Venting and Combustion Air Design Guide

Innovation Water Heaters

With Edge [i] Controller

Applies to models:

- INN 600N
- INN 800N
- INN 1060N
- INN 1350N

Disclaimer

The information contained in this manual is subject to change without notice from AERCO International, Inc. AERCO makes no warranty of any kind with respect to this material, including, but not limited to, implied warranties of merchantability and fitness for a particular application. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation may not apply. AERCO is not liable for errors appearing in this manual, not for incidental or consequential damages occurring in connection with the furnishing, performance, or use of these materials.

CLASSIFIED UL LOW LEAD COMPLIANT ANSI/NSF 372

GAS-FIRED c UL us LISTED

ASME HLW

Heating and Hot Water Solutions

TAG-0090_G • 5/29/2024

AERCO International, Inc. • 100 Oritani Drive • Blauvelt, NY 10913
USA: T: (845) 580-8000 • Toll Free: (800) 526-0288 • AERCO.com
Technical Support • (800) 526-0288 • Mon-Fri, 8 am - 5 pm EST

Contents

1 CODES, SAFETY & VENTING SYSTEMS

1.1 Introduction

The AERCO gas-fired water heater is a high efficiency, forced draft, domestic hot water heating unit with unique venting capabilities. All 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 AERCO water heaters 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.

The high efficiency is achieved through air/fuel modulation and the release of heat energy from the moisture condensing in the combustion products. Because condensation can occur in the exhaust vent system, a means must be provided to remove the moisture accumulation. Each model should be fitted with the supplied condensate removal trap.

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

1.2 Applicable Federal Codes

UNITED STATES:

NFPA 54/ANSI Z223.1…….National Fuel Gas Code

NFPA/ANSI 211……Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances

CANADA:

CSA B149.1…… Installation Codes for Gas-Burning Equipment

CSA B149.2…… Installation Codes for Gas-Burning Equipment

The above listed codes contain information for gas vented appliances requiring Category II, III and IV, vent sizing, location, air space clearances to combustibles and safe installation practices. The gas vent installer must comply with the above codes, as well as Local Codes and Regulations.

WARNING!

Installation should be done only by qualified venting systems personnel and in accordance with the manufacturer's recommendations. Installing or venting a heater or any other gas appliance with improper methods or materials may result in serious injury or death due to fire or to asphyxiation from poisonous gases (carbon monoxide is odorless and invisible).

WARNING!

- For correct installation of vent system, read all of these instructions and refer to the vent pipe manufacturer's instructions.
- Failure to use the venting system described in this document will void the manufacturer's warranty and may result in rapid deterioration of the venting system, creating a health hazard.
- Faulty vent installation can allow toxic fumes to be released into living areas. This may cause serious bodily injury or property damage. Improper assembly may also affect vent performance.
- Install separate vents for forced exhaust appliances and natural draft appliances. A common vent between natural draft and forced exhaust appliances may cause toxic gases to exhaust through the natural draft appliance rather than to outside air. Breathing exhaust gases will cause serious personal injury or death.

1.3 Gas Vent Categories

Innovation-Edge water heaters are approved for a Category II and Category IV vent configuration as well as for ducted combustion air installations.

CAUTION!

Provisions for combustion and ventilation air in accordance with Section 5.3, (Air for Combustion and Ventilation) of the National Fuel Gas Code - ANSI Z223.1, or Sections 7.2, 7.3, or 7.4 of CAN/CSA B149.1, Installation Codes, or applicable provisions of the local building codes.

Federal Codes categorize gas appliances by the vented flue gas pressure and temperature as follows:

- **Category I**: A gas appliance that operates with a non-positive vent (or natural drafted vent) connector with a flue gas pressure and temperature at least 140°F (60°C) above its dew point.
- **Category II**: A gas appliance that operates with a non-positive vent (or natural drafted vent) connector with a flue gas pressure and temperature less than 140°F (60°C) above its dew point.
- **Category III**: A gas appliance that operates with a positive vent (fan forced vent) connector with a flue gas pressure and temperature at least 140°F (60°C) above its dew point.
- **Category IV**: A gas appliance that operates with a positive vent (fan forced vent) connector with a flue gas pressure and temperature less than 140°F (60°C) above its dew point.
- **Direct Vent**: A gas appliance constructed and installed so that all air for combustion is derived directly from, and all flue gases discharged to, the outdoors.

1.4 Certified Venting Materials for Flue Pipe Systems

Innovation Water Heaters are 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. Consult local codes and authorities prior to installation.

The following vent materials are allowed:

- Category II or IV UL1738 or Type BH under ULCS636 listed Polypropylene and Stainless-Steel
- Where codes allow, PVC and CPVC may be used.
- AERCO recommends the use of AL29-4C Stainless Steel and Polypropylene as the preferred venting material for all Innovation Water Heaters.
- Stainless Steel venting thickness should conform to the following requirements:

TABLE 1: Flue System Minimum Thickness for AL29-4C in Inches (mm)

Diameter	3" to 8" (51 – 203 mm)	9" to 16" (229 – 406 mm)	18" to 24" (457 – 610 mm)	26" to 30" (660 – 762 mm)
Material Thickness in Inches (mm)	0.015 (0.38)	0.020 (0.51)	0.024 (0.61)	0.034 (0.86)

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 vents passing through confined or enclosed building spaces be made of AL29-4C Stainless Steel as the most corrosion resistant vent material currently available.

Proper clearances to combustibles must be maintained per UL and vent manufacturer requirements. The UL, National Fuel Gas Code (ANSI Z223.1/ NFPA54) 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 Canadian installations must comply with CSA B149.1 installation code.

CAUTION!

- The Vent Pipe Systems below are for Category II and IV appliances. Do not use these vent pipe systems for venting appliances burning fuels such as wood, coal, oil or kerosene.
- Maintain clearances from combustible construction for heater, vent connector, and steam and hot-water pipes.
- Do not use these vent pipe systems for incinerators of any kind.

1.5 Exhaust Vent Connection Components

Figure 1 shows the components and part numbers for connecting the exhaust vents for Innovation-Edge models.

Exhaust Vent Adapters

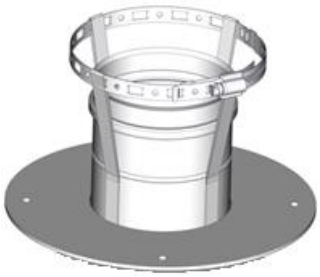
INN 600N **4" (102 mm) (PVC)** Kit # 24287	**INN 600N, INN 800N, INN 1060N, INN 1350N** **6" (152 mm) (PVC)** Kit # 24286
	
INN 00N **6" to 4" (152 to 102 mm) DuraVent® PolyPro Adapter** P/N 39006-1	**INN 600N, INN 800N, INN 1060N, INN 1350N** **6" (152 mm) DuraVent® PolyPro Adapter** P/N 39006-2
	

Figure 1: Exhaust Vent Connection Components

1.6 Acceptable Pressure Range

For individually vented units, the exhaust system must be designed so that pressure measured at every point is in the range from **-0.10" W.C. to +0.81" W.C. (-25 Pa to 202 Pa)**. For common vented units, the exhaust system must be designed so that pressure measured at every point is in the range of **-0.10" W.C. to +0.25" W.C. (-25 Pa to 62 Pa)**. Pressures below **-0.10" W.C. (-25 Pa)** (more negative) may cause flame instability. Pressures above **+0.25" W.C. (62 Pa)** for common vented units, or **+0.81 W.C. (202 Pa)** for individually vented units (more positive), will prevent flue gases from exiting.

