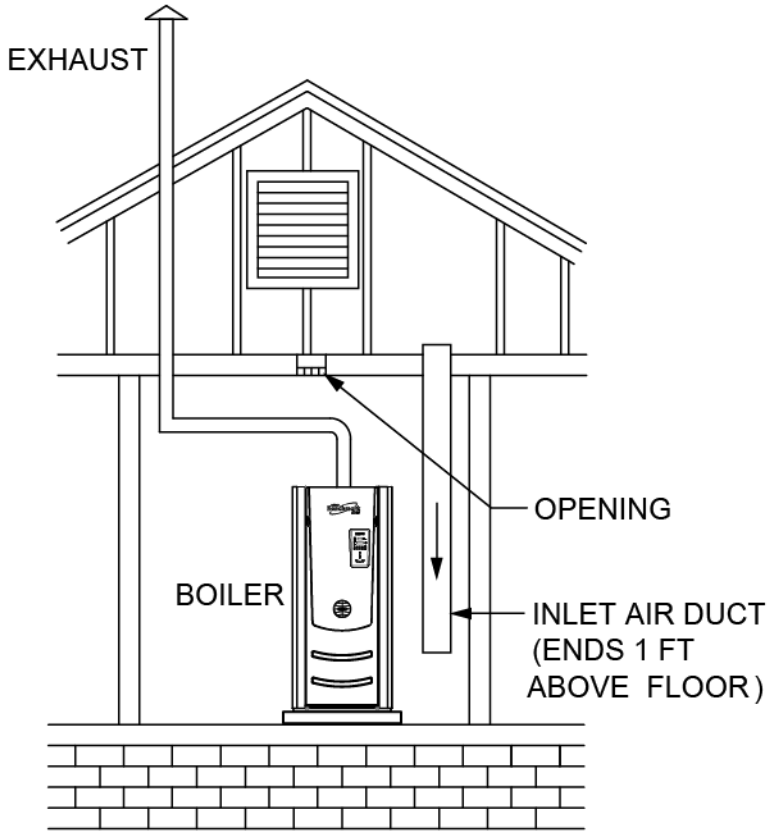


Figure 4: All Combustion Air from Outdoors - Through Ventilated Attic

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

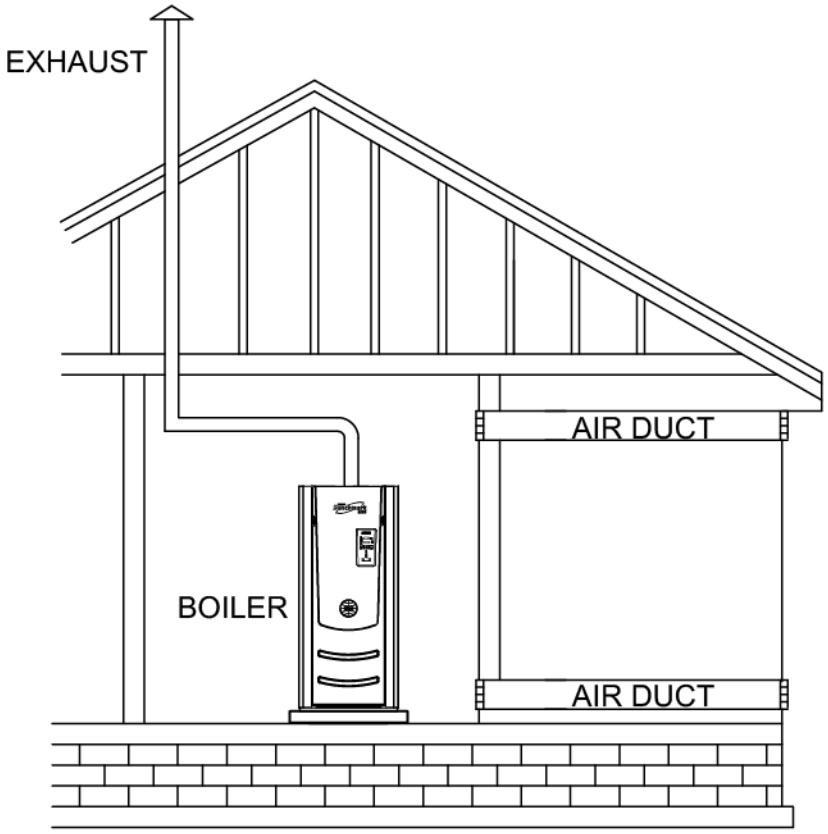


Figure 5: All Combustion Air from Outdoors Through Horizontal Ducts

1.8 One Permanent Opening Method

One permanent opening shall be provided, commencing within 12 inches (300 mm) of the top of the enclosure. The appliance shall have clearances of at least 1 inches (25 mm) from the sides and back of the appliance, and a clearance of 6 inches (150 mm) from the front. The opening shall 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 shall have a minimum free area as follows:

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

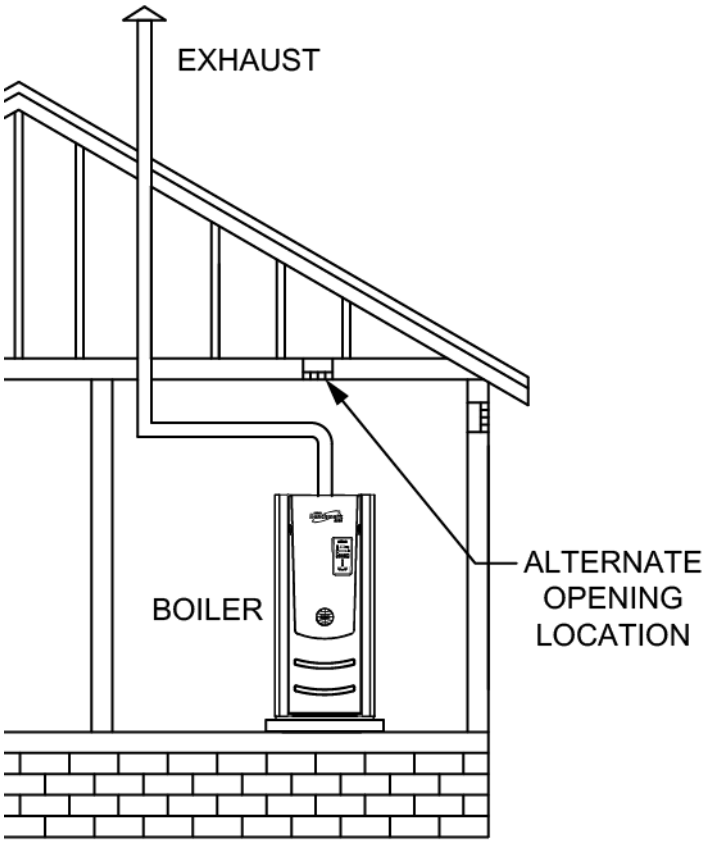


Figure 6: All Combustion Air from Outdoors Through Single Combustion Air Opening

1.9 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 the louver directly using the Auxiliary Relay. An external relay (supplied by others) must be employed for this purpose. The boiler power cannot support external accessories.

If the louver features a proof-of-open switch, it can 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 can 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 Boiler Management System II (BMS II) is being used to manage a multiple boiler installation, the louver can be opened using the System Start Relay of the BMS II. Refer to the BMS II Operations and Maintenance Manual, GF-124, for wiring connections and further details.

1.10 Direct Vent/Ducted Combustion Air

The Benchmark is approved for direct vent installation; i.e., it can draw all 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. The minimum ducted combustion-air duct sizes for the Benchmark boilers are as follows:

- BMK 750 = 6-inch diameter
- BMK 1000 = 6-inch diameter
- BMK 1500 = 6-inch diameter
- BMK 2000 = 8-inch diameter
- BMK 2500 = 8-inch diameter
- BMK 3000 = 8-inch diameter
- BMK 6000 = 14-inch diameter

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

If the system is designed around common air intake it cannot be common exhaust.

The length and restriction of the ducted combustion duct directly impact the size, length and restriction of the discharge venting. The direct vent air intake should be located at least 3 feet below any vent termination within 10 feet.

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

IMPORTANT!

COMMON BREECHING OF AIR INTAKES CAN NOT BE COMBINED WITH COMMON BREECHING OF EXHAUSTS.

1.11 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. Tables 1 through 5 at the end of this Guide 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 Tables 1, 2 and 3, consult the device manufacturer for actual pressure drop values. If rectangular duct is to be used, consult Table 5 for a round diameter duct size that has the identical pressure drop per length of rectangular duct.

The pressure drop values in Table 1b and 1c are in equivalent feet of 8-inch diameter exhaust vent. Note that 1 equivalent foot of 8-inch diameter vent is equal to 0.00546-inch W.C.

The pressure drop values used in Table 1a are in equivalent feet of 6-inch diameter exhaust vent. Note that 1 equivalent foot of 6-inch diameter vent is equal to 0.00581-inch W.C.

1.12 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 Table 3, Part 1 and Part 2. 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.

1.13 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. 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. Pressures below -0.25” W.C. (more negative) may cause flame instability. Pressures above +0.25” W.C. for common vented units, or +0.81 W.C. for individually vented units (more positive), will prevent flue gases from exiting.

1.14 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” to +0.25” W.C. 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.

1.15 Corrections for Altitude

Table 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.*

IMPORTANT!

MANIFOLDED SYSTEMS CANNOT BE USED FOR BOTH COMMON BREECHING OF AIR INTAKES AND EXHAUST VENTS.. ONLY ONE TYPE OF COMMON BREECHING (AIR INTAKE OR EXHAUST) CAN BE USED; BUT NOT BOTH.

1.16 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 approval when designing manifolded exhaust vent systems.

1.17 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 acoustical behavior. Designers should consider minimizing the quantity of elbows in the design and the use of angles less than 90°, whenever possible. Five or fewer elbows are recommended for individual venting/connections; five or fewer are recommended for common sections. **The minimum distance required between two elbows is five feet**.

