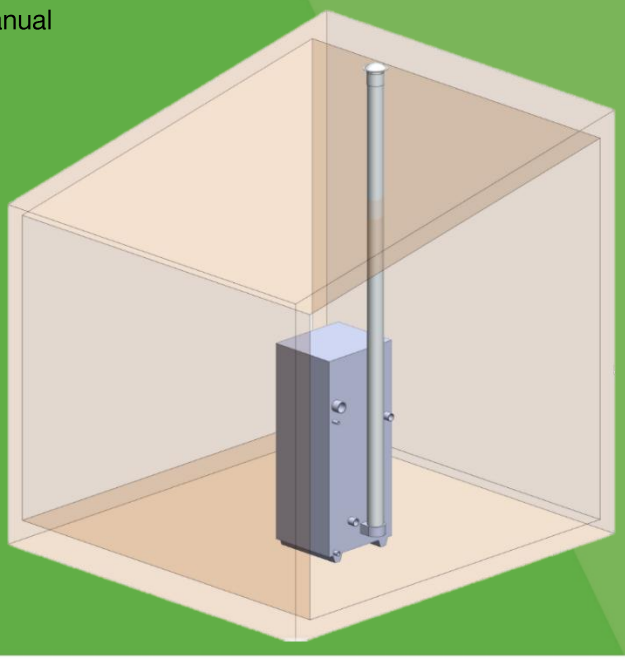
Venting & Combustion Air Design Guide

Benchmark® NX Boilers

Models 399 and 500

Other documents for this product include:

- OMM-0170 Edge X Controller Operation Manual
- OMM-0183 BMK NX 399-500 Edge Operation Maintenance Manual
- OMM-0184 BMK NX 399-500 Edge Reference Manual
- TAG-0119 BMK NX Gas Supply Guide
- TAG-0120 BMK NX Electrical Power Guide
- TAG-0121 Benchmark NX Gas Supply Design Guide
- TAG-0123 BMK NX Boiler Application Guide



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WARNING: QUALIFIED SERVICE PERSONNEL ONLY

This guide is intended for use by qualified professionals experienced in the design and installation of gas-fired boiler venting and combustion-air systems. Installation, adjustment, alteration, service, or maintenance must be performed by qualified personnel in accordance with installation instructions, applicable codes, and the vent manufacturer's instructions. Improper design, installation, adjustment, alteration, service, or maintenance can result in fire, explosion, carbon monoxide exposure, property damage, personal injury, or death. This guide is not a substitute for applicable codes or regulations. Where requirements differ, the applicable code or more restrictive requirement must be followed.

1. GENERAL

The AERCO Benchmark NX gas-fired boiler is a high efficiency, forced draft, hydronic-heating unit with unique venting capabilities. All Benchmark NX venting options (which include horizontal and vertical discharges, individual vent, and manifolded vent breeching), typically exceed the capabilities of competing combustion equipment. Benchmark NX boilers provide 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 NX boiler's high efficiency is achieved through precise delivery of amount of gas 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 NX model is fitted with a condensate removal trap as indicated in Figure 3-1, which illustrates the air inlet, vent connections and condensate removal connections for the BMK NX 399 (399MBH) and BMK NX 500 (500 MBH) models.

2. APPROVED VENT MATERIALS

WARNING: FIRE AND CARBON MONOXIDE HAZARD

Use only vent materials, components, and configurations permitted by this guide, the appliance installation instructions, and applicable codes. Improper vent materials, connections, sizing, installation, or termination can permit flue-gas leakage or improper combustion and may result in fire, carbon monoxide exposure, serious personal injury, or death.

The Benchmark NX 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. AERCO recommends the use of Category II or IV UL1738 or Type BH under ULCS636 listed Polypropylene and Stainless Steel as the preferred venting material for all Benchmark NX boilers. Where codes allow, BMK NX boilers may be vented with UL 1738 Category II or IV PVC and CPVC. Stainless Steel venting should conform to the following:

Diameter:	3" to 8"	9" to 16"	18" to 24"	26" to 30"
Material Thickness:	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.

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.

BMK NX 399 & 500: Available materials from vent manufacturers

Vent Manufacturer/Product	Material	Appliance Adapter
Centrotherm/Innoflue - Appliance adapter	PolyPro	ISAALE0404
DuraVent/PolyPro - Appliance adapter	PolyPro	4PPS-ADL
DuraVent/Fas-N-Seal - Appliance adapter	Stainless Steel	FSA-4PVCM-4FNSF
Heat Fab/Saf-T-Vent - Appliance adapter	Stainless Steel	9401PVC
Z-Flex/Z-Vent - Appliance adapter	Stainless Steel	2SVSLA04
Metal Fab/Corr/Guard - Appliance adapter	Stainless Steel	4CGPVCA
Security Chimney/Secure Seal - Appliance adapter	Stainless Steel	SS4PVCU
Centrotherm/Innoflue – Concentric Vent terminal kit Horizontal	PolyPro	ICVKH46 (4”/6”)
Centrotherm/Innoflue – Concentric Vent terminal kit Vertical	PolyPro	ICVKV46 (4”/6”)
DuraVent/PolyPro – Concentric Vent terminal kit Horizontal	PolyPro	4PPS-HKC (4”/6”)
DuraVent/PolyPro – Concentric Vent terminal kit Vertical	PolyPro (Black cap)	4PPS-VKC (4”/6”)
DuraVent/PolyPro – Concentric Vent terminal kit Vertical	PolyPro (Terra-cotta cap)	4PPS-VK-TCC (4”/6”)

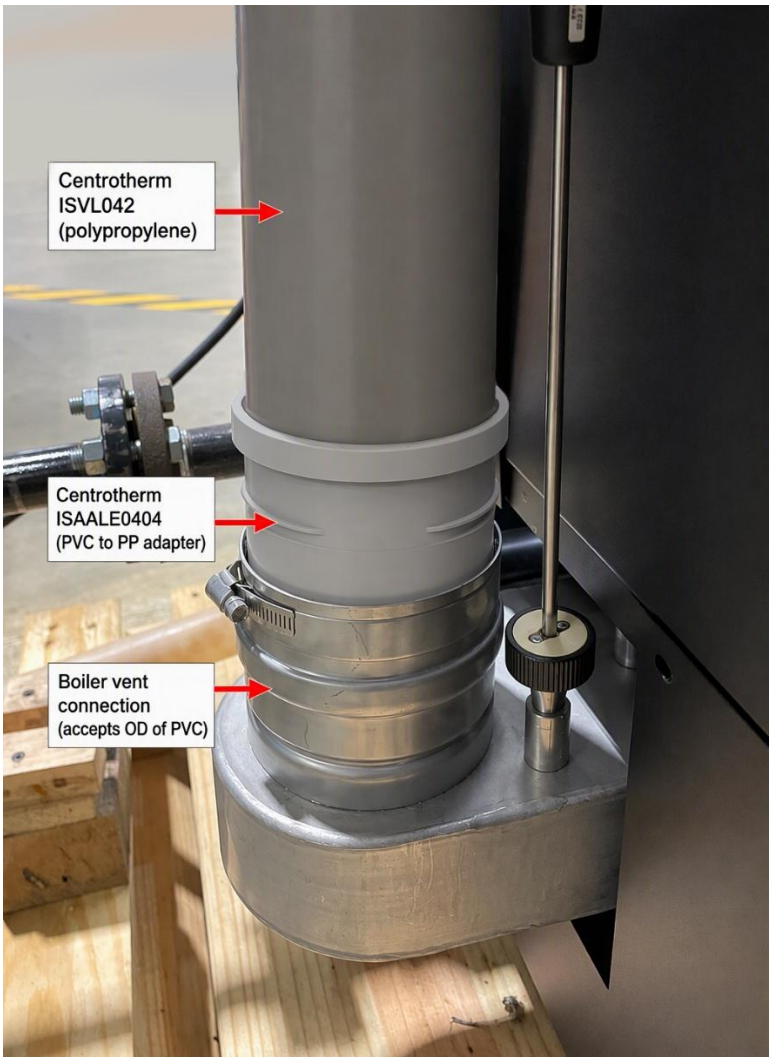


Figure 2-1: Example PVC-to-Polypropylene Adapter and Initial Straight Length

3. CODE REQUIRED VENT TERMINATIONS

WARNING: CARBON MONOXIDE HAZARD

Improper vent termination can allow flue gases to enter the building through doors, windows, air intakes, or other openings. Locate all vent terminations in accordance with this guide and applicable codes. Failure to do so can result in carbon monoxide exposure, serious personal injury, or death.