1.7 Exhaust Fans

If the Innovation-Edge water heater'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 -0.1" to +0.25" W.C. (-25 Pa to 62 Pa) pressure range at the outlet of each unit. Also, the designer must ensure that the exhaust fan material is acceptable for use with Category IV appliances.

1.8 Exhaust Muffler Guidelines

Innovation-Edge units require an exhaust muffler when they are 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 an Innovation-Edge installation:

- The total linear length from exhaust to termination is less than 25 linear feet (7.5 linear m) 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 unit vertical connectors are not included in the determination.

> **EXAMPLE**: If the installation has a 20 foot (6.1 m) common vertical, and each unit has a 10-foot vertical connector, the total vertical section is only 20 feet (6.1 m). Because this length is less than 25 linear feet (7.5 m), a muffler is required.

If the muffler must be mounted horizontally, add a condensate drain and trap with the drain port oriented downward.

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

1.9 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.

2 COMBUSTION AIR SYSTEM

WARNING!
Air openings to combustion area must not be obstructed. Use the information below to ensure that adequate combustion air is maintained.

2.1 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 that are detrimental to the operation of combustion equipment. Common sources of these chemicals are swimming pools, degreasing compounds, water softener salts, plastic processing and refrigerants. This will ensure the longevity of the equipment and maintain warranty validation.

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

Air intakes must not be in the proximity of garages, industrial and medical hood venting, loading docks or refrigerant vent lines. Water heaters must not be installed in the proximity of activities that generate dust if that dust can enter the boiler intake. Water heaters 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, a disposable air intake filter must be temporarily installed above the combustion air inlet. Air filters may be required year-round if dust or debris can enter the combustion air tube. Consult OMM-0153 for details. Combustion air temperatures as low as **-30 °F (-34.4 °C)** can be used without affecting the integrity of the equipment; however, the combustion settings may require adjustment to compensate for site conditions.

2.2 Combustion Air Requirements

Innovation water heaters require the following combustion air volumes when operated at full capacity:

INNOVATION-EDGE
INN 600N – 130 SCFM (2.8 m^3/min)
INN 800N – 170 SCFM (4.8 m^3/min)
INN 1060N – 225 SCFM (6.4 m^3/min)
INN 1350N – 285 SCFM (8.1 m^3/min)

These flows MUST be accommodated. Air supply is a direct requirement of NFPA 54, CSA B149.1-10 (Canada) and local codes that should be consulted for correct design implementation.

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

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, to prevent infiltration of chemicals.

2. When calculating free area using louvers and grilles, the required size of the openings for combustion, ventilation, and dilution air shall be based on the total free area of each opening.
   - If the free area through a designed louver or grille is known, it shall be used in calculating the size of opening required to provide the free area specified.
   - If the louver and grille design free areas are ***not*** known, the following will be assumed: For wooden louvers a 25% free area; for metal louvers and grilles a 75% free area opening.
3. When terminating the combustion air through the roof:
   - The combustion air inlet must be 3 ft. (0.9 m) below any vent outlet within 10 ft. (3 m) (Figure 10).
   - The combustion air inlet must also face away from the vent outlet (see Figure 10).
4. All inlet air ducts must be sealed air tight.
5. The mechanical room *must **not** be under negative pressure* (even when the combustion air is direct ducted). If necessary, ventilate the room to prevent this condition from occurring.

WARNING!

- Non-motorized louvers and grilles must be fixed in an open position.
- Minimum screens mesh size shall not be smaller than 1 inch (25.4 mm) mesh.

6. Air intakes must not be located in the proximity of garages, industrial and medical hood venting, loading docks or refrigerant vent lines. Water Heaters must not be installed in the proximity of activities that generate dust if that dust can enter the Water Heater intake. Water Heaters must be located to prevent moisture and precipitation from entering combustion air inlets.
7. If a Water Heater 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, a disposable air intake filter MUST be installed temporarily above the 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 Operations and Maintenance Manual for details.
8. Combustion air temperatures as low as -30°F (-34°C) can be used without affecting the integrity of the equipment; however, combustion settings may require adjustment for site conditions.

2.3 Combustion Air from WITHIN The Building

Wherever combustion air originates from in the building, it 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 (654 mm^2/0.29 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 (305 mm) of the top of the enclosure, and one opening shall commence within 12 inches (305 mm) of the bottom. (See Figure 2).
- For Canadian installations, refer and adhere to the latest publication of CAN/CSA B149.1.

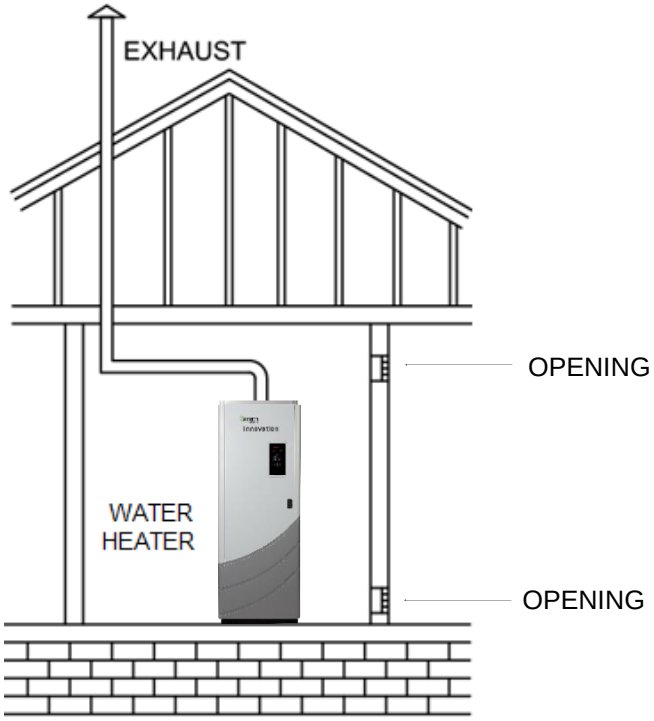


Figure 2: All Combustion Air from Adjacent Indoor Spaces through Indoor Openings

2.4 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.

2.4.1 Two-Permanent-Openings Method (USA Only)

Two permanent openings shall be provided; one commencing within 12 inches (305 mm) of the top of the enclosure and one commencing within 12 inches (305 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 (654 mm^2/1.17 kW) of total input rating of all appliances in the space (see Figures 4 and 5).