1.18 Exhaust Muffler And Air Inlet Attenuator Guidelines

The Benchmark requires an exhaust muffler when it is installed in a noise-sensitive application and when the exhaust vent ducting is relatively short in length. The following criteria should 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

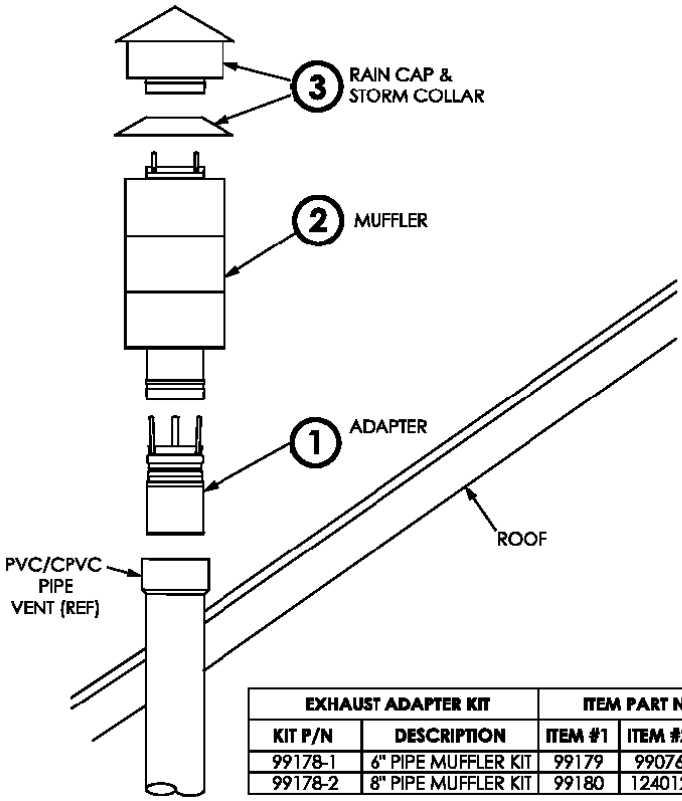
- The **total vertical section** of exhaust vent is **less than 25 linear feet** in length, and the vent terminates in close proximity to residences, offices, hotel/hospital rooms, classrooms etc.

For manifolded exhaust systems, the total vertical section includes only the common vertical; individual boiler vertical connectors are not included in the determination. For example, if the installation has a 20-foot common vertical, and each boiler has a 10-foot vertical connector, the total vertical section is only 20 feet. Because this length is less than 25 linear feet, a muffler is required.

For manifolded ducted combustion, the total vertical section includes only the common vertical; individual boiler vertical connectors are not included in the determination.

For example, if a manifolded ducted combustion has 20-foot common vertical, and each boiler has a 10-foot vertical connector, the total vertical section is only 20 feet. Because this is less than 25 linear feet, an attenuator is required.

An adapter kit is available for the BMK 750 and BMK 1000 units allowing the use of a muffler with PVC piping. When using PVC piping, it is necessary to install the muffler at the end of the vent piping, as shown in Figure 7. Part numbers for 6" and 8" kits are also shown in Figure 7.



EXHAUST ADAPTER KIT		ITEM PART NUMBER		
KIT P/N	DESCRIPTION	ITEM #1	ITEM #2	ITEM #3
99178-1	6" PIPE MUFFLER KIT	99179	99076	99181
99178-2	8" PIPE MUFFLER KIT	99180	124012	99182

Figure 7: Muffler Adapter Kits for BMK 750 & BMK 1000 Using PVC Pipe Exhaust Venting

Contact your local AERCO sales representative for more information on the AERCO exhaust muffler and air inlet attenuator.

1.19 Vent and Combustion Air System Design Requirements

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

Benchmark Model	**Minimum Exhaust Vent & Combustion Air Duct Diameter**
BMK 750	6 inch dia.
BMK 1000	6 inch dia.
BMK 1500	6 inch dia.
BMK 2000	8 inch dia.
BMK 2500	8 inch dia.
BMK 3000	8 inch dia.
BMK 6000	14 inch dia.

A ¼-inch NPT combustion test hole is provided on each unit's exhaust manifold connection (See Figures 8a, 8b, 8c and 8d). A 24-inch length of straight vent is recommended downstream of the exhaust manifold, as illustrated in these figures.

The vent system should always be pitched up ¼ inch per foot 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 should be performed to assure correct drainage.

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

Horizontal vent and ductwork should be supported to prevent sagging, in accordance with local code and the vent manufacturer's requirements. Vertical vent and ductwork should be supported to prevent excessive stress on the horizontal runs. The exhaust manifold and inlet air adapter should never be used as weight-supporting elements. The supports should 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.