The guidelines 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' (0.9 M)** above the roof through properly flashed penetrations, and at least **2 feet (0.61 m)** above any object within a **10'(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 NX vents must not be connected to another manufacturer's equipment.

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

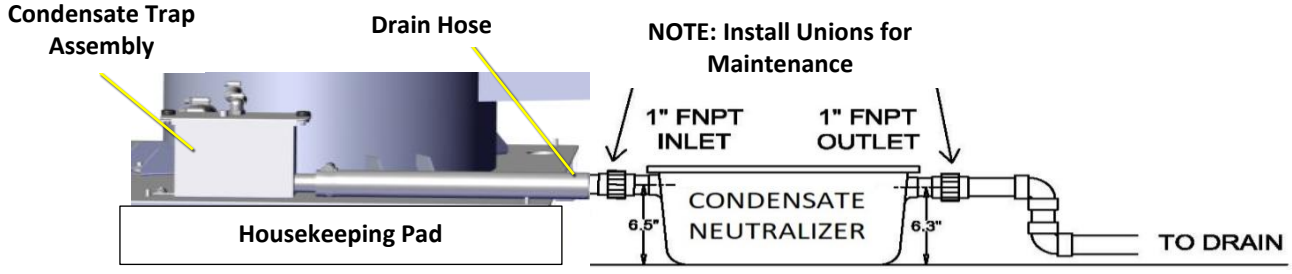


Figure 3-1: BMK NX 399/500 Condensate Outlet

4. EXHAUST AND COMBUSTION AIR SUPPLY

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

UNIT	VOLUME at 60°F (15.6°C)	Air Inlet Adapter Size
BMK NX 399	88 SCFM (2.49 m^3/min)	4 inch
BMK NX 500	110 SCFM (3.11 m^3/min)	4 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 NX boilers though the air inlet on the rear of the unit.

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 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 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, at 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 OMM-0183 for details.

Combustion air temperatures as low as **-30 °F (-34.4 °C)** can be used without affecting the integrity of the equipment; 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^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 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 4-1).
- For Canadian installations, refer and adhere to the latest publication of CAN/CSA B149.1.

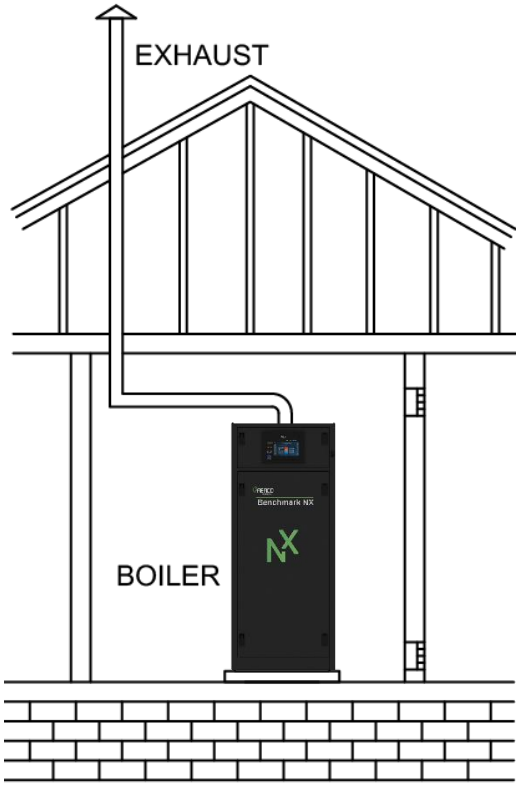


Figure 4-1: All Combustion Air from Adjacent Indoor Spaces through Indoor Combustion Air Openings

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.

WARNING: INADEQUATE COMBUSTION AIR
Failure to provide sufficient combustion and ventilation air can result in improper combustion and accumulation of carbon monoxide. Size and locate all combustion-air openings in accordance with applicable codes and the requirements of this guide.

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^2 per 4,000 BTU/hr. (550 mm^2/kW)** of total input rating of all appliances in the space (see Figures 4-2 and 4-3).

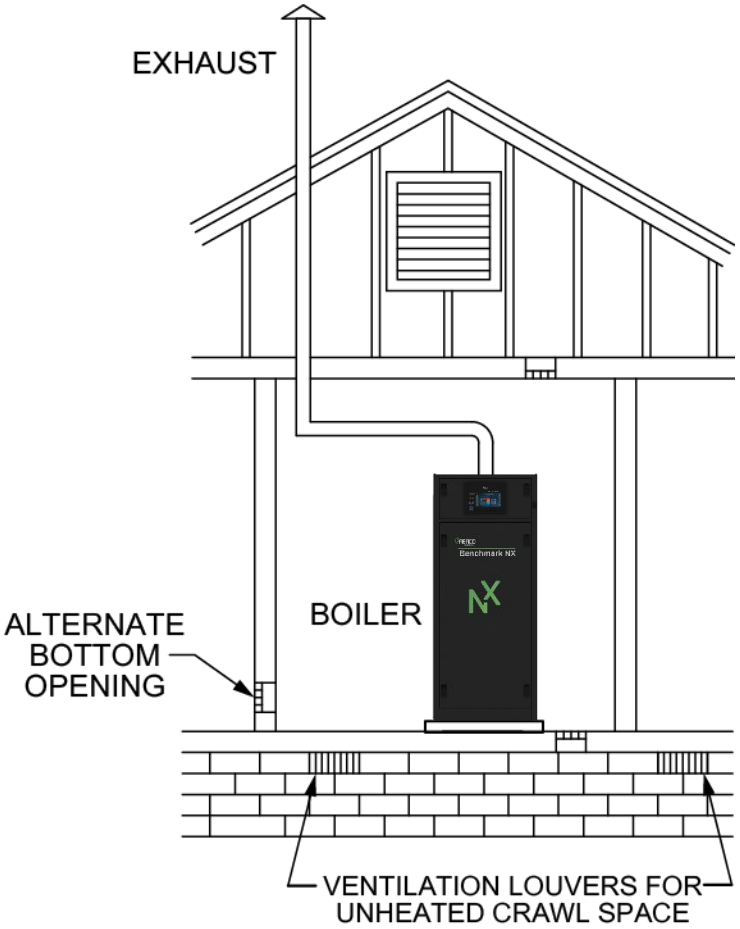


Figure 4-2: All Combustion Air from Outdoors - Inlet Air from Ventilated Crawl Space and Outlet Air to Ventilated Attic