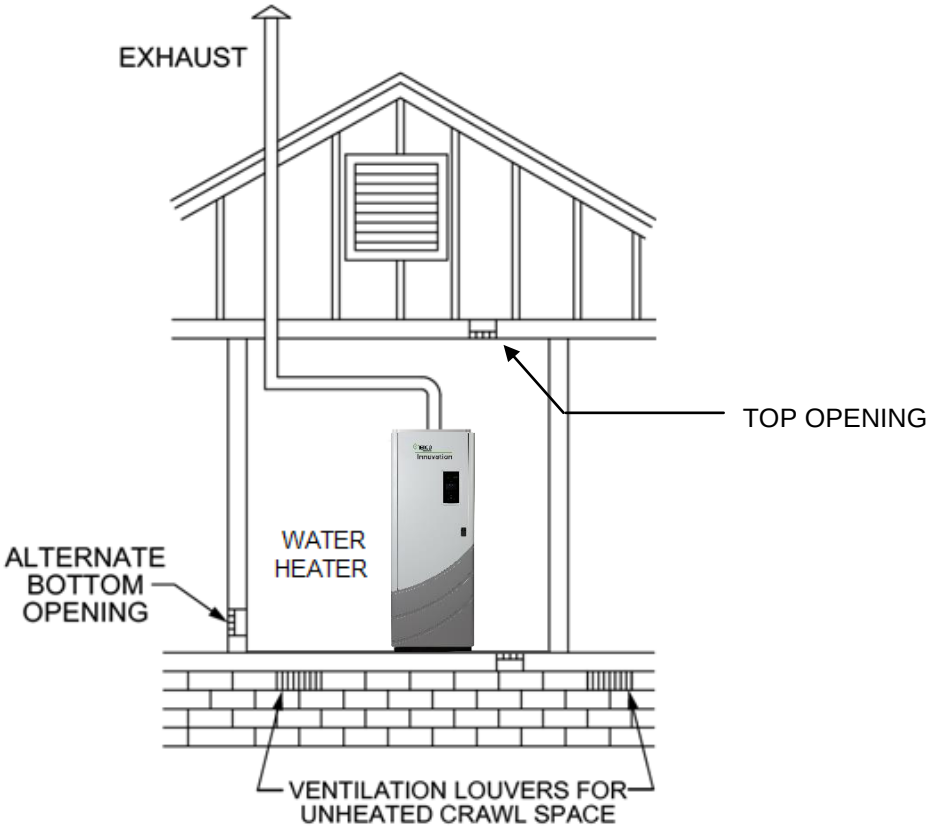


Figure 3: All Combustion Air from Outdoors - Inlet Air From Ventilated Crawl Space and Outlet Air to Ventilated Attic

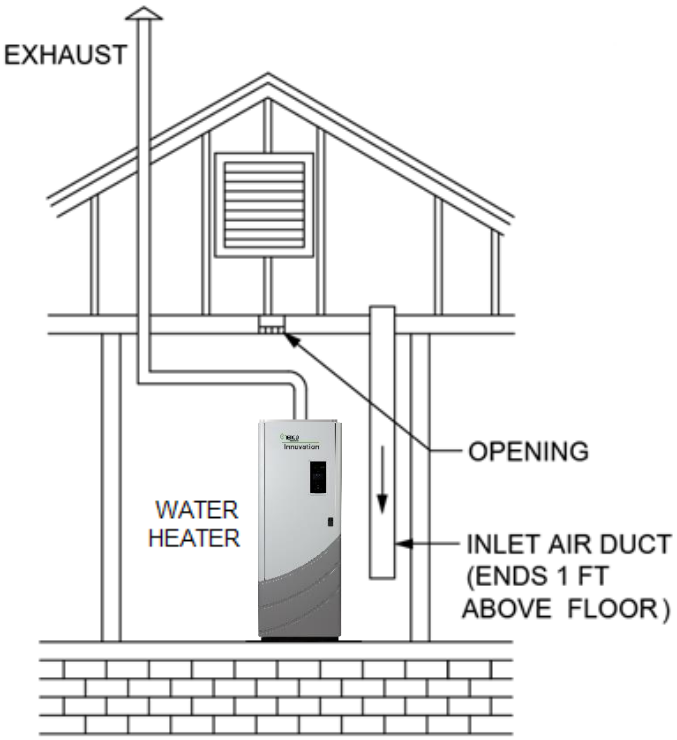


Figure 4: All Combustion Air from Outdoors – Through Ventilated Attic

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. (654 mm^2/0.59 kW) of total input rating of all appliances in the space (see Figure 5).

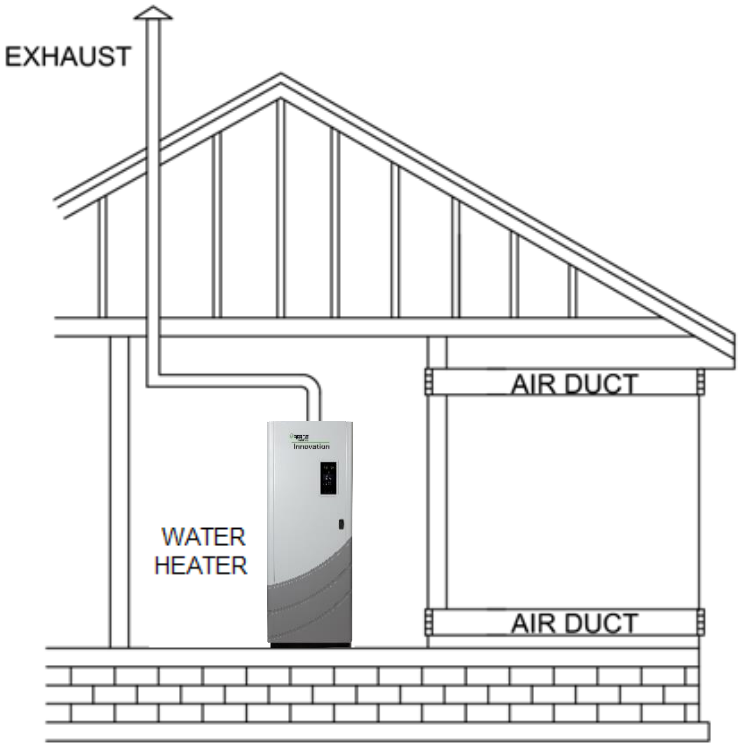


Figure 5: All Combustion Air from Outdoors – Through Horizontal Ducts

2.4.2 One Permanent Opening Method

One permanent opening shall be provided, commencing within 12 inches (305 mm) of the top of the enclosure. 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 (654 mm^2/0.88 kW) of the total input rating of all appliances located in the space.