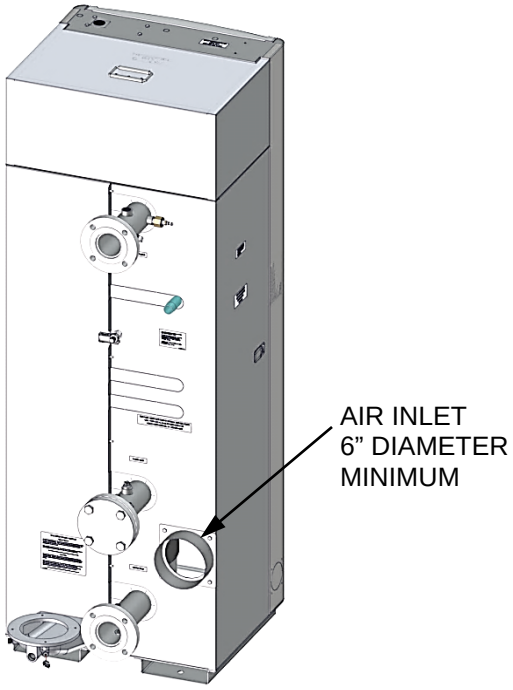


Figure 8a: Ducted Combustion Connection for BMK 750 & BMK 1000 Boilers

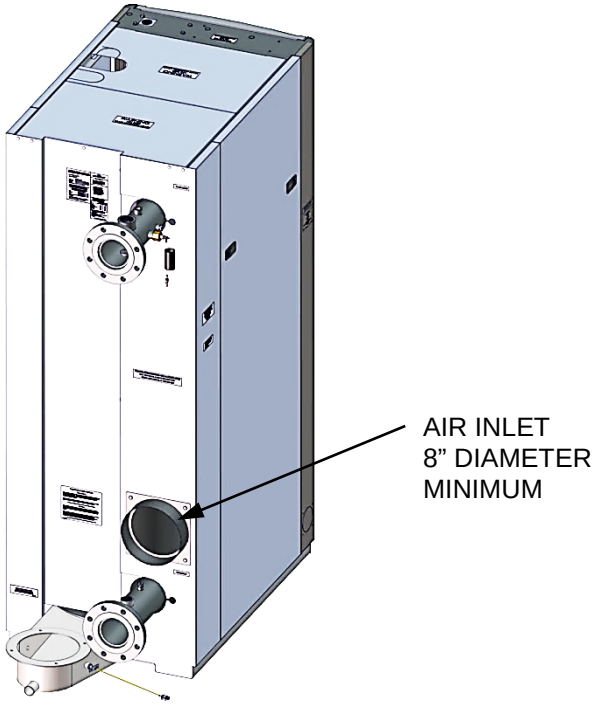


Figure 8b: Ducted Combustion Connection for BMK 1500 & BMK 2000 Boilers

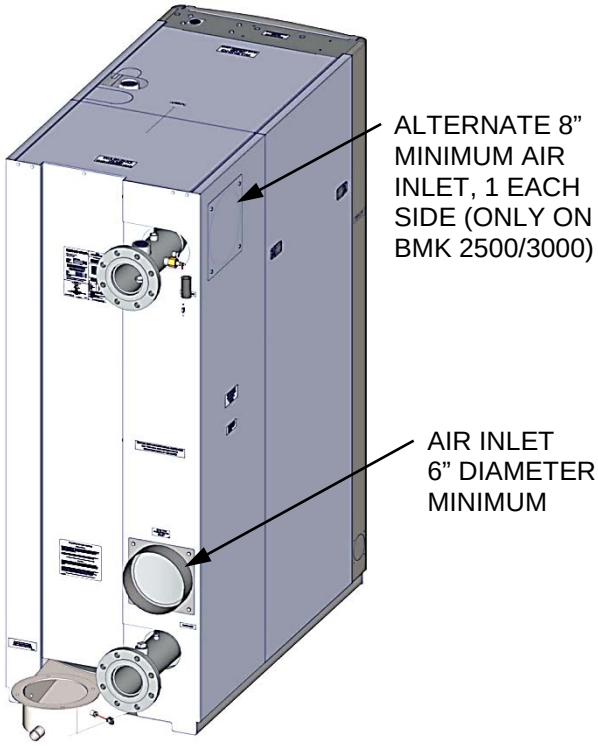


Figure 8c: Ducted Combustion Connection for a BMK 2500 & BMK 3000 Boiler

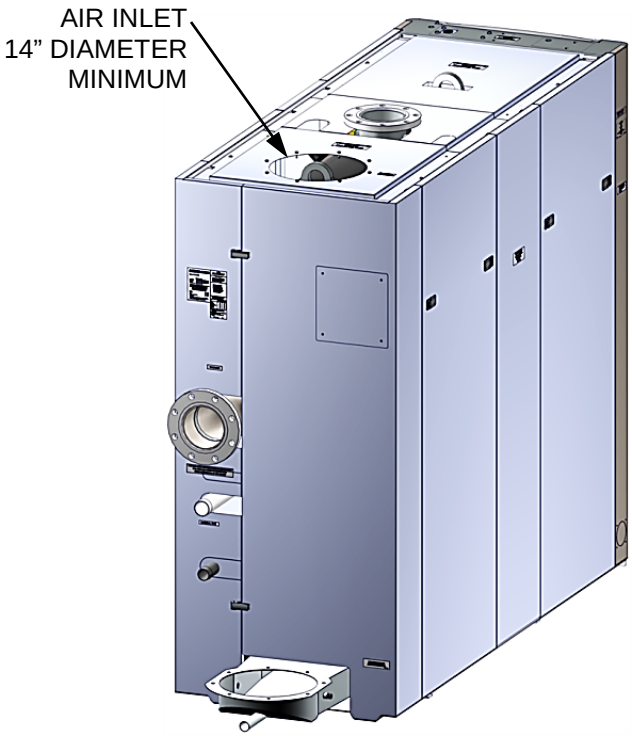


Figure 8d: Ducted Combustion Connection for a BMK 6000 Boiler

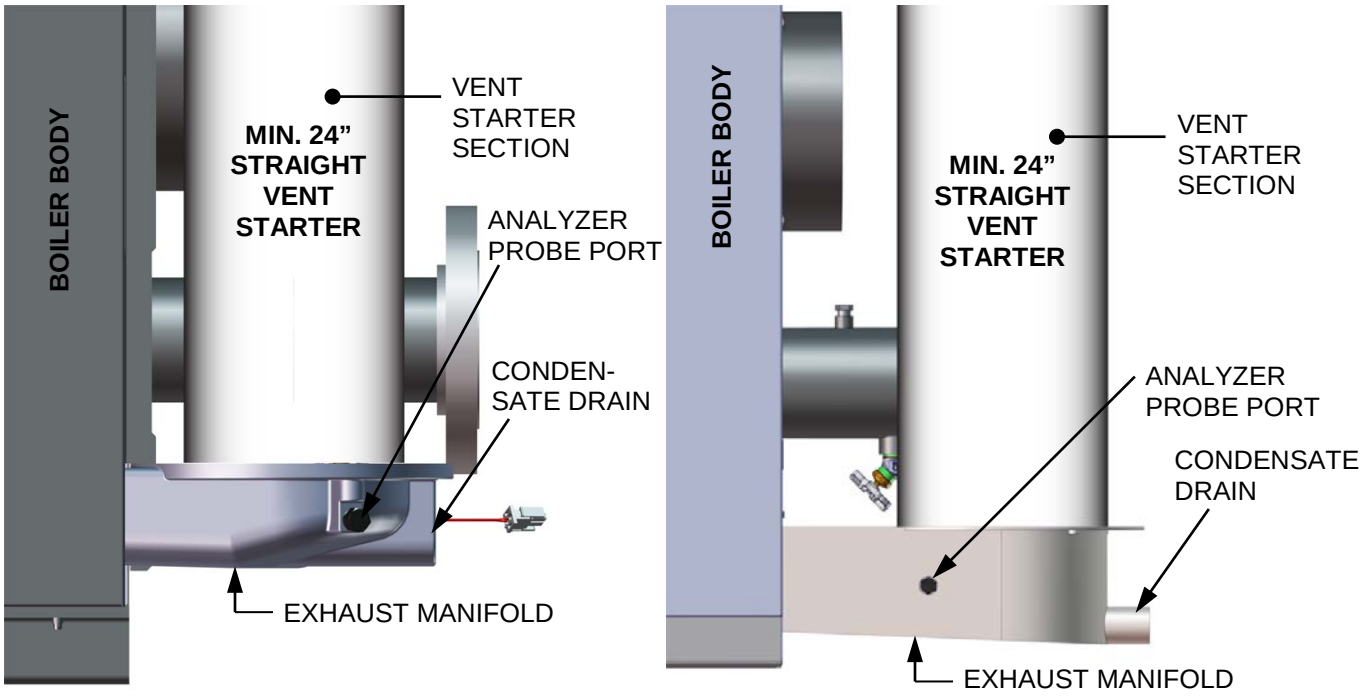


Figure 9a: Vent Starter Section – Left Side View

BMK 750 & BMK 1000 (Left) & BMK 1500 & BMK 2000 (Right)

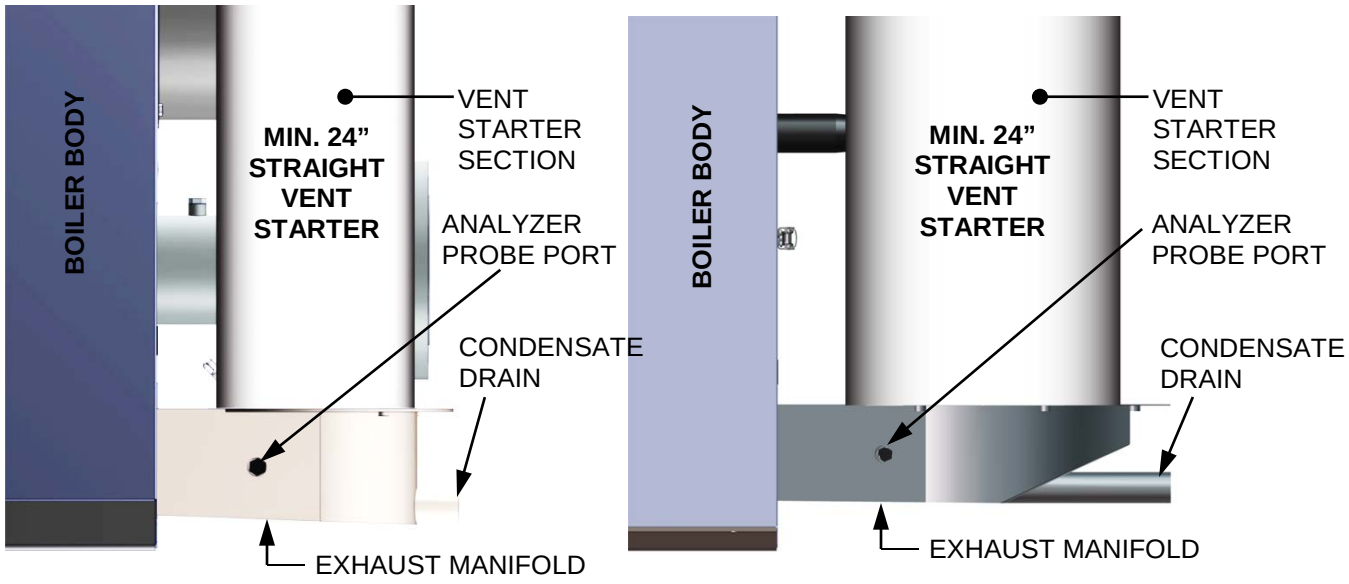


Figure 9b: Vent Starter Section – Left Side View

BMK 2500 & BMK 3000 (Left) & BMK 6000 (Right)

1.20 Condensate Removal

The exhaust vent system must be pitched back toward the Benchmark unit by a minimum of ¼-inch per foot 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 should be connected to the trap assembly and run to drain. Care should be taken to avoid hose kinks and to avoid raising the hose above the trap assembly. Condensate should 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 should 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:

- BMK 750 = 6 gallons per hour
- BMK 1000 = 8 gallons per hour
- BMK 1500 = 9 gallons per hour
- BMK 2000 = 10 gallons per hour
- BMK 2500 = 15 gallons per hour
- BMK 3000 = 20 gallons per hour
- BMK 6000 = 40 gallons 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 should be designed in accordance with local codes that specify acceptable pH limits. If required, any type of commercially available neutralizer may be used.

1.21 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. The maximum combined pressure drop of the vent and combustion air system must not exceed 140 equivalent feet 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 Table 4 to correct for installations above sea level.
4) Determine the natural draft, if any, from Table 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.

1.21.1 BMK 1500 Example:

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

1) An 6-inch diameter exhaust vent with three 90° elbows, two 45° elbows, 50 feet of horizontal run, 20 feet of vertical run
2) A rain cap termination
3) A 6-inch diameter ducted combustion air duct with two 90° elbows and 50 feet of run

CALCULATION:

6-inch Diameter Exhaust Vent Pressure

Two 90° elbows: 2 x 13.11 = 26.22 ft
One 45° elbow: 1 x 9.98= 9.98 ft
35 feet total run
(5 horizontal + 20 vertical):25 x 1.70 = 42.50 ft
Rain cap exit loss: 1 x 21.95 = 21.95 ft
Vent drop subtotal: = 100.65 ft
Altitude correction: $\frac{100.65}{0.982\ (CF)}$ = 102.49 ft
Natural draft for 20 feet @ 20°F outside temperature: = 12.6 ft
Altitude correction:-12.6 x 0.982 CF = -12.37 ft
Total vent drop: = 90.12 ft

6-inch Diameter Combustion Air Duct Pressure

Two 90° elbows: 2 x 5.84 = 11.68 ft
50 feet total run: 20 x 1.06 = 21.20 ft
Entrance loss: 1 x 8.60 = 8.60 ft

Combustion air drop subtotal: = 41.48 ft

Altitude correction: = $\frac{41.48}{0.982\ CF}$ = 42.24 ft
Combustion air drop total: = 42.24 ft

System total pressure drop

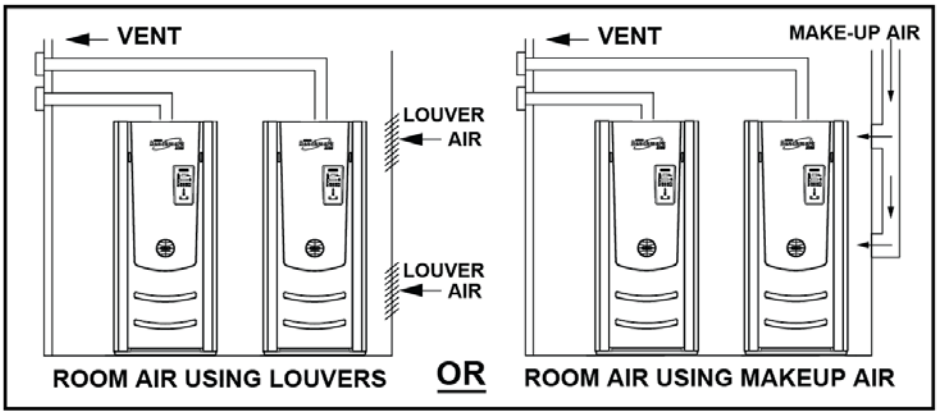
Vent drop + combustion air duct pressure drop
= 90.12 + 42.24
= 132.36 ft