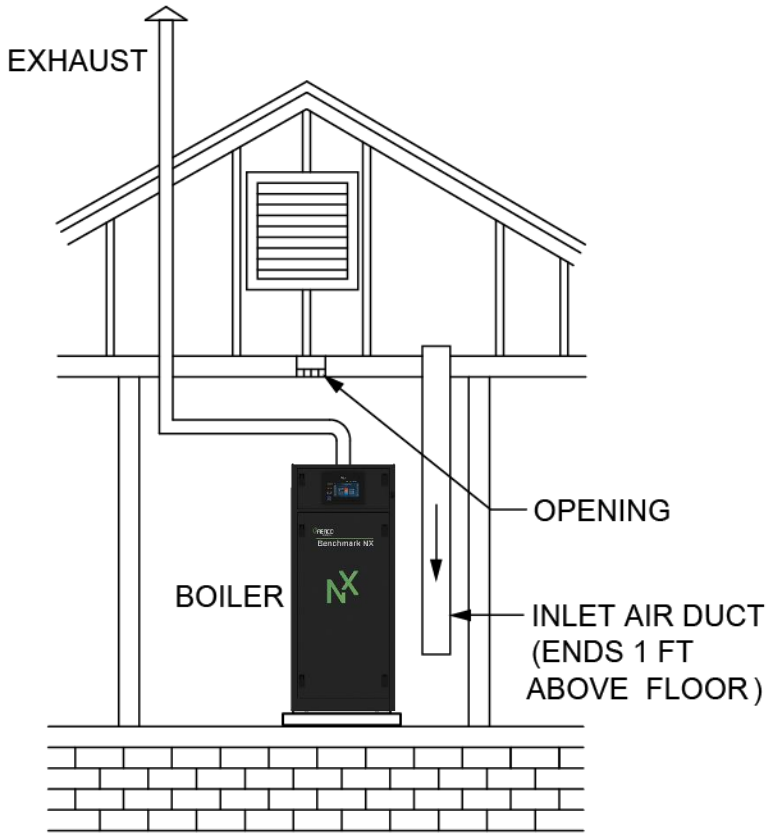


Figure 4-3: All Combustion Air from Outdoors - Through Ventilated Attic

2. When communicating with the outdoors through horizontal ducts, each opening must have a minimum free area of **1 inch^2 per 2,000 BTU/hr. (1100 mm^2/kW)** of total input rating of all appliances in the space (see Figure 4-4).

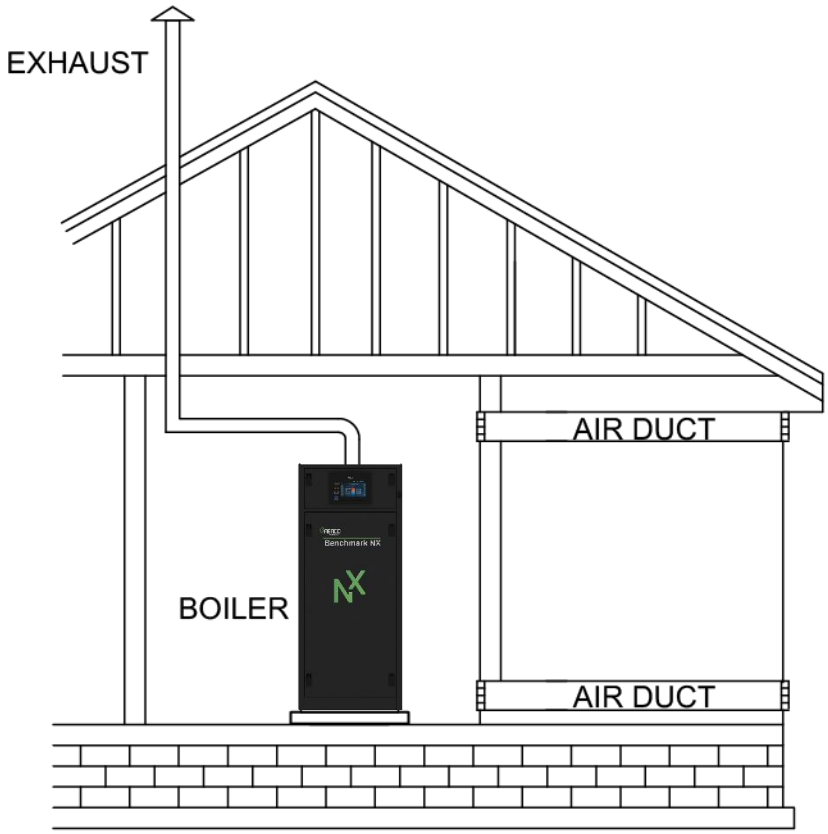


Figure 4-4: All Combustion Air from Outdoors Through Horizontal Ducts

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 4-5) and must 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.

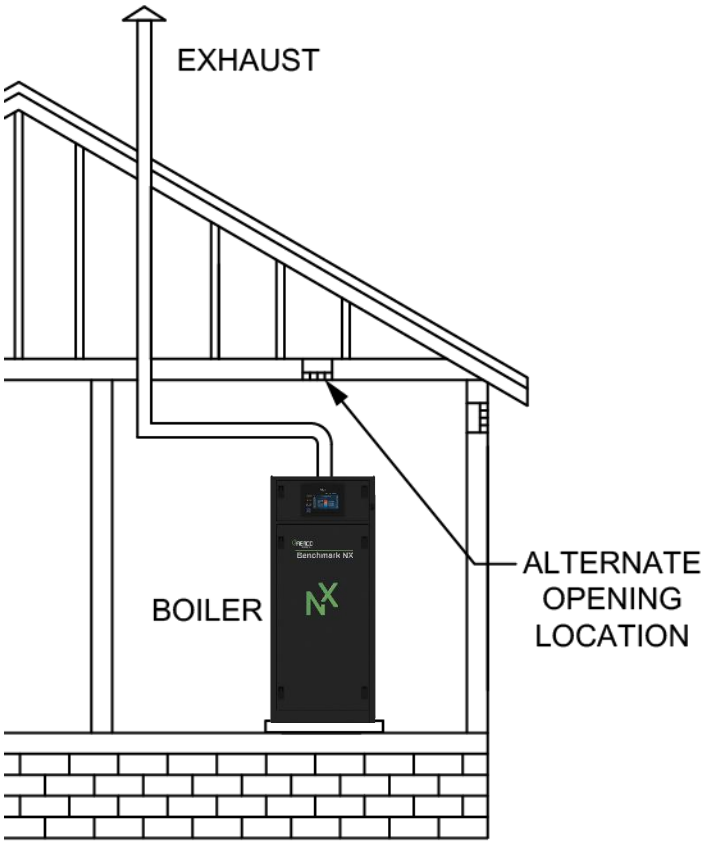


Figure 4-5: All Combustion Air from Outdoors Through Single Combustion Air Opening

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

4.6 Opening A Louver Through The Benchmark Nx Boiler

A louver can be opened using the auxiliary relay contacts. 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 24 VAC at 6 amps.

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: **Auxiliary Delay** — programmable from 0 to 240 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 **Auxiliary Delay** parameter, refer to OMM-0183.

4.7 Ducted Combustion Air

The Benchmark NX 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 NX 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 NX 399 and 500 boilers is 4-inch diameter (10.1 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 NX supports several venting and combustion air options, and although the application parameters vary, there are basic similarities among all systems. Sections 9.1 and 9.2 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 9, consult the device manufacturer for actual pressure drop values. If a rectangular duct is to be used, consult the table in Section 9.5 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 NX 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 9.3. 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 between **-0.25" W.C. and +0.60" W.C. (-62 Pa to 149 Pa)**. For common vented units, the exhaust system must be designed so that pressure measured at every point is between **-0.25" W.C. and +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 **+0.60 W.C. (149 Pa)** for individually vented units, will prevent flue gases from exiting.

4.11 Exhaust Fans

If the 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 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 8-4).

IMPORTANT: Manifolded exhaust or combustion-air systems require project-specific engineering review. Contact AERCO before installation for design review and approval of configurations subject to AERCO approval requirements.

4.13 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.

4.14 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.

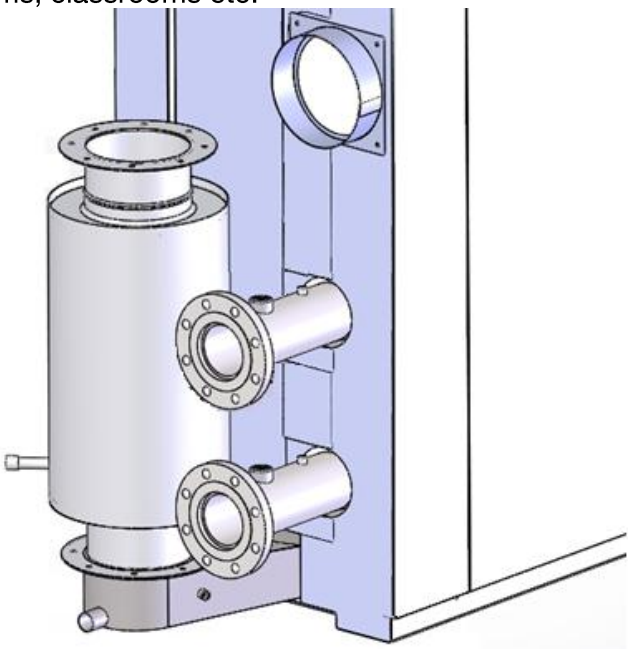


Figure 4-6: Flanged AERCO Exhaust Muffler

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.