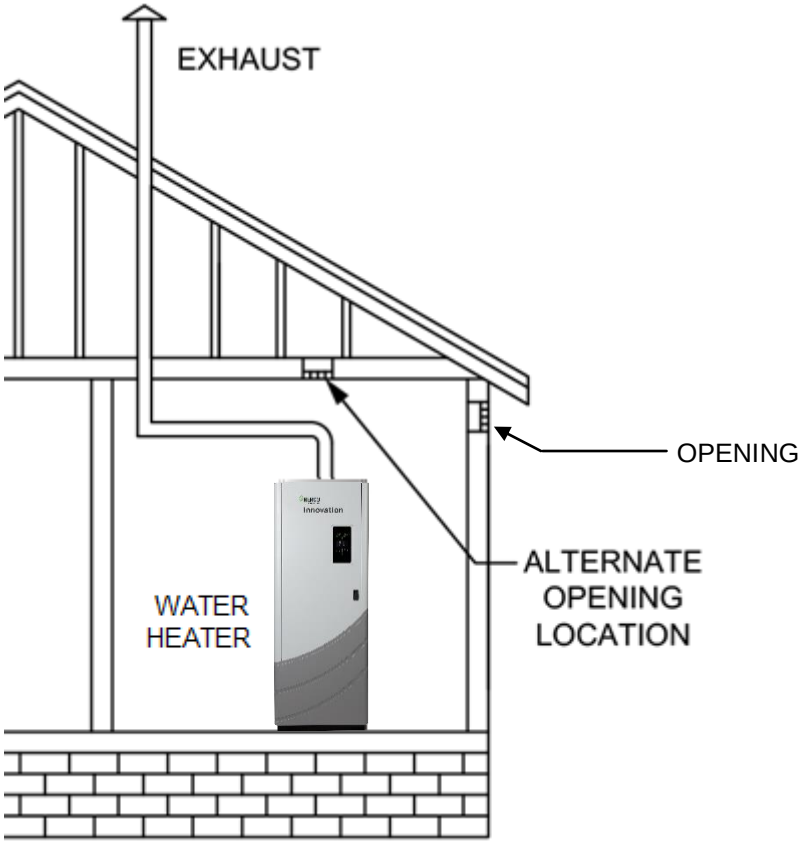


Figure 6: All Combustion Air from Outdoors Through Single Combustion Air Opening

The following table lists the minimum required air openings in square inches (square centimeters) freely communicating with the outdoors for mechanical room combustion and ventilation air for each unit. For multiple unit installations, sum the openings for the specific heater sizes.

TABLE 2: Summary of Minimum Required Air Openings For Mechanical Room Combustion & Ventilation Air				
Model	**Two Openings from within the Building, each having an opening, in² (cm²)**	**Two Direct or Vertical Duct Openings, each having an opening, in² (cm²)**	**Two Horizontal Ducts, each having an opening, in² (cm²)**	**Single Permanent Opening, in² (cm²)**
INN 600N	600 in² (0.39 m²)	150 in² (0.97 m²)	300 in² (0.19 m²)	200 in² (0.13 m²)
INN 800N	800 in² (0.52 m²)	200 in² (0.13 m²)	400 in² (0.26 m²)	270 in² (0.17 m²)
INN 1060N	1060 in² (0.68 m²)	265 in² (0.17 m²)	530 in² (0.34 m²)	355 in² (0.23 m²)
INN 1350N	1360 in² (0.87 m²)	340 in² (0.22 m²)	680 in² (0.44 m²)	455 in² (0.29 m²)

2.5 Combustion Air Pipe Sizing

In computing the pressure loading effect of the combustion piping system, an equivalent straight-length of piping is used. This equivalent length of piping is the combined sum of all equivalent lengths of piping and piping components used in construction, including:

1. All straight horizontal and vertical pipe sections.
2. All equivalent lengths of fittings, bends and end terminations.
3. All equivalent lengths associated with extrance or transition effects, for example a sudden expansion or contraction.

Table 3 provides the required combustion pipe size for the Innovation-Edge water heaters along with some rule-of-thumb guidelines for estimating the equivalent lengths of common piping components.

TABLE 3: Rule-of-Thumb Maximum Combustion Air Run Lengths				
Model No.	**Minimum Pipe Diameter**	**Maximum Length Equivalent Ft. (m)**	**Equivalent Pipe Lengths Examples**	
			Sharp 90° Elbow Equiv. Ft (m)	**45° Elbow Equiv. Ft (m)**
INN 600N, INN 800N, INN 1060N, INN 1350N	6" (152 mm)	*140 ft. (42.7 m)	10 ft. (3.05 m)	5 ft. (1.5 m)

NOTE: The maximum combined pressure drop of the exhaust and intake-air vents is **140** equivalent-feet (42.7 m) for **6"** (152 mm) pipe (all models). For the INN600N using **4"** (102 mm) pipe the maximum combined pressure drop of exhaust and intake-air vents is **80** (24.4 m) equivalent-feet. See Section 3.5.

Rule-of-Thumb Examples – Standard North American units of measure:

1. A 40 foot length of combustion air pipe and 1 sharp 90° elbow plus two termination 90° elbows add up to 40 ft. + 10 ft. + (2 x 10 ft.) = 70 equivalent ft.
2. A 30 foot (9.1 m) length of combustion air pipe and 2 sharp 90° elbows plus two termination 90° elbows add up to 30 ft. + (2 x 10 ft.) + (2 x 10 ft.) = 70 equivalent ft. (21.3 m).

Rule-of-Thumb Examples – Metric units of measure:

1. A 12 m length of combustion air pipe and 1 sharp 90° elbow plus two termination 90° elbows add up to 12 m + 3 m + (2 x 3 m) = 21 equivalent m
2. A 9 m length of combustion air pipe and 2 sharp 90° elbows plus two termination 90° elbows add up to 9 m + (2 x 3 m) + (2 x 3 m) = 21 m

For more detailed analysis see sections 3.8 and the Example.

2.6 Common Combustion Air Systems

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

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 (1 m) below any vent termination within 10 feet (3.1 m).

A screen with mesh size not smaller than 1” x 1” (25 mm x 25 mm) must be installed at the inlet of the ducted combustion air duct.

For systems using manifolded ducted combustion, use the longest length of common duct and the individual branch to the furthest unit to calculate the pressure drop. Figures 7a and 7b illustrate preferred and acceptable designs.