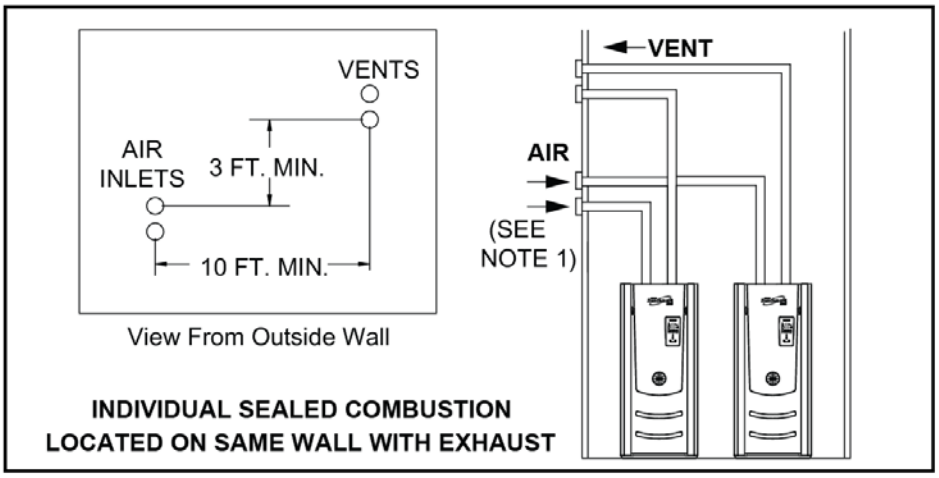
Conclusion:

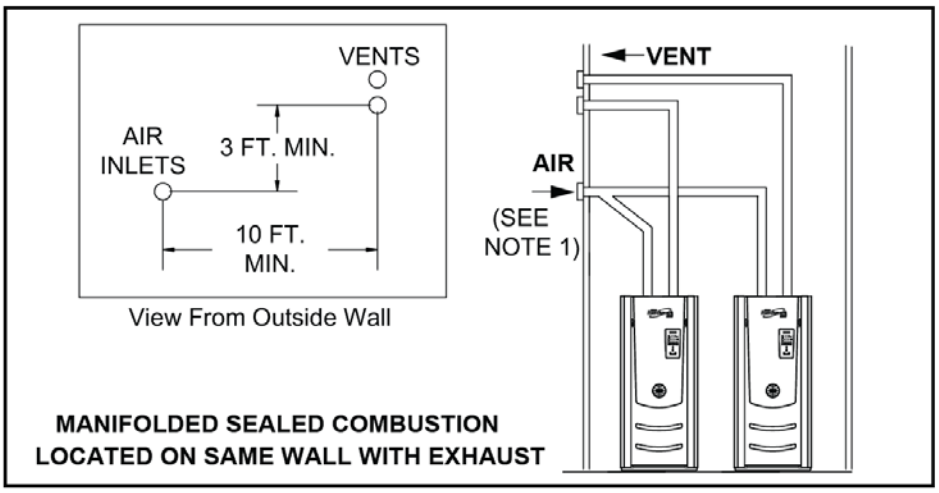
Pressure drop is less than 140 equivalent feet. System OK.

1.22 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.



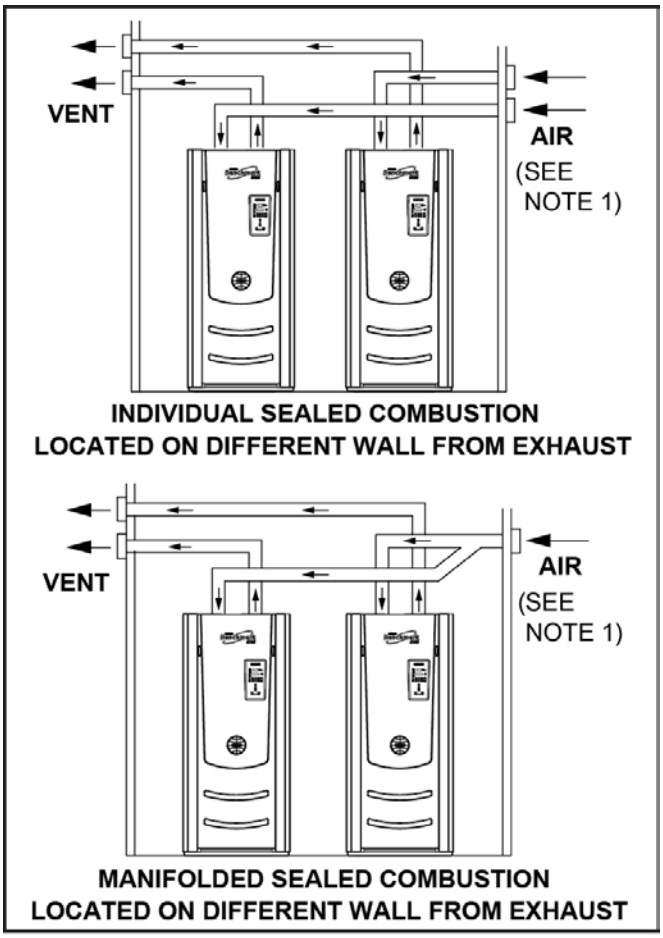




PREFERRED INSTALLATIONS

NOTE 1
For high wind, wind blocked 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.

Figure 10a: Individual Vents – Preferred Installations



NOTE 1

For high wind, wind blocked 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.

Figure 10b: Individual Vents – Acceptable Installations

1.23 Common Vent Breeching (Manifolded)

AERCO forced draft boilers are designed for application in common vent systems.

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

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" should not be used to accomplish these connections. See Figure 11a.

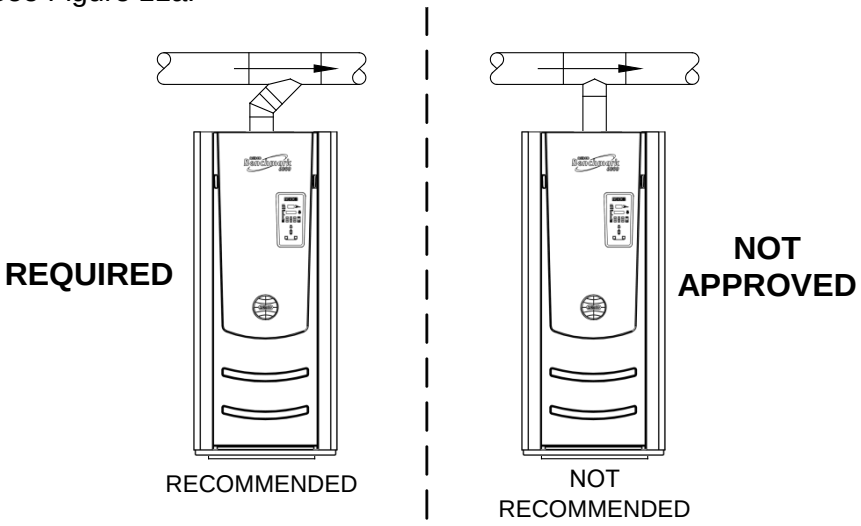


Figure 11a: Recommended Connections to Common Vent Breeching

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.

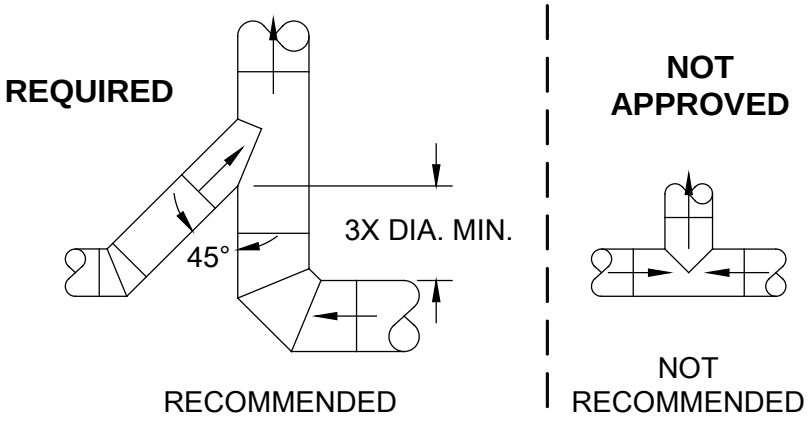


Figure 11b: Required Interconnection of Groups of Units

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.

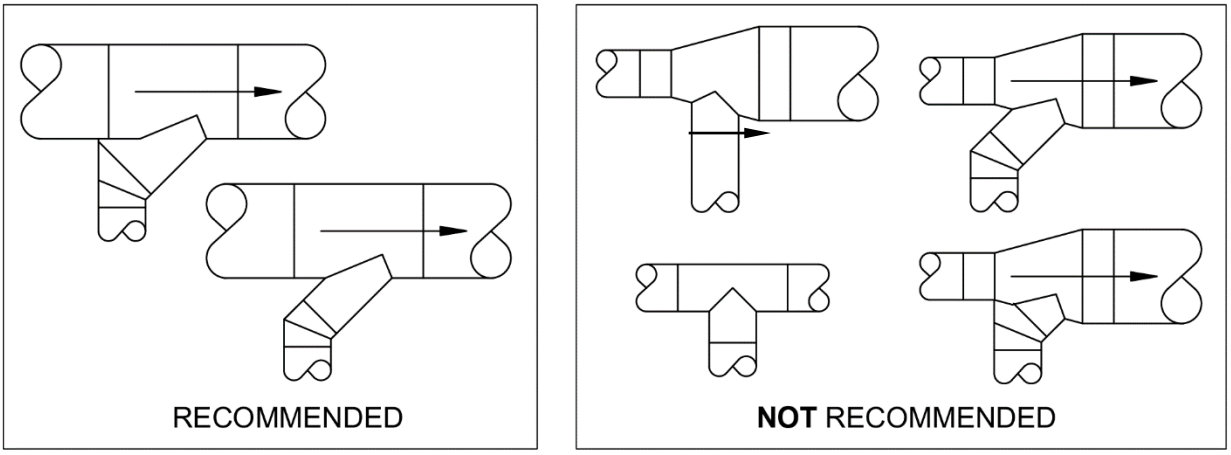


Figure 12: Required Transition Vent Sections

The vent system should always be pitched up ¼-inch per foot 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 should never be interconnected to those connected to other manufacturers' equipment.