4.15 Vent & Combustion Air System Design Requirements

The minimum exhaust vent and combustion air duct sizes for Benchmark NX boilers models are:

	Minimum Diameter	
Model	**Combustion Air Duct**	**Exhaust Vent Diameter**
BNX 399	4 inch (10.2 cm)	4 inch (10.2 cm)
BNX 500	4 inch (10.2 cm)	4 inch (10.2 cm)

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 NX 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.

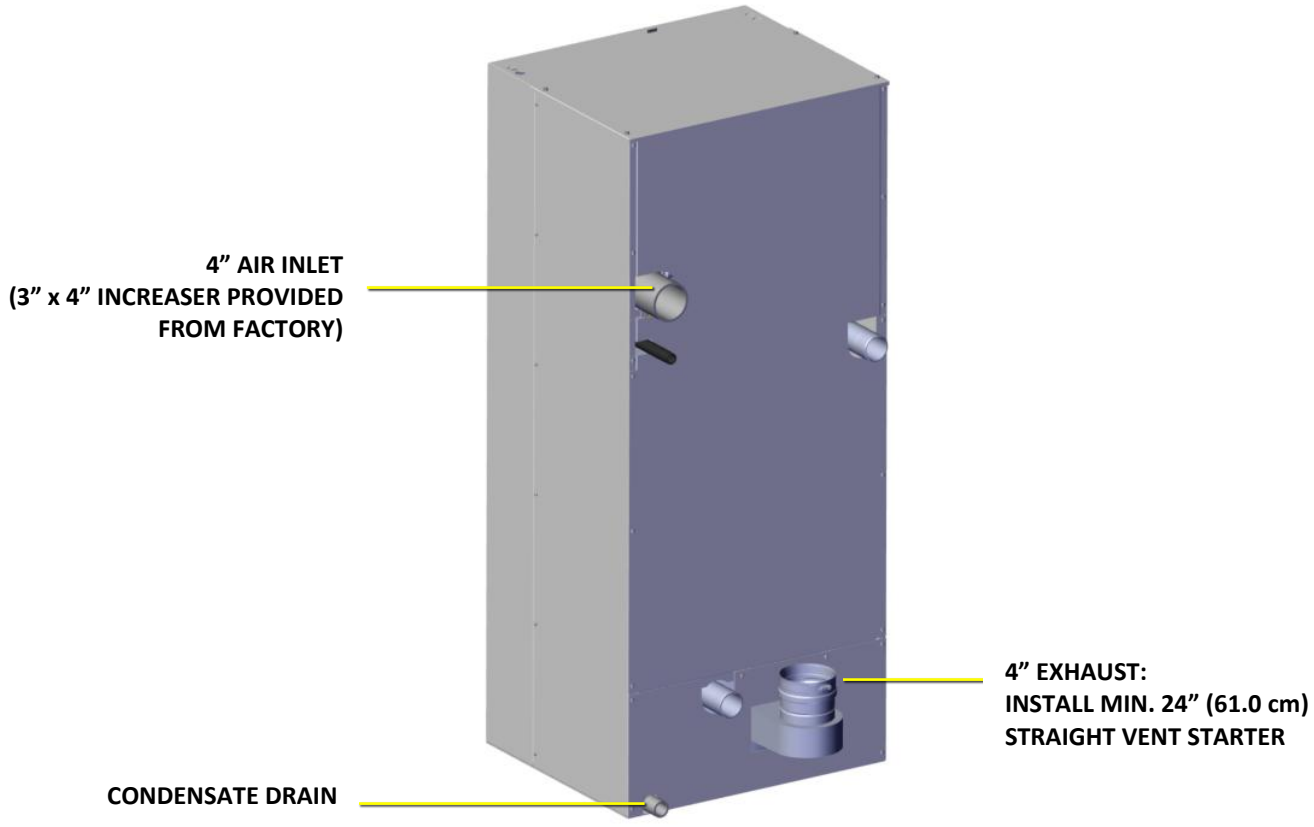


Figure 4-7: Vent and Ducted Combustion Connection for BNX 399 & BNX 500 Boilers

5. CONDENSATE REMOVAL

The exhaust vent system must be pitched back toward the Benchmark NX 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 inlet is pre-piped inside the unit. At the condensate trap outlet, a 1-1/4" EPDM rubber hose is preinstalled from the factory. A field-sourced polypropylene hose must be used to route the condensate from the trap to a condensate neutralizer tank or nearby floor drain. Additional field-sourced fittings may be necessary to connect the polypropylene hose to a condensate neutralizer. 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:

- BNX 399 = 3.8 gallons (14.4 L) per hour
- BNX 500 = 4.9 gallons (18.6 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 NX 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. The maximum combined pressure drop of the vent and combustion air system must not exceed **120 equivalent feet (36.6 m)** of length.

COMBUSTION AIR PIPE SIZING

The total length is the combined length of straight horizontal and vertical runs, and the equivalent straight length of fittings.

TABLE 1: Combustion Air Run Equivalent Lengths				
Model No.	**Pipe Diameter**	**Equivalent Pipe Lengths Examples**		
		Sharp 90° Elbow Equiv. Ft (m)	**Sweep 90° Elbow Equiv. Ft (m)**	**45° Elbow Equiv. Ft (m)**
BMK NX 399	*4" (102 mm)*	10 ft. *(3.0 m)*	5 ft. *(1.5 m)*	5 ft. *(1.5 m)*
BMK NX 500	*4" (102 mm)*	10 ft. *(3.0 m)*	5 ft. *(1.5 m)*	5 ft. *(1.5 m)*

VENT PIPE SIZING

The total length is the combined length of straight horizontal and vertical runs, and the equivalent straight length of fittings.

TABLE 1: Vent Run Equivalent Lengths						
Model No.	**Pipe Diam.**	**Equivalent Pipe Lengths Examples**				
		Sharp 90° Elbow Equiv. Ft (m)	**Sweep 90° Elbow Equiv. Ft (m)**	**45° Elbow Equiv. Ft (m)**	**Velocity Cone Equiv. Ft (m)**	**Termination Tee Equiv. Ft (m)**
BMK NX 399	*4" (102 mm)*	10 ft. *(3.0 m)*	5 ft. *(1.5 m)*	5 ft. *(1.5 m)*	10 ft. *(3.0 m)*	15 ft. *(4.6 m)*
BMK NX 500	*4" (102 mm)*	10 ft. *(3.0 m)*	5 ft. *(1.5 m)*	5 ft. *(1.5 m)*	10 ft. *(3.0 m)*	15 ft. *(4.6 m)*

6.1 Calculation Example

BMK NX 399

Combustion Air: A 20 foot length of combustion air pipe and 1 sharp 90° elbow plus two termination 90° elbows. **20ft + 10 ft. + (2 x 10 ft.) = 50 equivalent ft**

Vent: A 30 foot length of vent pipe and 2 sharp 90° elbow plus a termination exit cone (velocity cone). **30ft + (2 x 10 ft.) + 10 ft. = 60 equivalent ft**

Total = 50 ft + 60 ft = 110 equivalent ft. This is less than 120 equivalent ft – System OK.

7. MANIFOLDED DUCTED COMBUSTION AIR

For systems using manifolded ducted combustion ductwork, use the longest total duct run including both the common and individual sections to calculate the pressure drop.