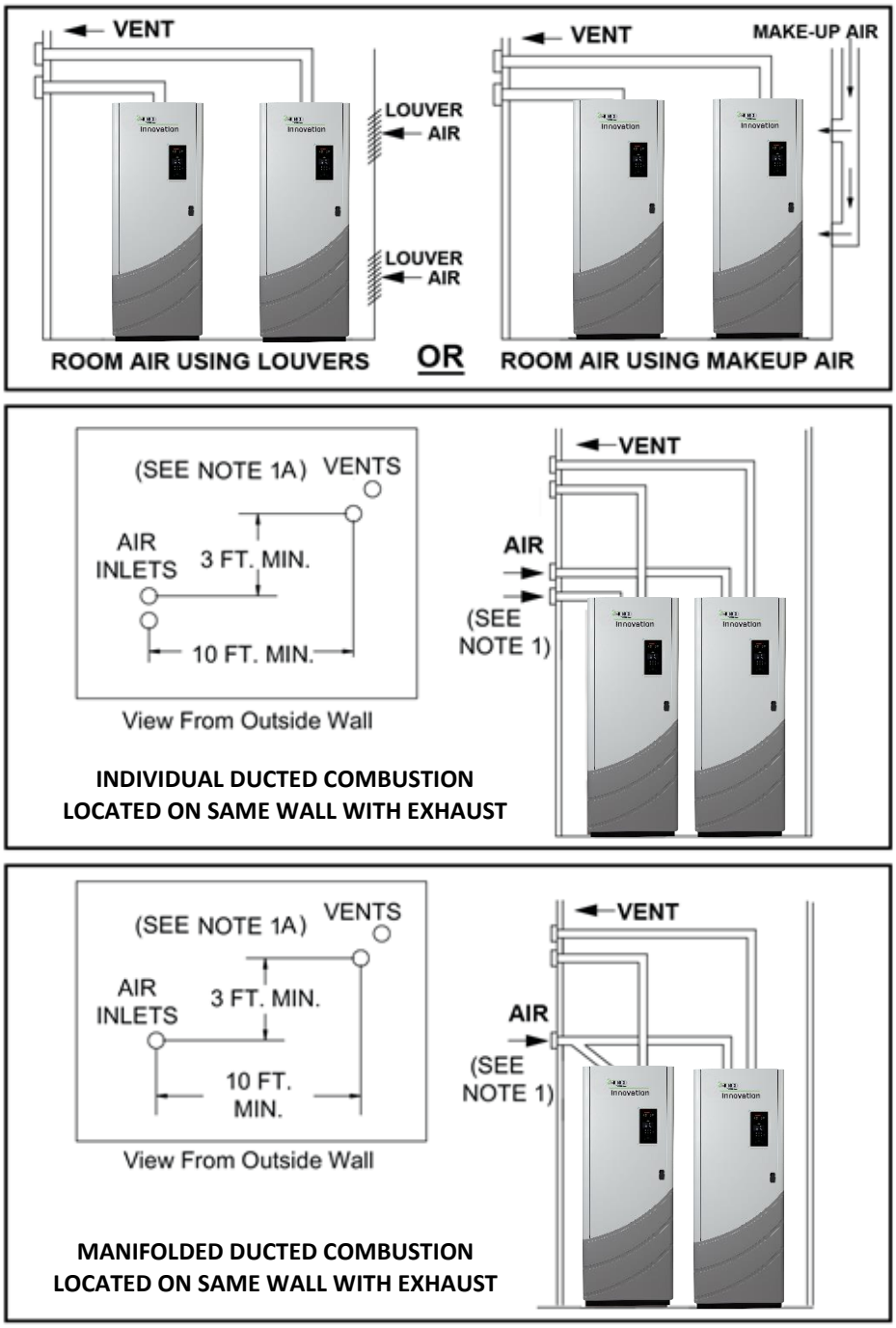


Figure 7a: Individual Vents – <u>PREFERRED Installations</u>

NOTE: 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.

NOTE: Flue terminations should never be stacked, as condensate from the upper termination might freeze over and block lower terminations.

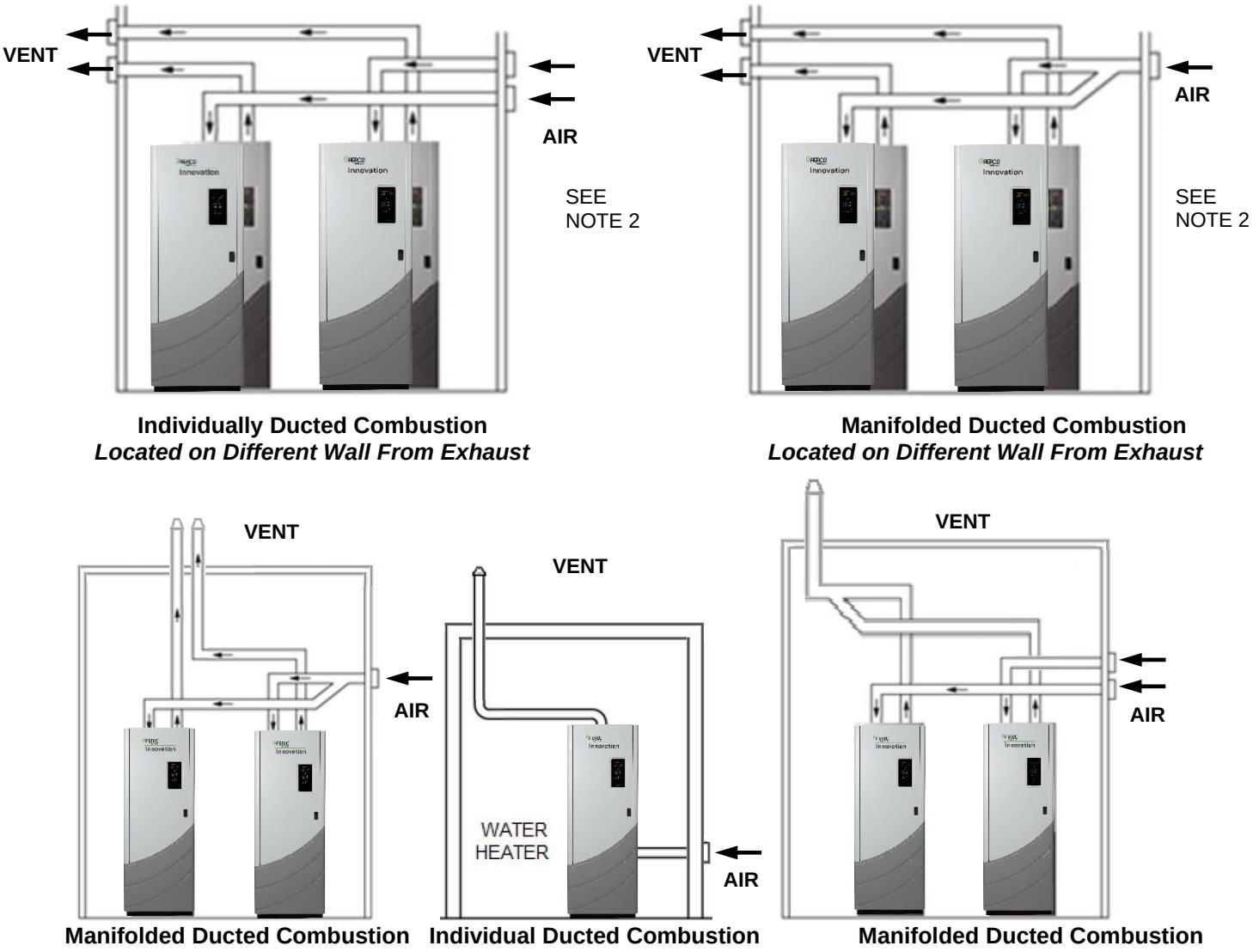


Figure 7b: Individual Vents – <u>ACCEPTABLE Installations</u>

NOTE: 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.

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.