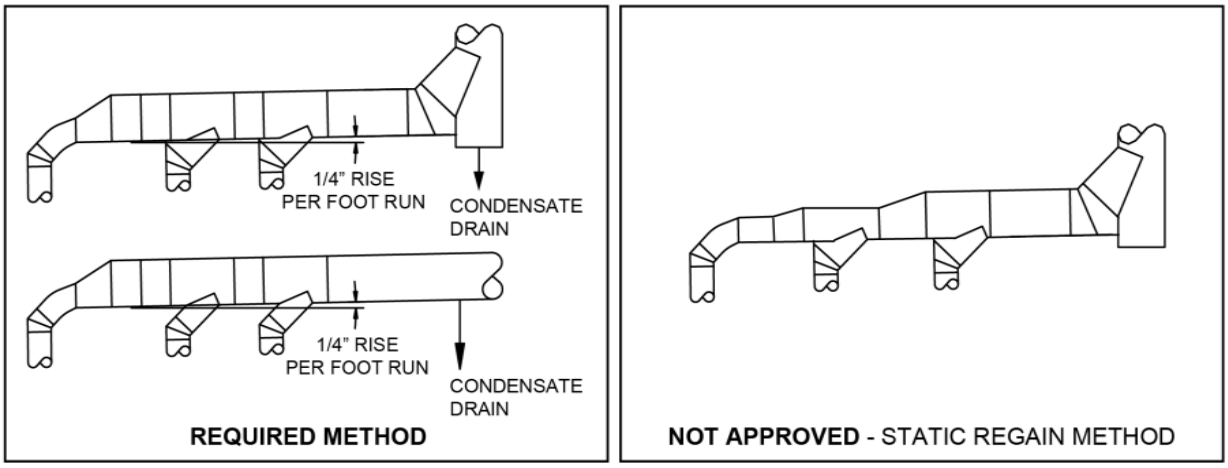


Figure 13: Connection of Unit at End of Vent Main

1.24 Pressure Drop and Draft Data Tables

Table 1a:
Discharge Flue Vent Pressure Drop (Eq. Ft.) for Single BMK 750 Boiler

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

Flue Vent (in. Dia.)	Flue Velocity (ft/sec)	Straight Run (eq. ft / foot)	90° elbow (eq. ft)	45° elbow (eq. ft)	Exit Loss Horiz. Term. (eq. ft)	Exit Loss Rain Cap (eq. ft)
6	16.65	0.45	2.90	2.15	3.59	5.13
8	9.37	0.11	0.74	0.56	1.14	2.11
10	5.99	0.04	0.26	0.20	0.47	0.86
12	4.16	0.02	0.11	0.09	0.22	0.42
14	3.06	0.01	0.06	0.04	0.12	0.23

Table 1b:
Discharge Flue Vent Pressure Drop (Eq. Ft.) for Single BMK 1000 Boiler

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

Flue Vent (in. Dia.)	Flue Velocity (ft/sec)	Straight Run (eq. ft / foot)	90° elbow (eq. ft)	45° elbow (eq. ft)	Exit Loss Horiz. Term. (eq. ft)	Exit Loss Rain Cap (eq. ft)
6	22.20	0.77	5.15	3.82	6.39	9.12
8	12.49	0.18	1.32	0.99	2.02	3.75
10	7.99	0.06	0.47	0.36	0.83	1.54
12	5.55	0.03	0.20	0.16	0.40	0.74
14	4.08	0.01	0.10	0.08	0.22	0.40

Table 1c:
Discharge Flue Vent Pressure Drop (Eq. Ft.) for Single BMK 1500 Boiler

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

Flue Vent (in. Dia.)	Flue Velocity (ft/sec)	Straight Run (eq. ft / foot)	90° elbow (eq. ft)	45° elbow (eq. ft)	Exit Loss Horiz. Term. (eq. ft)	Exit Loss Rain Cap (eq. ft)
6	34.43	1.77	13.11	9.98	15.37	21.95
8	19.37	0.40	3.13	2.36	4.86	9.03
10	12.40	0.13	1.06	0.80	1.99	3.70
12	8.62	0.05	0.46	0.35	0.96	1.78
14	6.33	0.03	0.24	0.19	0.52	0.96
16	4.85	0.01	0.14	0.11	0.30	0.56

Table 1d:
Discharge Venting Pressure Drop for Single BMK 2000 Boiler

(Assuming 180ºF Water Temperature and 20ºF Rise at Sea Level)

Flue Vent (in. Dia.)	Flue Velocity (ft/sec)	Straight Run (eq. ft / foot)	90° elbow (eq. ft)	45° elbow (eq. ft)	Exit Loss Horiz. Term. (eq. ft)	Exit Loss Rain Cap (eq. ft)
8	26.35	0.71	5.86	4.42	9.00	16.71
10	16.87	0.23	2.08	1.59	3.69	6.85
12	11.71	0.09	0.91	0.70	1.78	3.30
14	8.60	0.04	0.46	0.35	0.96	1.78
16	6.59	0.02	0.25	0.20	0.56	1.04
18	5.21	0.01	0.15	0.12	0.35	0.65

Table 1e:
Discharge Venting Pressure Drop for Single BMK 2500 Boiler

(Assuming 180ºF Water Temperature and 20ºF Rise at Sea Level)

Flue Vent (in. Dia.)	Flue Velocity (ft/sec)	Straight Run (eq. ft / foot)	90° elbow (eq. ft)	45° elbow (eq. ft)	Exit Loss Horiz. Term. (eq. ft)	Exit Loss Rain Cap (eq. ft)
8	25.62	0.93	5.54	4.17	8.51	15.89
10	16.49	0.30	1.97	1.51	3.48	6.47
12	11.39	0.12	0.86	0.67	1.68	3.12
14	8.37	0.06	0.43	0.34	0.91	1.68
16	6.40	0.03	0.24	0.19	0.53	0.99
18	5.06	0.02	0.14	0.11	0.33	0.62

Table 1f:
Discharge Flue Vent Pressure Drop (Eq. Ft.) for Single BMK 3000 Boiler

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

Flue Vent (in. Dia.)	Flue Velocity (ft/sec)	Straight Run (eq. ft / foot)	90° elbow (eq. ft)	45° elbow (eq. ft)	Exit Loss Horiz. Term. (eq. ft)	Exit Loss Rain Cap (eq. ft)
8	29.28	1.24	7.54	5.68	11.58	21.50
10	19.13	0.40	2.68	2.05	4.74	8.81
12	13.28	0.16	1.17	0.90	2.29	4.25
14	9.76	0.08	0.58	0.46	1.23	2.29
16	7.47	0.04	0.32	0.25	0.72	1.34
18	5.90	0.02	0.19	0.15	0.45	0.84

Table 1g:
Discharge Flue Vent Pressure Drop (Eq. Ft.) for Single BMK 6000 Boiler

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

Flue Vent (in. Dia.)	Flue Velocity (ft/sec)	Straight Run (eq. ft / foot)	90° elbow (eq. ft)	45° elbow (eq. ft)	Exit Loss Horiz. Term. (eq. ft)	Exit Loss Rain Cap (eq. ft)
12	30.59	0.64	6.20	4.80	12.13	22.53
14	22.48	0.29	3.11	2.42	6.55	12.16
16	17.21	0.15	1.72	1.34	3.84	7.13
18	13.60	0.08	1.02	0.79	2.40	4.45
20	11.01	0.05	0.64	0.50	1.57	2.92

Table 2a:
Ducted Combustion Air Duct Pressure Drop (Eq. Ft.) for BMK 750 Boiler

		Outside Air Temperature (°F)								
Inlet Duct & No. Boilers	**Duct Section Type**	**-30 °F**	**-15 °F**	**0 °F**	**20 °F**	**40 °F**	**60 °F**	**80 °F**	**100 °F**	**120 °F**
6" Duct Single Boiler	Straight Run	0.27	0.27	0.28	0.29	0.30	0.31	0.32	0.33	0.34
	90° Elbow	1.18	1.23	1.29	1.38	1.47	1.57	1.68	1.79	1.91
	45° Elbow	0.87	0.91	0.96	1.02	1.09	1.16	1.24	1.32	1.41
	Ent. Loss	1.83	1.92	2.02	2.15	2.29	2.45	2.61	2.79	2.97
8" Duct Single Boiler	Straight Run	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08
	90° Elbow	0.30	0.31	0.33	0.35	0.38	0.40	0.43	0.46	0.49
	45° Elbow	0.23	0.24	0.25	0.27	0.28	0.30	0.32	0.34	0.37
	Ent. Loss	0.58	0.61	0.64	0.68	0.73	0.77	0.83	0.88	0.94
8" Duct Two Boilers	Straight Run	0.20	0.21	0.22	0.23	0.25	0.26	0.28	0.30	0.32
	90° Elbow	1.20	1.26	1.32	1.41	1.50	1.60	1.71	1.83	1.95
	45° Elbow	0.90	0.95	1.00	1.06	1.13	1.21	1.29	1.38	1.47
	Ent. Loss	2.32	2.43	2.55	2.72	2.90	3.10	3.31	3.53	3.76
10" Duct Two Boilers	Straight Run	0.07	0.07	0.07	0.08	0.08	0.09	0.09	0.10	0.11
	90° Elbow	0.43	0.45	0.47	0.50	0.53	0.57	0.61	0.65	0.69
	45° Elbow	0.33	0.34	0.36	0.38	0.41	0.44	0.47	0.50	0.53
	Ent. Loss	0.95	1.00	1.05	1.11	1.19	1.27	1.35	1.44	1.54
10" Duct Three Boilers	Straight Run	0.14	0.15	0.15	0.16	0.17	0.19	0.20	0.21	0.23
	90° Elbow	0.96	1.01	1.06	1.13	1.20	1.28	1.37	1.46	1.56
	45° Elbow	0.74	0.77	0.81	0.86	0.92	0.98	1.05	1.12	1.19
	Ent. Loss	2.14	2.24	2.35	2.51	2.68	2.86	3.05	3.25	3.47
12" Duct Three Boilers	Straight Run	0.06	0.06	0.06	0.07	0.07	0.08	0.08	0.09	0.09
	90° Elbow	0.42	0.44	0.46	0.49	0.53	0.56	0.60	0.64	0.68
	45° Elbow	0.32	0.34	0.36	0.38	0.41	0.43	0.46	0.49	0.53
	Ent. Loss	1.03	1.08	1.13	1.21	1.29	1.38	1.47	1.57	1.67
12" Duct Four Boilers	Straight Run	0.10	0.10	0.11	0.11	0.12	0.13	0.14	0.15	0.16
	90° Elbow	0.74	0.78	0.82	0.87	0.93	1.00	1.06	1.13	1.21
	45° Elbow	0.58	0.60	0.63	0.68	0.72	0.77	0.82	0.88	0.94
	Ent. Loss	1.83	1.92	2.02	2.15	2.29	2.45	2.61	2.79	2.97
14" Duct Four Boilers	Straight Run	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.07	0.07
	90° Elbow	0.37	0.39	0.41	0.44	0.47	0.50	0.53	0.57	0.61
	45° Elbow	0.29	0.30	0.32	0.34	0.36	0.39	0.41	0.44	0.47
	Ent. Loss	0.99	1.04	1.09	1.16	1.24	1.32	1.41	1.50	1.60