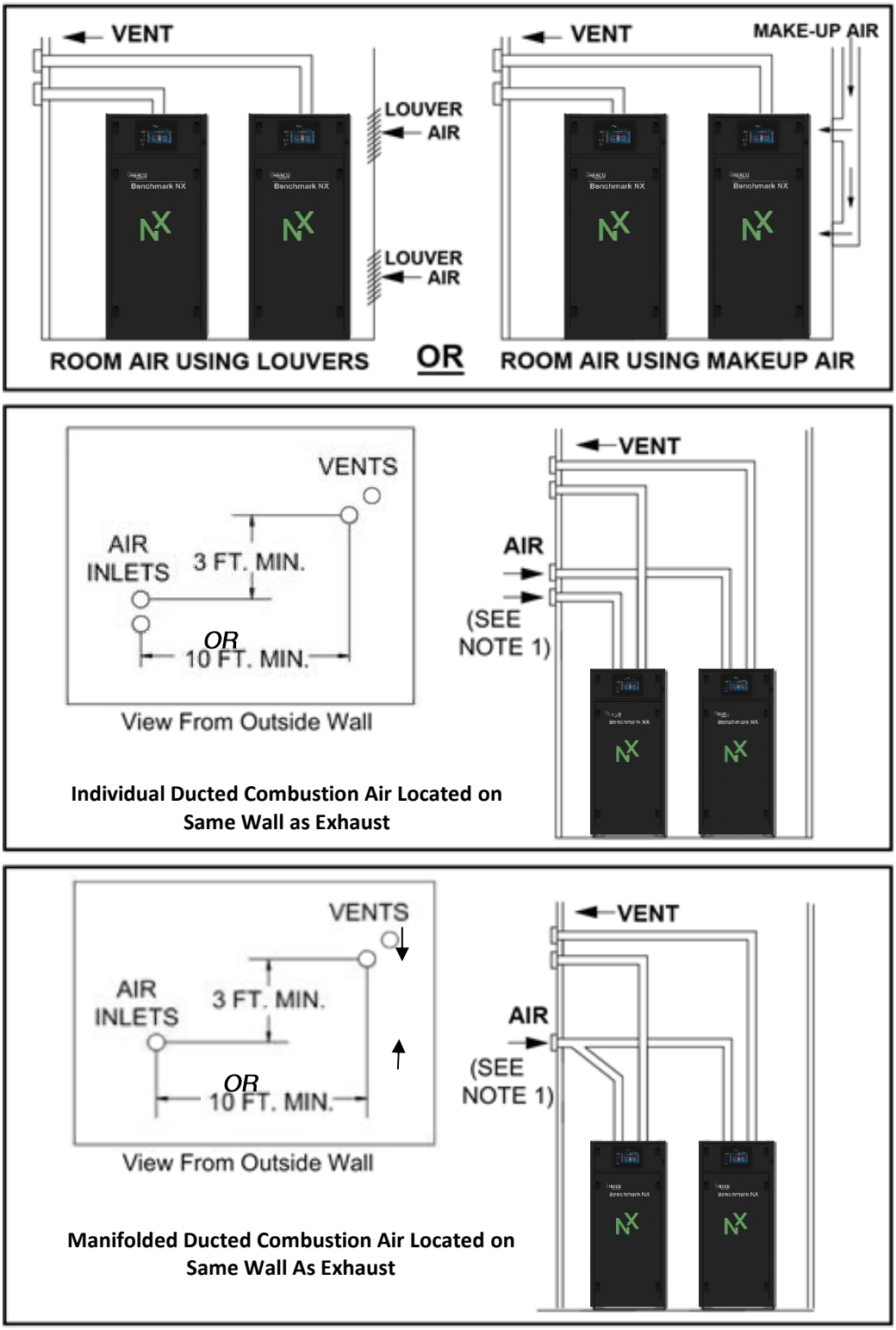
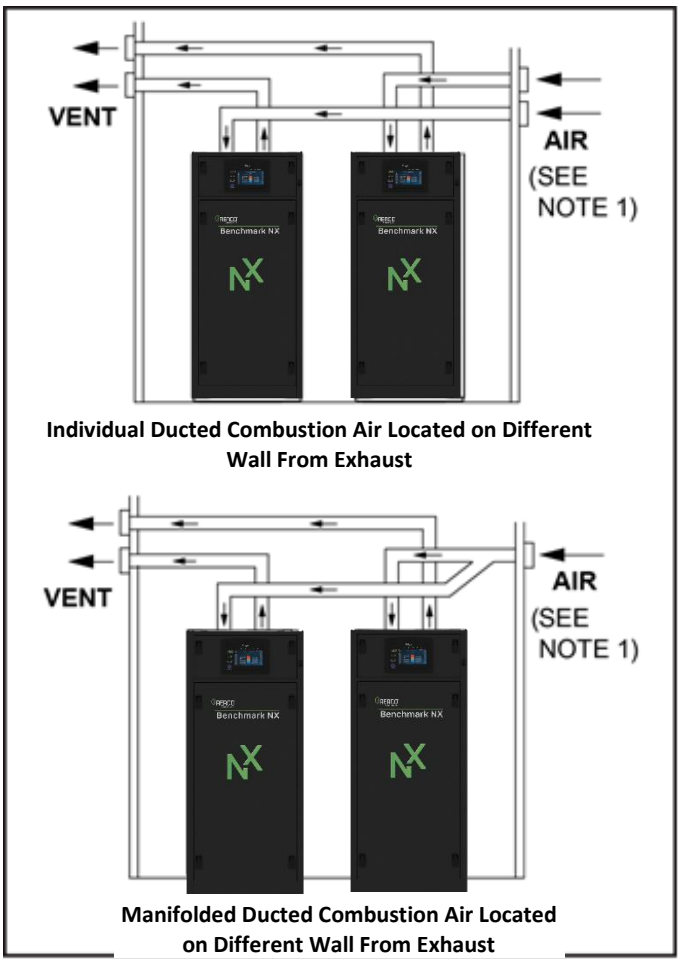


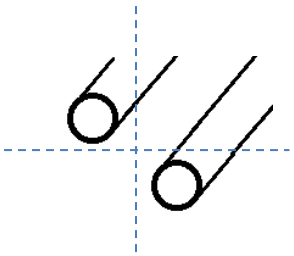
Figure 7-1: Individual Vents – <u>Preferred Installations</u>

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

NOTE:

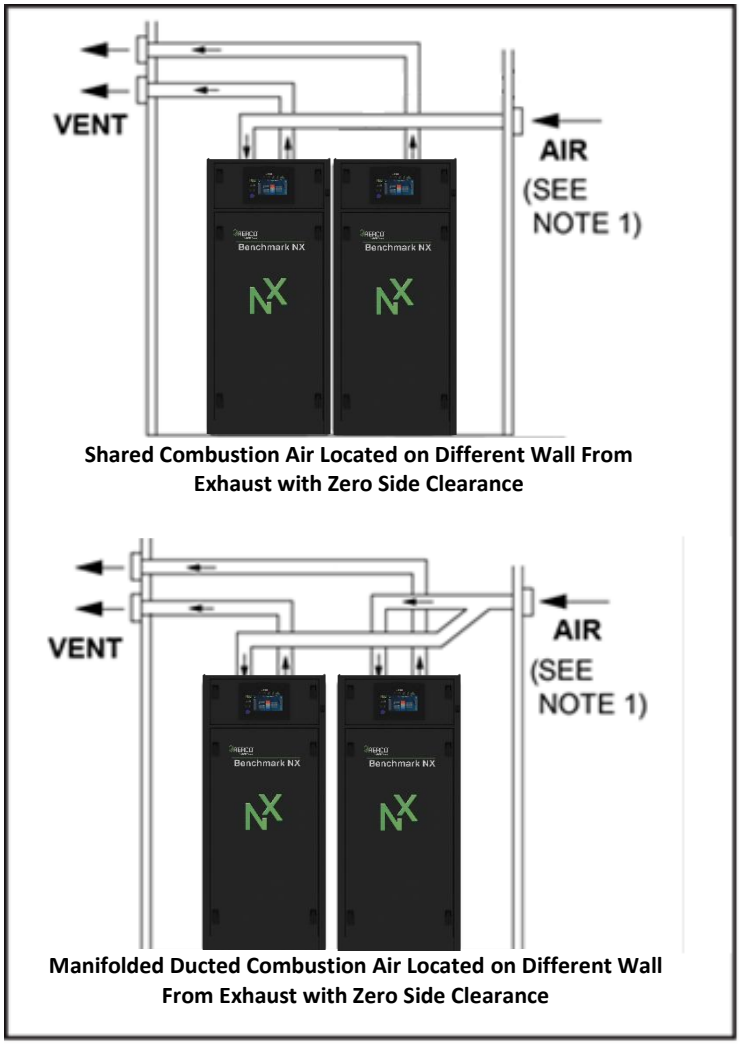
- For high wind sites, a tee must be installed at the fresh air inlet. The leg of the tee connects to the combustion air intake.
- On the flue vent side, a tee or exit cone (velocity cone) is the preferred termination method.
- The branches of the tee can be in the horizontal or vertical direction, as 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 7-2: Individual Vents – <u>Acceptable Installations</u>