3. VENT SYSTEM

The heater vent is fundamental for correct operation. Being a condensing heater, combustion gases are discharged at a very low temperature. It is therefore necessary for the venting system to be perfectly impermeable to combustion products condensate and to be made of corrosion resistant materials. Typical Category IV venting and ducted combustion air illustrations are shown in Figures 3 through 7. The various funnel joints shall be well sealed and/or equipped with suitable gaskets, in order to avoid any condensate drain and/or air intake. Ensure that the heater's vent section and height conform to national and local regulations (see Section 1.2 APPLICABLE FEDERAL CODES of this guide).

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

The vent system for Innovation-Edge water heaters must be installed in accordance with the following:

- AERCO's installation instructions, as described in this guide and the Innovation Installation, Operation and Maintenance Manual (OMM-0143, GF-216).
- If applicable, the vent system manufacturer's installation instructions.
- If the venting system has horizontal portions, they shall be supported to prevent sagging at intervals specified by the vent manufacturer.
- It must have a means for drainage and disposal of condensate (see below).
- For water heaters designed for connection to gas vents or chimneys, vent installations shall be in accordance with Part 7, Venting of Equipment, of the National Fuel Gas Code, ANSI Z223.1, or Section 7, Venting Systems and Air Supply for Appliances, of the CAN/CSA B149, Installation Codes, or applicable provisions of the local building codes.

3.1 Condensate Removal

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.

Condensate drain systems must be sized for full condensing mode. Innovation-Edge units will produce the following maximum condensate quantities in the full condensing mode:

Model	Gallons/Hour	Liters/Minute
INN 600N	4.5 gallons per hour	0.28 L/min
INN 800N	6 gallons per hour	0.38 L/min
INN 1060N	8 gallons per hour	0.50 L/min
INN 1350N	11 gallons per hour	0.69 L/min

In multiple water heater 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 units 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 AERCO water heaters 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.

3.2 Vent Installation

1. The water heaters covered in this section are design-certified as Category II and IV for venting, only when they are installed with manufacturer specified vent system components and installation practices.
2. Install vent pipe beginning at the water heater exhaust manifold and work toward the vent cap. **The first section (starter section) must be straight for a minimum of 24 inches (61 cm).** Start by cleaning the top surface of the exhaust manifold and the mating flange section of the duct starter piece with an alcohol swab and then apply a bead of high temperature red silicon sealant (such as Permatex Hi-Temp Red RTV or Loctite Superflex Red High Temp RTV) to that surface (see Figure 8, below).
3. Attach the exhaust connector to the exhaust manifold using the screws supplied with the kit. Use a cross-tip (Phillips) screwdriver at least 12 inches (305 mm) long. See Figure 1 (page 7) for the list of available exhaust vent connectors.
4. Vent connectors serving appliances vented by natural draft shall not be connected into any portion of mechanical draft systems operating under positive pressure
5. Horizontal vent runs shall be sloping upwards **not less than 1/4 inch per foot (21 mm/m)** from the heater to the vent termination.
6. The instructions for the installation of the venting system shall specify that the horizontal portions of the venting system shall be supported to prevent dips or sags where condensate could collect.
7. Rigidly support vent pipe every 5 feet (1.5 m) and at each elbow. Plumber straps may be used.
8. In a multiple unit common venting setup, to prevent internal exhaust gas recirculation when a unit is disabled/off, allow for at least 10 feet (3.1 m) of common vertical as a rule of thumb
9. Clearances and enclosures. ALL vent pipe and fittings must be installed with appropriate air space clearances to combustibles, per UL 1738. These clearances apply to indoor or outdoor vents, whether open, enclosed, horizontal or vertical or pass through floors, walls, roofs, or framed spaces. The appropriate air space clearances should be observed between joists, studs, sub floors, plywood, drywall, or plaster enclosures, insulated sheathing, rafters, roofing, and any other combustible material. Minimum clearance also apply to electrical wires and all building insulation.
10. Non-metallic vent pipe and fittings may NOT be covered with thermal insulation, unless it is design certified for coverage with insulation.
11. The vent shall not terminate:
    a. Over public walkways; or
    b. Near soffit vents or crawl space vents or other areas where condensate or vapor could create a nuisance or hazard or cause property damage; or
    c. Where condensate vaper could cause damage or could be detrimental to the operation of regulators, relief valves, or other equipment.
    d. For other than a direct vent appliance, the appliance must be located as close as practicable to a chimney or gas vent.