NOTES: 1) Calculation assumes 300 scfm per boiler at full fire rate
2) Units for "Straight Run" pressure drop values are (eq. ft. / foot)
3) Units for "Elbows" and "Ent. Loss" are (equivalent feet / item)

Table 2b:
Ducted Combustion Air Duct Pressure Drop (Eq. Ft.) for BMK 1000 Boiler

		Outside Air Temperature (°F)								
Inlet Duct & No. Boilers	**Duct Section Type**	**-30 °F**	**-15 °F**	**0 °F**	**20 °F**	**40 °F**	**60 °F**	**80 °F**	**100 °F**	**120 °F**
6" Duct Single Boiler	Straight Run	0.46	0.47	0.48	0.50	0.51	0.53	0.54	0.56	0.58
	90° Elbow	2.09	2.19	2.30	2.45	2.62	2.79	2.98	3.18	3.39
	45° Elbow	1.55	1.62	1.70	1.82	1.94	2.07	2.21	2.35	2.51
	Ent. Loss	3.26	3.42	3.58	3.82	4.08	4.35	4.64	4.95	5.29
8" Duct Single Boiler	Straight Run	0.11	0.11	0.12	0.12	0.12	0.13	0.13	0.14	0.14
	90° Elbow	0.53	0.56	0.59	0.63	0.67	0.71	0.76	0.81	0.87
	45° Elbow	0.40	0.42	0.44	0.47	0.50	0.54	0.57	0.61	0.65
	Ent. Loss	1.03	1.08	1.13	1.21	1.29	1.38	1.47	1.57	1.67
8" Duct Two Boilers	Straight Run	0.34	0.36	0.37	0.40	0.42	0.45	0.48	0.51	0.55
	90° Elbow	2.13	2.24	2.35	2.51	2.67	2.85	3.04	3.25	3.47
	45° Elbow	1.61	1.69	1.77	1.89	2.02	2.15	2.29	2.45	2.61
	Ent. Loss	4.12	4.32	4.54	4.84	5.16	5.51	5.88	6.27	6.69
10" Duct Two Boilers	Straight Run	0.11	0.12	0.12	0.13	0.14	0.15	0.16	0.17	0.18
	90° Elbow	0.76	0.80	0.84	0.89	0.95	1.01	1.08	1.15	1.23
	45° Elbow	0.58	0.61	0.64	0.68	0.73	0.78	0.83	0.88	0.94
	Ent. Loss	1.69	1.77	1.86	1.98	2.11	2.26	2.41	2.57	2.74
10" Duct Three Boilers	Straight Run	0.24	0.25	0.26	0.28	0.30	0.32	0.34	0.36	0.38
	90° Elbow	1.71	1.79	1.88	2.00	2.14	2.28	2.43	2.60	2.77
	45° Elbow	1.31	1.37	1.44	1.53	1.64	1.75	1.86	1.99	2.12
	Ent. Loss	3.80	3.98	4.18	4.46	4.76	5.08	5.42	5.78	6.16
12" Duct Three Boilers	Straight Run	0.10	0.10	0.11	0.11	0.12	0.13	0.14	0.15	0.16
	90° Elbow	0.74	0.78	0.82	0.87	0.93	1.00	1.06	1.13	1.21
	45° Elbow	0.58	0.60	0.63	0.68	0.72	0.77	0.82	0.88	0.94
	Ent. Loss	1.83	1.92	2.02	2.15	2.29	2.45	2.61	2.79	2.97
12" Duct Four Boilers	Straight Run	0.16	0.17	0.18	0.19	0.21	0.22	0.23	0.25	0.26
	90° Elbow	1.32	1.39	1.46	1.56	1.66	1.77	1.89	2.02	2.15
	45° Elbow	1.02	1.08	1.13	1.20	1.28	1.37	1.46	1.56	1.66
	Ent. Loss	3.26	3.42	3.58	3.82	4.08	4.35	4.64	4.95	5.29
14" Duct Four Boilers	Straight Run	0.08	0.08	0.08	0.09	0.10	0.10	0.11	0.12	0.12
	90° Elbow	0.66	0.70	0.73	0.78	0.83	0.89	0.95	1.01	1.08
	45° Elbow	0.52	0.54	0.57	0.61	0.65	0.69	0.74	0.79	0.84
	Ent. Loss	1.76	1.84	1.93	2.06	2.20	2.35	2.51	2.67	2.85

NOTES:

1) Calculation assumes 300 scfm per boiler at full fire rate
2) Units for "Straight Run" pressure drop values are (eq. ft. / foot)
3) Units for "Elbows" and "Ent. Loss" are (equivalent feet / item)

Table 2c:
Ducted Combustion Air Duct Pressure Drop (Eq. Ft.) for BMK 1500 Boiler

		Outside Air Temperature (°F)								
Inlet Duct & No. Boilers	**Duct Section Type**	**-30 °F**	**-15 °F**	**0 °F**	**20 °F**	**40 °F**	**60 °F**	**80 °F**	**100 °F**	**120 °F**
6" Duct Single Boiler	Straight Run	0.98	1.00	1.02	1.06	1.09	1.13	1.16	1.20	1.24
	90° Elbow	4.97	5.21	5.47	5.84	6.23	6.64	7.09	7.56	8.07
	45° Elbow	3.78	3.97	4.17	4.44	4.74	5.06	5.40	5.76	6.14
	Ent. Loss	7.33	7.69	8.07	8.60	9.18	9.79	10.45	11.15	11.89
8" Duct Single Boiler	Straight Run	0.23	0.24	0.24	0.25	0.26	0.27	0.28	0.29	0.30
	90° Elbow	1.19	1.25	1.31	1.39	1.49	1.59	1.69	1.81	1.93
	45° Elbow	0.89	0.94	0.98	1.05	1.12	1.19	1.27	1.36	1.45
	Ent. Loss	2.32	2.43	2.55	2.72	2.90	3.10	3.31	3.53	3.76
10" Duct Two Boilers	Straight Run	0.24	0.25	0.26	0.28	0.30	0.32	0.34	0.36	0.38
	90° Elbow	1.60	1.68	1.77	1.88	2.01	2.14	2.29	2.44	2.60
	45° Elbow	1.21	1.27	1.33	1.42	1.51	1.61	1.72	1.84	1.96
	Ent. Loss	3.80	3.98	4.18	4.46	4.76	5.08	5.42	5.78	6.16
12" Duct Two Boilers	Straight Run	0.10	0.10	0.11	0.11	0.12	0.13	0.14	0.15	0.16
	90° Elbow	0.70	0.73	0.77	0.82	0.88	0.93	1.00	1.06	1.13
	45° Elbow	0.53	0.56	0.59	0.62	0.67	0.71	0.76	0.81	0.86
	Ent. Loss	1.83	1.92	2.02	2.15	2.29	2.45	2.61	2.79	2.97
12" Duct Three Boilers	Straight Run	0.20	0.21	0.22	0.24	0.26	0.27	0.29	0.31	0.33
	90° Elbow	1.57	1.65	1.73	1.85	1.97	2.10	2.24	2.39	2.55
	45° Elbow	1.20	1.26	1.32	1.41	1.50	1.60	1.71	1.82	1.94
	Ent. Loss	4.12	4.32	4.54	4.84	5.16	5.51	5.88	6.27	6.69
14" Duct Three Boilers	Straight Run	0.09	0.10	0.10	0.11	0.12	0.13	0.14	0.14	0.15
	90° Elbow	0.82	0.86	0.90	0.96	1.02	1.09	1.17	1.24	1.33
	45° Elbow	0.63	0.66	0.70	0.74	0.79	0.85	0.90	0.96	1.03
	Ent. Loss	2.22	2.33	2.45	2.61	2.79	2.97	3.17	3.38	3.61
14" Duct Four Boilers	Straight Run	0.16	0.17	0.18	0.19	0.20	0.22	0.23	0.25	0.26
	90° Elbow	1.45	1.53	1.60	1.71	1.82	1.94	2.07	2.21	2.36
	45° Elbow	1.12	1.18	1.24	1.32	1.41	1.50	1.60	1.71	1.83
	Ent. Loss	3.95	4.15	4.35	4.64	4.95	5.29	5.64	6.02	6.42
16" Duct Four Boilers	Straight Run	0.08	0.09	0.09	0.10	0.10	0.11	0.12	0.13	0.13
	90° Elbow	0.84	0.88	0.93	0.99	1.06	1.13	1.20	1.28	1.37
	45° Elbow	0.66	0.69	0.73	0.78	0.83	0.88	0.94	1.00	1.07
	Ent. Loss	2.32	2.43	2.55	2.72	2.90	3.10	3.31	3.53	3.76