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 7-3: Individual Vents – <u>ACCEPTABLE Installations</u>

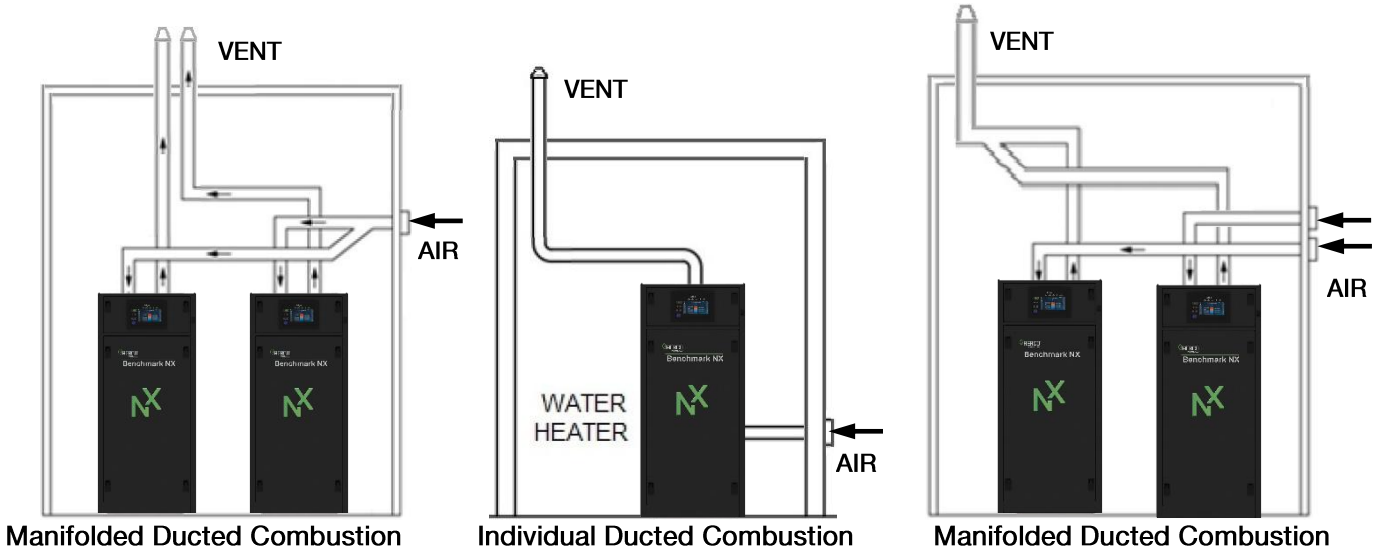
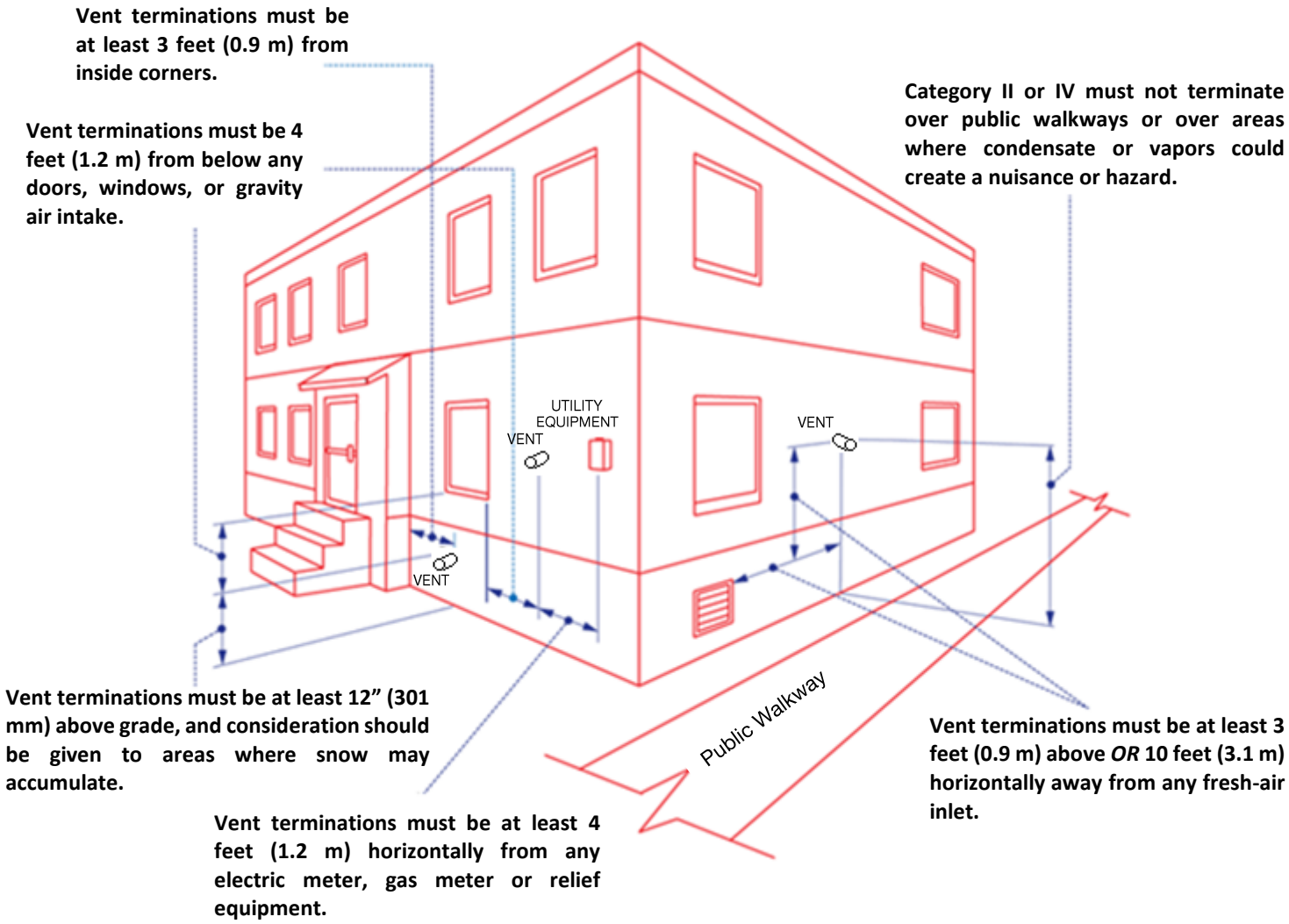


Figure 7-4: Individual Vents – <u>ACCEPTABLE Installations</u>

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 7-5: 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 7-6):

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.