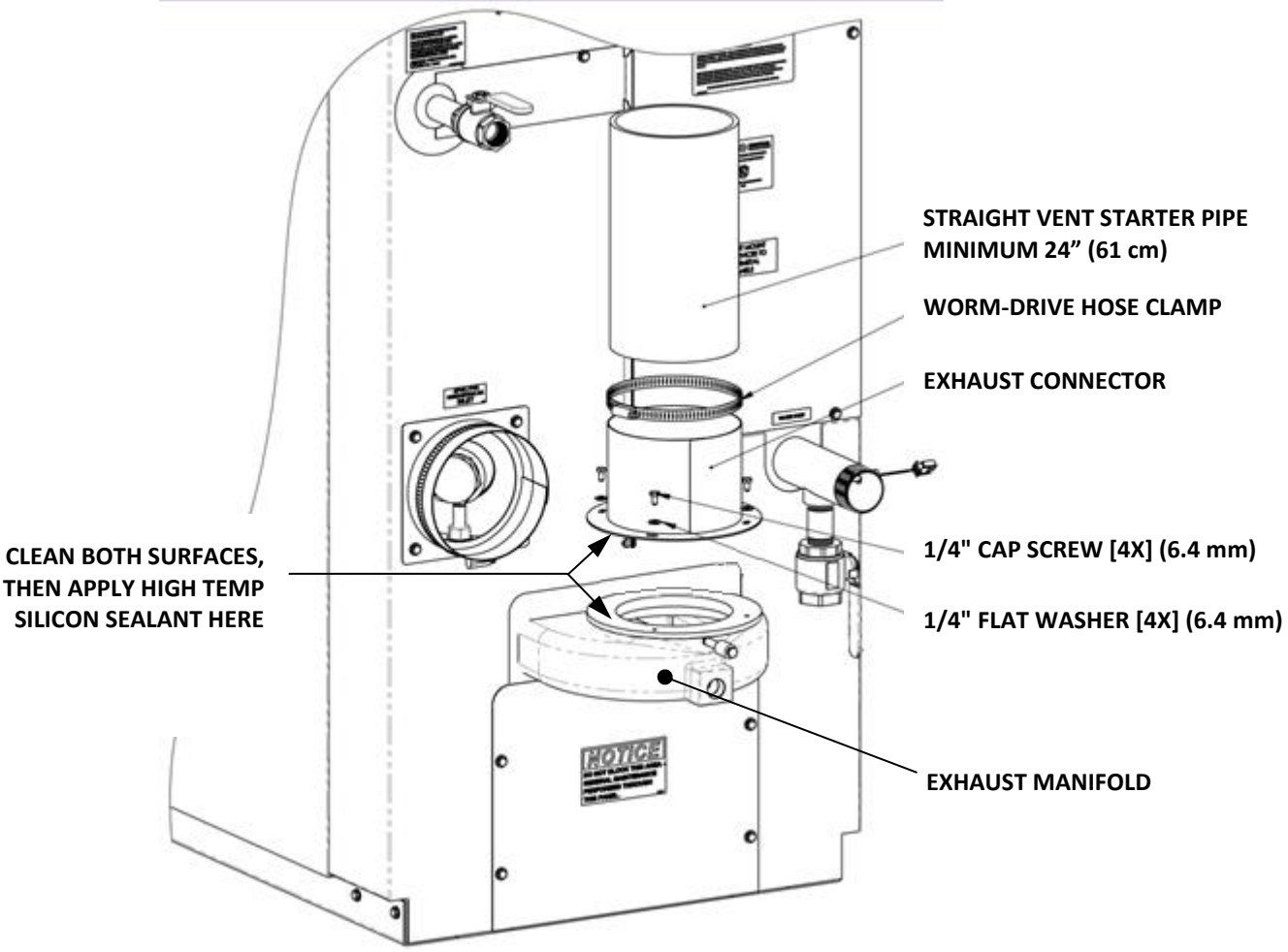


Figure 8: Vent Installation onto Water Heater – Innovation Shown

WARNING
Do not insulate or otherwise wrap vent pipe or fittings.

Sections 3.3 and 3.4, below, discuss specific installation regulations for side-wall and vertical terminations, respectively.

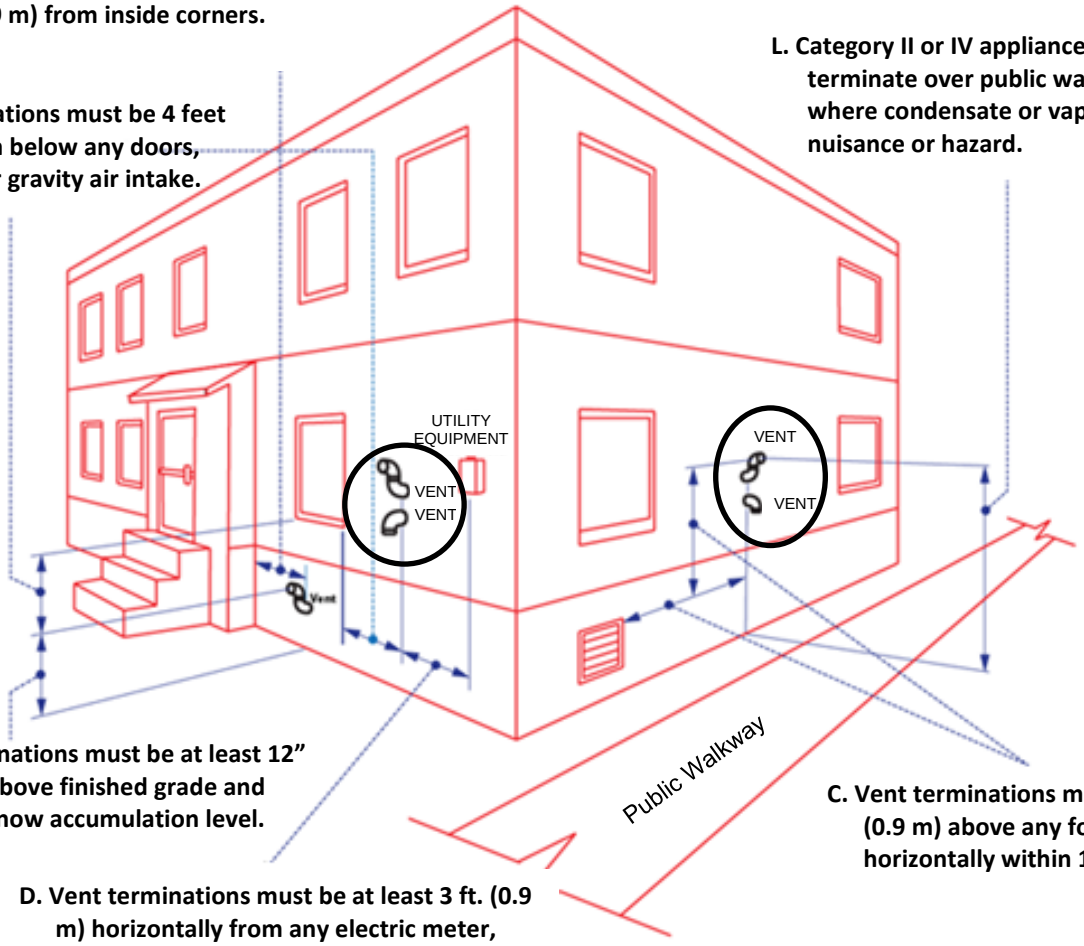
3.3 Installation Requirements for Venting Through A Wall

The minimum distances from adjacent public walkways, adjacent buildings, operable windows and building openings shall not be less that those values specified in the National Fuel Gas Code, ANSI Z223.1 and/or CAN/CSA B149, Installation Codes.

Refer to the table, the notes below and Figure 9 when determining the location and clearances of direct of vent terminals (for other than direct vent terminal, see the table at the end of this section).

Direct Vent Terminal Clearances		US	Canadian
A	Above finished grade, veranda, porch, deck or balcony, or above normally expected snow accumulation level in areas where snow accumulates. (A)	12 in. (30.5 cm)	
B	To window or door that may open. (B)	1 ft. (30 cm)	3 ft. (0.9 m)
C	Above any forced air inlet located within 10 feet (3.1 m). (-)	3 ft. (0.9 m)	-
D	Horizontally from electric meters, gas meters, regulators and relief equipment within height of 15 ft. (4.6 m) (H)	3 ft. (0.9 m)	
E	To permanently closed window. (C)	As specified by manufacturer	
F	Vertically to ventilated soffit located above the terminal within a horizontal distance of 2 ft. (61 cm) from the center line of the terminal. (D)		
G	Clearance to unventilated soffit. (E)		
F	Clearance to outside corner. (F)		
G	Clearance to inside corner. (G)		
H	Clearance to each side of center line extended above meter/regulator assembly. (H)	As specified by manufacturer	3 ft. (91 cm) within heights of 15 ft. (4.6 m)
I	Clearance to service regulator vent outlet. (I)	As specified by manufacturer	3 ft. (91 cm)
J	Clearance to non-mechanical air supply inlet to building or combustion air inlet to any other appliance. (J)	1 ft. (30 cm)	3 ft. (91 cm)
K	Clearance to mechanical air supply inlet. (K)	3 ft. (91 cm) above if within 10 ft. (3 m.) horizontally	6 ft. (1.83 m)
L	Clearance above paved sidewalk or paved driveway located on public property. (L)	Not Allowed	7 ft. (2.13 m)
M	Clearance under veranda, porch, deck or balcony. (M)	As specified by manufacturer	1 ft. (30 cm)

NOTE: In Massachusetts, when side-wall venting is used, the vent termination must be located a minimum of 4 feet above grade. For detailed information pertaining to side-wall venting within the Commonwealth of Massachusetts, see Section 1.4: *For Massachusetts Installations* in the *Innovation-Edge Install-Operation-Maintenance Manual* (OMM-0143, GF-216).