NOTES: 1) Calculation assumes 300 scfm per boiler at full fire rate
2) Units for "Straight Run" pressure drop values are (eq. ft. / foot)
3) Units for "Elbows" and "Ent. Loss" are (equivalent feet / item)

Table 2d:
Ducted Combustion Air Duct Pressure Drop for BMK 2000 Boiler

		Outside Air Temperature (°F)								
Inlet Duct & No. Boilers	**Duct Section Type**	**-30 °F**	**-15 °F**	**0 °F**	**20 °F**	**40 °F**	**60 °F**	**80 °F**	**100 °F**	**120 °F**
8" Duct Single Boiler	Straight Run	0.40	0.41	0.42	0.43	0.44	0.46	0.47	0.49	0.50
	90° Elbow	2.13	2.24	2.35	2.51	2.67	2.85	3.04	3.25	3.47
	45° Elbow	1.61	1.69	1.77	1.89	2.02	2.15	2.29	2.45	2.61
	Ent. Loss	4.12	4.32	4.54	4.84	5.16	5.51	5.88	6.27	6.69
10" Duct Single Boiler	Straight Run	0.13	0.13	0.14	0.14	0.15	0.15	0.16	0.16	0.17
	90° Elbow	0.76	0.80	0.84	0.89	0.95	1.01	1.08	1.15	1.23
	45° Elbow	0.58	0.61	0.64	0.68	0.73	0.78	0.83	0.88	0.94
	Ent. Loss	1.69	1.77	1.86	1.98	2.11	2.26	2.41	2.57	2.74
12" Duct Two Boilers	Straight Run	0.16	0.17	0.18	0.19	0.21	0.22	0.23	0.25	0.26
	90° Elbow	1.32	1.39	1.46	1.56	1.66	1.77	1.89	2.02	2.15
	45° Elbow	1.02	1.08	1.13	1.20	1.28	1.37	1.46	1.56	1.66
	Ent. Loss	3.26	3.42	3.58	3.82	4.08	4.35	4.64	4.95	5.29
14" Duct Two Boilers	Straight Run	0.08	0.08	0.08	0.09	0.10	0.10	0.11	0.12	0.12
	90° Elbow	0.66	0.70	0.73	0.78	0.83	0.89	0.95	1.01	1.08
	45° Elbow	0.52	0.54	0.57	0.61	0.65	0.69	0.74	0.79	0.84
	Ent. Loss	1.76	1.84	1.93	2.06	2.20	2.35	2.51	2.67	2.85
16" Duct Three Boilers	Straight Run	0.08	0.09	0.09	0.10	0.10	0.11	0.12	0.13	0.13
	90° Elbow	0.82	0.86	0.91	0.97	1.03	1.10	1.18	1.25	1.34
	45° Elbow	0.64	0.67	0.71	0.76	0.81	0.86	0.92	0.98	1.04
	Ent. Loss	2.32	2.43	2.55	2.72	2.90	3.10	3.31	3.53	3.76
18" Duct Three Boilers	Straight Run	0.05	0.05	0.05	0.05	0.06	0.06	0.07	0.07	0.08
	90° Elbow	0.49	0.51	0.54	0.57	0.61	0.65	0.70	0.74	0.79
	45° Elbow	0.38	0.40	0.42	0.45	0.48	0.51	0.54	0.58	0.62
	Ent. Loss	1.45	1.52	1.59	1.70	1.81	1.93	2.06	2.20	2.35
18" Duct Four Boilers	Straight Run	0.08	0.08	0.09	0.09	0.10	0.11	0.11	0.12	0.13
	90° Elbow	0.87	0.91	0.96	1.02	1.09	1.16	1.24	1.32	1.41
	45° Elbow	0.68	0.71	0.75	0.80	0.85	0.91	0.97	1.03	1.10
	Ent. Loss	2.57	2.70	2.83	3.02	3.22	3.44	3.67	3.91	4.18
20" Duct Four Boilers	Straight Run	0.05	0.05	0.05	0.06	0.06	0.06	0.07	0.07	0.08
	90° Elbow	0.55	0.57	0.60	0.64	0.68	0.73	0.78	0.83	0.88
	45° Elbow	0.43	0.45	0.47	0.50	0.53	0.57	0.61	0.65	0.69
	Ent. Loss	1.69	1.77	1.86	1.98	2.11	2.26	2.41	2.57	2.74

NOTES: 1) Calculation assumes 500 scfm per boiler at full fire rate.
2) Units for “Straight Run” pressure drop values are (eq. ft. / foot).
3) Units for “Elbows” and “Ent. Loss” are (equivalent feet / item).

Table 2e:
Ducted Combustion Air Duct Pressure Drop for BMK 2500 Boiler

		Outside Air Temperature (°F)								
Inlet Duct & No. Boilers	**Duct Section Type**	**-30 °F**	**-15 °F**	**0 °F**	**20 °F**	**40 °F**	**60 °F**	**80 °F**	**100 °F**	**120 °F**
8" Duct Single Boiler	Straight Run	0.40	0.41	0.42	0.43	0.44	0.46	0.47	0.49	0.50
	90° Elbow	2.13	2.24	2.35	2.51	2.67	2.85	3.04	3.25	3.47
	45° Elbow	1.61	1.69	1.77	1.89	2.02	2.15	2.29	2.45	2.61
	Ent. Loss	4.12	4.32	4.54	4.84	5.16	5.51	5.88	6.27	6.69
10" Duct Single Boiler	Straight Run	0.13	0.13	0.14	0.14	0.15	0.15	0.16	0.16	0.17
	90° Elbow	0.76	0.80	0.84	0.89	0.95	1.01	1.08	1.15	1.23
	45° Elbow	0.58	0.61	0.64	0.68	0.73	0.78	0.83	0.88	0.94
	Ent. Loss	1.69	1.77	1.86	1.98	2.11	2.26	2.41	2.57	2.74
12" Duct Two Boilers	Straight Run	0.16	0.17	0.18	0.19	0.21	0.22	0.23	0.25	0.26
	90° Elbow	1.32	1.39	1.46	1.56	1.66	1.77	1.89	2.02	2.15
	45° Elbow	1.02	1.08	1.13	1.20	1.28	1.37	1.46	1.56	1.66
	Ent. Loss	3.26	3.42	3.58	3.82	4.08	4.35	4.64	4.95	5.29
14" Duct Two Boilers	Straight Run	0.08	0.08	0.08	0.09	0.10	0.10	0.11	0.12	0.12
	90° Elbow	0.66	0.70	0.73	0.78	0.83	0.89	0.95	1.01	1.08
	45° Elbow	0.52	0.54	0.57	0.61	0.65	0.69	0.74	0.79	0.84
	Ent. Loss	1.76	1.84	1.93	2.06	2.20	2.35	2.51	2.67	2.85
16" Duct Three Boilers	Straight Run	0.08	0.09	0.09	0.10	0.10	0.11	0.12	0.13	0.13
	90° Elbow	0.82	0.86	0.91	0.97	1.03	1.10	1.18	1.25	1.34
	45° Elbow	0.64	0.67	0.71	0.76	0.81	0.86	0.92	0.98	1.04
	Ent. Loss	2.32	2.43	2.55	2.72	2.90	3.10	3.31	3.53	3.76
18" Duct Three Boilers	Straight Run	0.05	0.05	0.05	0.05	0.06	0.06	0.07	0.07	0.08
	90° Elbow	0.49	0.51	0.54	0.57	0.61	0.65	0.70	0.74	0.79
	45° Elbow	0.38	0.40	0.42	0.45	0.48	0.51	0.54	0.58	0.62
	Ent. Loss	1.45	1.52	1.59	1.70	1.81	1.93	2.06	2.20	2.35
18" Duct Four Boilers	Straight Run	0.08	0.08	0.09	0.09	0.10	0.11	0.11	0.12	0.13
	90° Elbow	0.87	0.91	0.96	1.02	1.09	1.16	1.24	1.32	1.41
	45° Elbow	0.68	0.71	0.75	0.80	0.85	0.91	0.97	1.03	1.10
	Ent. Loss	2.57	2.70	2.83	3.02	3.22	3.44	3.67	3.91	4.18
20" Duct Four Boilers	Straight Run	0.05	0.05	0.05	0.06	0.06	0.06	0.07	0.07	0.08
	90° Elbow	0.55	0.57	0.60	0.64	0.68	0.73	0.78	0.83	0.88
	45° Elbow	0.43	0.45	0.47	0.50	0.53	0.57	0.61	0.65	0.69
	Ent. Loss	1.69	1.77	1.86	1.98	2.11	2.26	2.41	2.57	2.74

NOTES: 1) Calculation assumes 700 scfm per boiler at full fire rate.

4) Units for “Straight Run” pressure drop values are (eq. ft. / foot).

5) Units for “Elbows” and “Ent. Loss” are (equivalent feet / item).