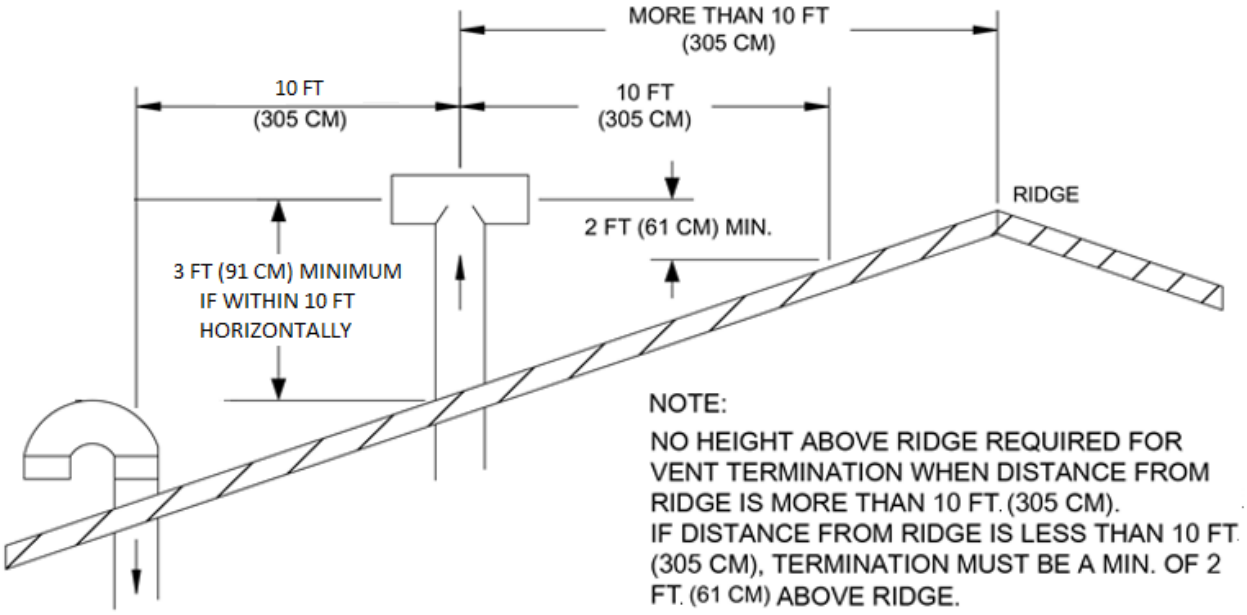


Figure 7-6: Acceptable Combustion Air Inlet & Vent Outlet Configuration

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 8-1. 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.

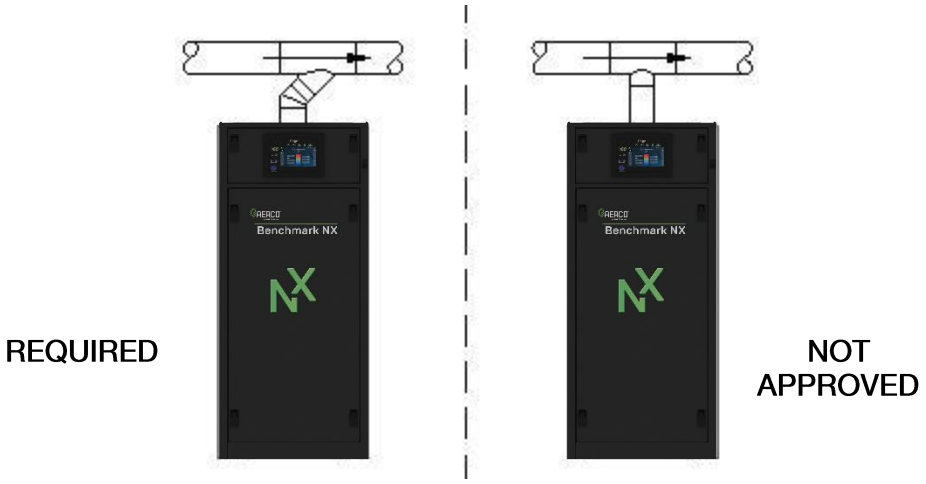


Figure 8-1: Required Connections to Common Vent Breeching

Interconnection of groups of units must *never* be accomplished via a “tee”. As shown in Figure 8-2, 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.

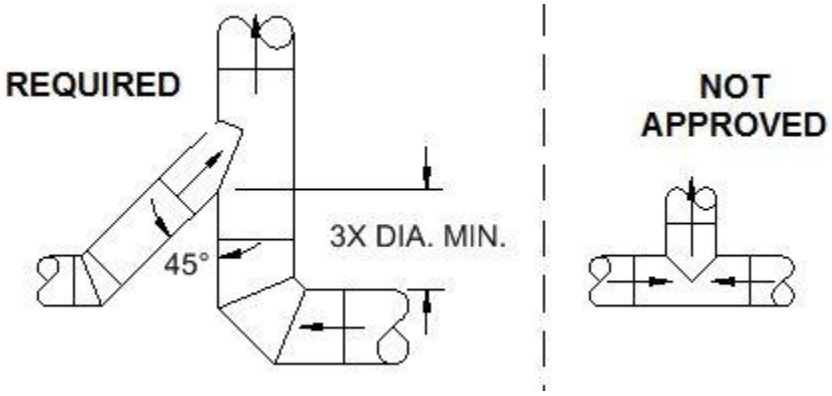


Figure 8-2: Required Interconnection of Groups of Units

Figure 8-3 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.

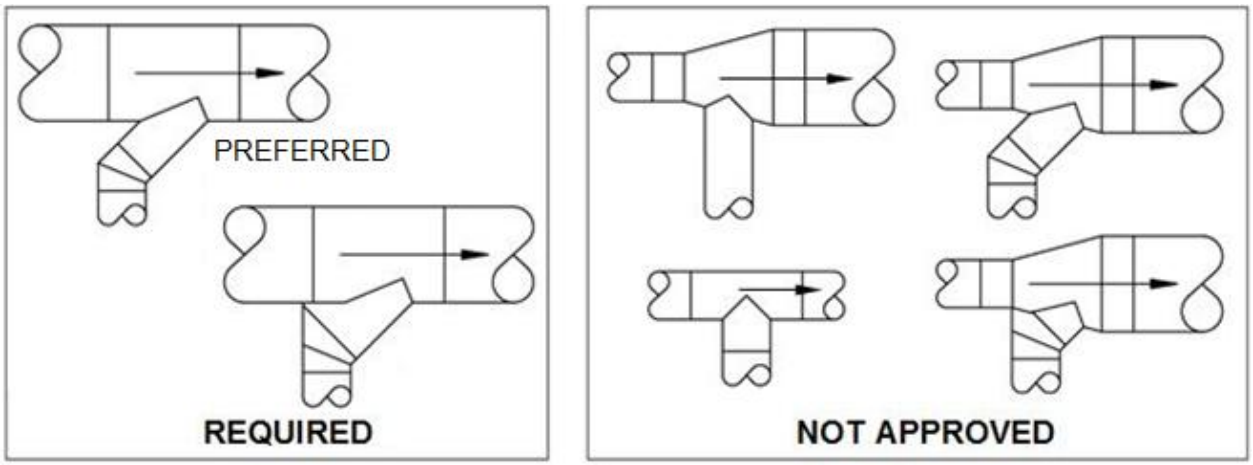


Figure 8-3: Required Transition Vent Sections

The vent system should always be pitched up ¼-inch per foot (21 mm per m) of run towards the vent termination (see Figure 8-4). 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 8-4, 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.

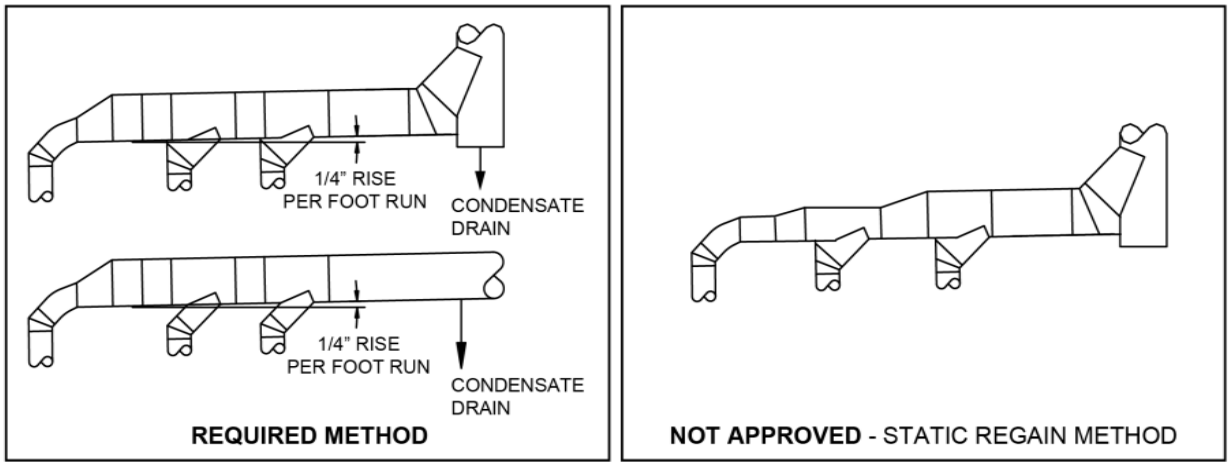


Figure 8-4: Connection of Unit at End of Vent Main

9. CONCENTRIC VENT

9.1 Sidewall Termination – Concentric Vent

A concentric vent termination must terminate outside the structure and must be installed as shown in Figure 9-1.

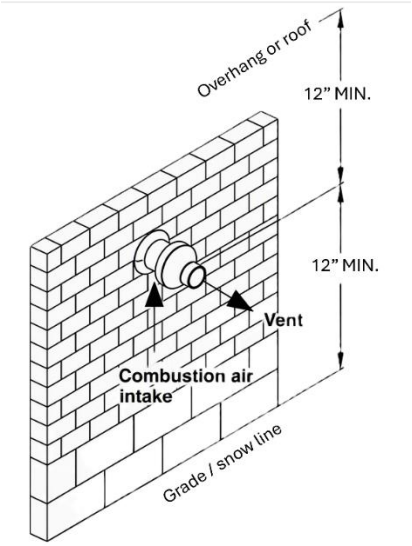


Figure 9-1: Concentric Sidewall Termination Clearances

9.2 Multi-Venting Sidewall Terminations – Concentric Vent

When two or more concentric vent terminations are near each other, each appliance must be individually vented and vent terminations must be installed as shown in Figure 9-2. It is important that vent terminations be made as shown to avoid recirculation of flue gas.

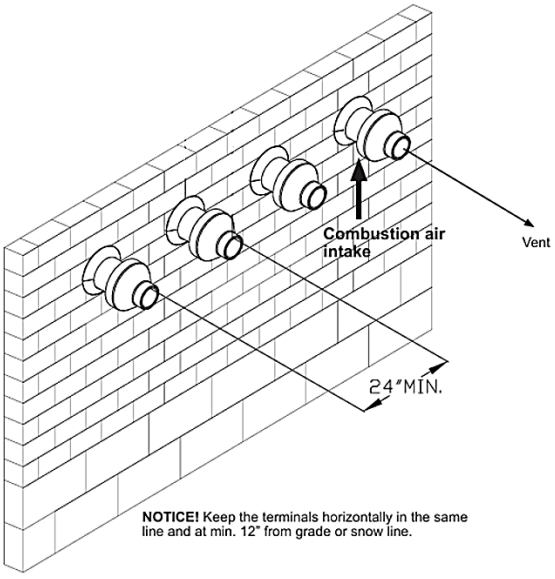


Figure 9-2: Concentric Sidewall Multiple-Unit Termination Clearances

9.3 Vertical Termination – Concentric Vent

Both combustion air and vent pipes must attach to the termination. The termination must terminate outside the structure and must be installed as shown in Figure 9-3.

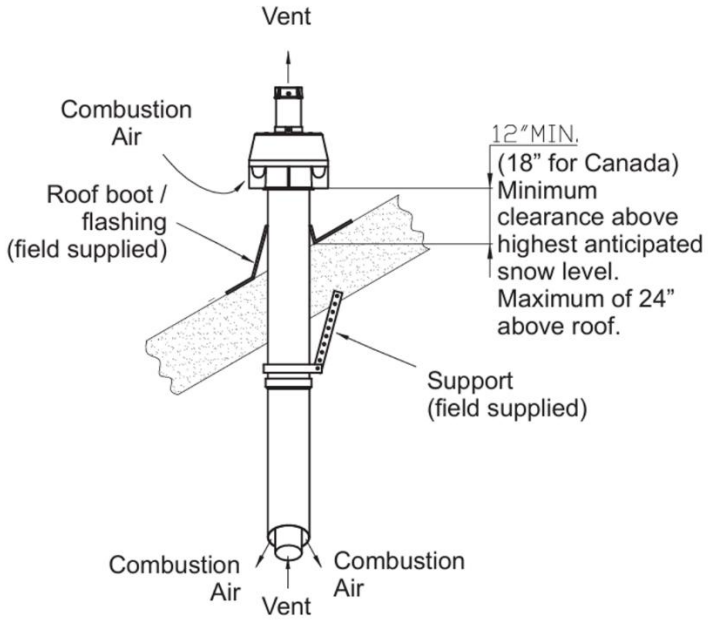


Figure 9-3: Concentric Vertical Terminations

9.4 Multi-Venting Vertical Terminations – Concentric Vent

When two or more concentric vent terminations are near each other, each appliance must be individually vented and they must be installed as shown in Figure 9-4. It is important that vent terminations be made as shown to avoid recirculation of flue gases.

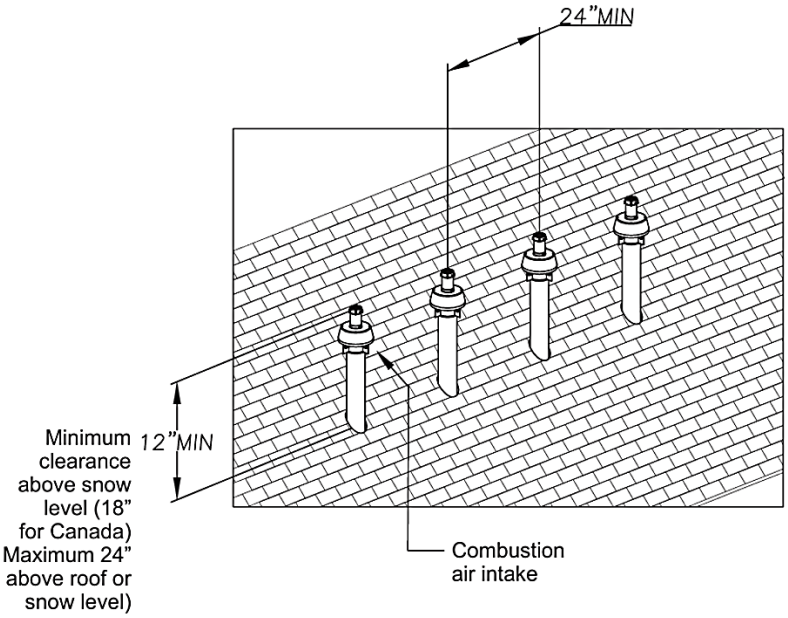


Figure 9-4: Concentric multiple appliances vertical terminations

9.5 Termination Installation – Concentric Vent

Install concentric vent terminations as follows:

1. Determine the best location for the termination (see Figures 9-1 and 9-2 for sidewall; Figures 9-3 and 9-4 for vertical terminations).
2. The total length of piping for vent or air must not exceed 140 eq ft.
3. You must consider the surroundings when terminating the vent and air:
    a) Position the vent termination where vapors will not damage nearby shrubs, plants or air conditioning equipment or be objectionable.
    b) The flue products will form a noticeable plume as they condense in cold air. Avoid areas where the plume could obstruct window views.
    c) Prevailing winds could cause freezing of condensate and water/ice buildup where flue products impinge on building surfaces or plants.
    d) Avoid possibility of accidental contact of flue products with people or animals
    e) Do not terminate above any door or window. Condensate can freeze, causing ice formations.
    f) Locate or guard vent to prevent condensate damage to exterior finishes.
4. Install the concentric vent termination following the vent manufacturer's instructions.
5. Operate the appliance one (1) heat cycle to ensure combustion air and vent pipes are properly connected to the concentric vent termination connections.



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