Table 2f:
Ducted Combustion Air Duct Pressure Drop (Eq. Ft.) for BMK 3000 MMBTU Boiler

		Outside Air Temperature (°F)								
Inlet Duct & No. Boilers	**Duct Section Type**	**-30 °F**	**-15 °F**	**0 °F**	**20 °F**	**40 °F**	**60 °F**	**80 °F**	**100 °F**	**120 °F**
8" Duct Single Boiler	Straight Run	0.85	0.87	0.89	0.91	0.94	0.97	1.00	1.03	1.06
	90° Elbow	4.75	4.98	5.23	5.58	5.95	6.35	6.77	7.23	7.71
	45° Elbow	3.57	3.75	3.93	4.20	4.48	4.78	5.09	5.44	5.80
	Ent. Loss	9.27	9.73	10.21	10.89	11.62	12.39	13.22	14.11	15.05
10" Duct Single Boiler	Straight Run	0.28	0.28	0.29	0.30	0.31	0.32	0.32	0.33	0.34
	90° Elbow	1.60	1.68	1.77	1.88	2.01	2.14	2.29	2.44	2.60
	45° Elbow	1.21	1.27	1.33	1.42	1.51	1.61	1.72	1.84	1.96
	Ent. Loss	3.80	3.98	4.18	4.46	4.76	5.08	5.42	5.78	6.16
12" Duct Two Boilers	Straight Run	0.35	0.37	0.38	0.41	0.43	0.46	0.49	0.52	0.55
	90° Elbow	2.80	2.93	3.08	3.28	3.50	3.74	3.99	4.25	4.54
	45° Elbow	2.13	2.23	2.34	2.50	2.67	2.85	3.04	3.24	3.46
	Ent. Loss	7.33	7.69	8.07	8.60	9.18	9.79	10.45	11.15	11.89
14" Duct Two Boilers	Straight Run	0.16	0.17	0.18	0.19	0.20	0.21	0.23	0.24	0.25
	90° Elbow	1.45	1.53	1.60	1.71	1.82	1.94	2.07	2.21	2.36
	45° Elbow	1.12	1.18	1.24	1.32	1.41	1.50	1.60	1.71	1.83
	Ent. Loss	3.95	4.15	4.35	4.64	4.95	5.29	5.64	6.02	6.42
16" Duct Three Boilers	Straight Run	0.18	0.19	0.19	0.21	0.22	0.23	0.25	0.27	0.28
	90° Elbow	1.90	1.99	2.09	2.23	2.38	2.54	2.71	2.89	3.08
	45° Elbow	1.49	1.56	1.64	1.74	1.86	1.99	2.12	2.26	2.41
	Ent. Loss	5.21	5.47	5.74	6.12	6.53	6.97	7.44	7.94	8.47
18" Duct Three Boilers	Straight Run	0.10	0.10	0.11	0.11	0.12	0.13	0.14	0.15	0.16
	90° Elbow	1.16	1.22	1.28	1.37	1.46	1.56	1.66	1.77	1.89
	45° Elbow	0.92	0.96	1.01	1.08	1.15	1.23	1.31	1.40	1.49
	Ent. Loss	3.26	3.42	3.58	3.82	4.08	4.35	4.64	4.95	5.29
18" Duct Four Boilers	Straight Run	0.17	0.18	0.19	0.20	0.21	0.22	0.24	0.25	0.27
	90° Elbow	2.07	2.17	2.28	2.43	2.59	2.77	2.95	3.15	3.36
	45° Elbow	1.63	1.71	1.80	1.92	2.04	2.18	2.33	2.48	2.65
	Ent. Loss	5.79	6.07	6.37	6.80	7.25	7.74	8.25	8.81	9.40
20" Duct Four Boilers	Straight Run	0.10	0.11	0.11	0.12	0.12	0.13	0.14	0.15	0.16
	90° Elbow	1.30	1.37	1.44	1.53	1.63	1.74	1.86	1.98	2.12
	45° Elbow	1.03	1.08	1.13	1.21	1.29	1.37	1.46	1.56	1.67
	Ent. Loss	3.80	3.98	4.18	4.46	4.76	5.08	5.42	5.78	6.16

NOTES: 1) Calculation assumes 700 scfm per boiler at full fire rate
2) Units for "Straight Run" pressure drop values are (eq. ft. / foot)
3) Units for "Elbows" and "Ent. Loss" are (equivalent feet / item)

Table 2g:
Ducted Combustion Air Duct Pressure Drop for BMK 6000 MMBTU Boiler

		Outside Air Temperature (°F)								
Inlet Duct & No. Boilers	**Duct Section Type**	**-30 °F**	**-15 °F**	**0 °F**	**20 °F**	**40 °F**	**60 °F**	**80 °F**	**100 °F**	**120 °F**
14" Duct Single Boiler	Straight Run	0.16	0.17	0.18	0.19	0.20	0.22	0.23	0.25	0.26
	90° Elbow	1.49	1.57	1.64	1.75	1.87	2.00	2.13	2.27	2.42
	45° Elbow	1.16	1.22	1.28	1.36	1.46	1.55	1.66	1.77	1.89
	Ent. Loss	3.95	4.15	4.35	4.64	4.95	5.29	5.64	6.02	6.42
16" Duct Single Boiler	Straight Run	0.08	0.09	0.09	0.10	0.10	0.11	0.12	0.13	0.13
	90° Elbow	0.82	0.86	0.91	0.97	1.03	1.10	1.18	1.25	1.34
	45° Elbow	0.64	0.67	0.71	0.76	0.81	0.86	0.92	0.98	1.04
	Ent. Loss	2.32	2.43	2.55	2.72	2.90	3.10	3.31	3.53	3.76
18" Duct Two Boilers	Straight Run	0.17	0.18	0.19	0.20	0.21	0.23	0.24	0.26	0.28
	90° Elbow	1.96	2.05	2.15	2.30	2.45	2.62	2.79	2.98	3.18
	45° Elbow	1.53	1.60	1.68	1.79	1.91	2.04	2.18	2.32	2.48
	Ent. Loss	5.79	6.07	6.37	6.80	7.25	7.74	8.25	8.81	9.40
20" Duct Two Boilers	Straight Run	0.10	0.11	0.11	0.12	0.13	0.13	0.14	0.15	0.16
	90° Elbow	1.23	1.29	1.35	1.44	1.54	1.64	1.75	1.87	1.99
	45° Elbow	0.96	1.00	1.05	1.12	1.20	1.28	1.36	1.46	1.55
	Ent. Loss	3.80	3.98	4.18	4.46	4.76	5.08	5.42	5.78	6.16
22" Duct Three Boilers	Straight Run	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.22
	90° Elbow	1.80	1.89	1.99	2.12	2.26	2.41	2.57	2.75	2.93
	45° Elbow	1.41	1.47	1.55	1.65	1.76	1.88	2.00	2.14	2.28
	Ent. Loss	5.84	6.12	6.43	6.85	7.31	7.80	8.32	8.88	9.47
24" Duct Three Boilers	Straight Run	0.09	0.09	0.10	0.10	0.11	0.12	0.12	0.13	0.14
	90° Elbow	1.22	1.28	1.34	1.43	1.53	1.63	1.74	1.85	1.98
	45° Elbow	0.95	1.00	1.04	1.11	1.19	1.27	1.35	1.44	1.54
	Ent. Loss	4.12	4.32	4.54	4.84	5.16	5.51	5.88	6.27	6.69
24" Duct Four Boilers	Straight Run	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.23	0.24
	90° Elbow	2.17	2.27	2.39	2.54	2.71	2.90	3.09	3.30	3.52
	45° Elbow	1.69	1.77	1.86	1.98	2.11	2.25	2.40	2.57	2.74
	Ent. Loss	7.33	7.69	8.07	8.60	9.18	9.79	10.45	11.15	11.89
26" Duct Four Boilers	Straight Run	0.10	0.11	0.11	0.12	0.13	0.13	0.14	0.15	0.16
	90° Elbow	1.50	1.57	1.65	1.76	1.88	2.01	2.14	2.28	2.44
	45° Elbow	1.17	1.23	1.29	1.37	1.46	1.56	1.67	1.78	1.90
	Ent. Loss	5.32	5.58	5.86	6.25	6.66	7.11	7.59	5.78	8.63

NOTES: 1) Calculation assumes 1200 scfm per boiler at full fire rate
2) Units for "Straight Run" pressure drop values are (eq. ft. / foot)
3) Units for "Elbows" and "Ent. Loss" are (equivilent feet / item)

Table 3a- Part 1:
Gross Natural Draft (Inch W.C.) for BMK 1000 & BMK 750 Low NOx Boilers

	Outside Air Temperature (°F)								
Stack Height (ft)	**-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 3a-Part 2:
Gross Natural Draft (Eq. Ft.) for BMK 1000 & BMK 750 Low NOx Boilers

	Outside Air Temperature (°F)								
Stack Height (ft)	**-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 3b-Part 1:

Gross Natural Draft (Inch W.C.) for BMK 1500, BMK 2000, BMK 2500, BMK 3000 Low NOx Boilers

	Outside Air Temperature (°F)								
Stack Height (ft)	**-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 3b-Part 2:

Gross Natural Draft (Eq. Ft.) for BMK 1500, BMK 2000, BMK 2500, BMK 3000 Low NOx Boilers

	Outside Air Temperature (°F)								
Stack Height (ft)	**-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 3c-Part 1:
Gross Natural Draft (Inch W.C.) for BMK 6000 Low NOx Boilers

	Outside Air Design Temperature (°F)								
Stack Height (ft)	**-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 3c-Part 2:
Gross Natural Draft (Eq. Ft.) for BMK 6000 Low NOx Boilers

	Outside Air Temperature (°F)								
Stack Height (ft)	**-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 4: Altitude Correction

Site Elevation (feet above sea level)	Altitude Correction Factor (CF)
0	1
500	0.982
1000	0.964
1500	0.947
2000	0.930
2500	0.913
3000	0.896
3500	0.880
4000	0.864
4500	0.848
5000	0.832
5500	0.817
6000	0.801
6500	0.787
7000	0.772
7500	0.758
8000	0.743
8500	0.729
9000	0.715
9500	0.701
10000	0.688

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

Adjacent Side of Duct (in.)	Side of Rectangular Duct (in.)									
	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

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)

Change Log:

Date	Description	Changed By
11/19/2013	Rev R: Changed references to “Sealed combustion” to “ducted combustion air”. Also added section 1.13 “Acceptable Pressure Range” to page 14.	Curtis Harvey
12/03/2013	Rev S: Corrected calculation in section 1.21.1 to read: 2 X 13.11 = 26.22	Chris Blair

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