NOTE: This Figure is only to show code requirements, *not* how vents should be terminated.

Figure 9: Determining Location of Vent Outlet

The following are clearances for other than direct vent terminals:

Other than Direct Vent Terminal Clearances		US	Canadian
A	Above finished grade, veranda, porch, deck or balcony.	12 in. (30.5 cm)	
B	To window or door that may open.	4 ft. (1.2 m)	3 ft. (0.9 m)
C	To permanently closed window.	As specified by manufacturer	
D	Vertically to ventilated soffit located above the terminal within a horizontal distance of 2 ft. (61 cm) from the center line of the terminal.		
E	Clearance to unventilated soffit.		
F	Clearance to outside corner.		
G	Clearance to inside corner.		

In addition to the requirements above, note the following:

a. Do not locate the vent termination too close to shrubbery as flue products may stunt growth or kill them.

b. If horizontal vents terminate where snow can accumulate, you must take all necessary steps to eliminate the possibility that accumulated snow might block the vent.

c. Some building materials may be affected by flue products expelled near unprotected surfaces. Sealing or shielding of exposed surfaces with a corrosion resistant material (such as aluminum sheet) may be required to prevent staining or deterioration.

d. The vent system size and location must also comply with the US or Canadian Codes listed in Section 1.2, above.

3.4 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 10):

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 and H-termination for high-wind areas.

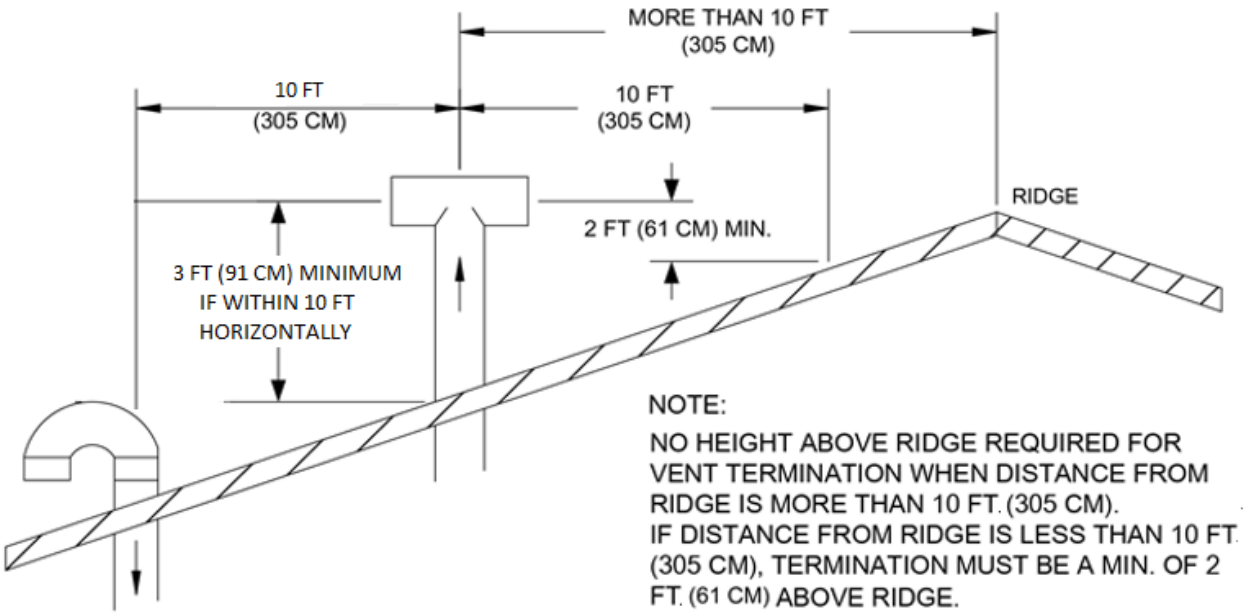


Figure 10: Acceptable Combustion Air Inlet & Vent Outlet Configuration

3.5 Vent Pipe Sizing

The maximum length is the combined length of straight horizontal and vertical runs, and the equivalent straight length of fittings and transition pieces of pipe. The maximum equivalent lengths and minimum pipe diameters are given below in Table 4 for each heater.

TABLE 4: Venting Pipe Run Lengths

Model No.	INN 600N	INN 600N, INN 800N, INN 1060N, INN 1350N
Vent Diameter	4” (102 mm)	6” (152 mm)
Maximum Vent Equivalent Feet (Meters)	80 ft. (24.4 m)	140 ft. (42.7 m)

Examples:

1. A 40 foot (12.2 m) length of vent pipe and 1 sharp 90° elbow plus a termination (exit cone or rain cap) add up to 40 ft. + 10 ft. + 10 ft. = 60 equivalent ft. (18.3 m).
2. A 30 foot (9.1 m) length of vent pipe and 2 sharp 90° elbows plus a termination (exit cone or rain cap) add up to 30 ft. + (2 x 10 ft.) + 10 ft. = 60 equivalent ft. (15.25 m)

NOTE: The maximum combined pressure drop of the exhaust and intake-air vents is **140** equivalent-feet (42.7 m) for **6”** (152 mm) pipe (all models). For the INN 600N using **4”** (102 mm) pipe the maximum combined pressure drop of exhaust and intake-air vents is **80** (24.4 m) equivalent-feet.

3.6 Common Vent Pipe Sizing

IMPORTANT NOTES:
1. AERCO forced draft water heaters 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.

Connections to common vent breeching or duct work must be accomplished with a 45° lateral or boot-tee in the direction of flow in the main breeching. Straight “tees” should not be used to accomplish these connections. See Figure 11a. Similarly, transition from common horizontal vent to common vertical vent section with condensate drain should use lateral or boot-tee, as shown in Figure 13, below.

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.

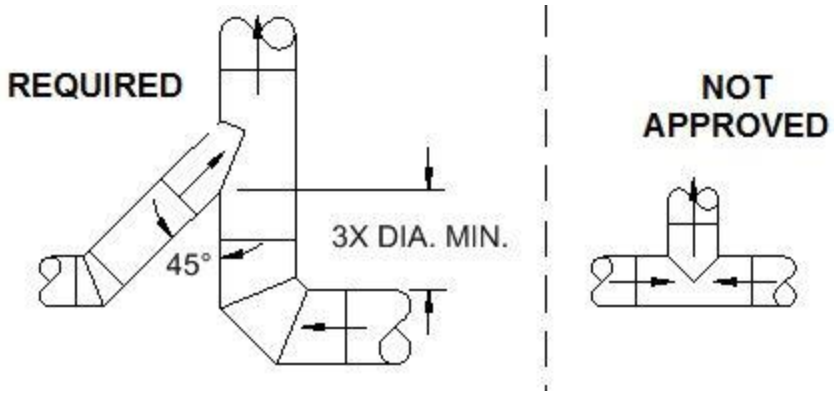


Figure 11b: Required Interconnection of Groups of Units

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 preferred "transition" assembly will reduce the overall system pressure drop.

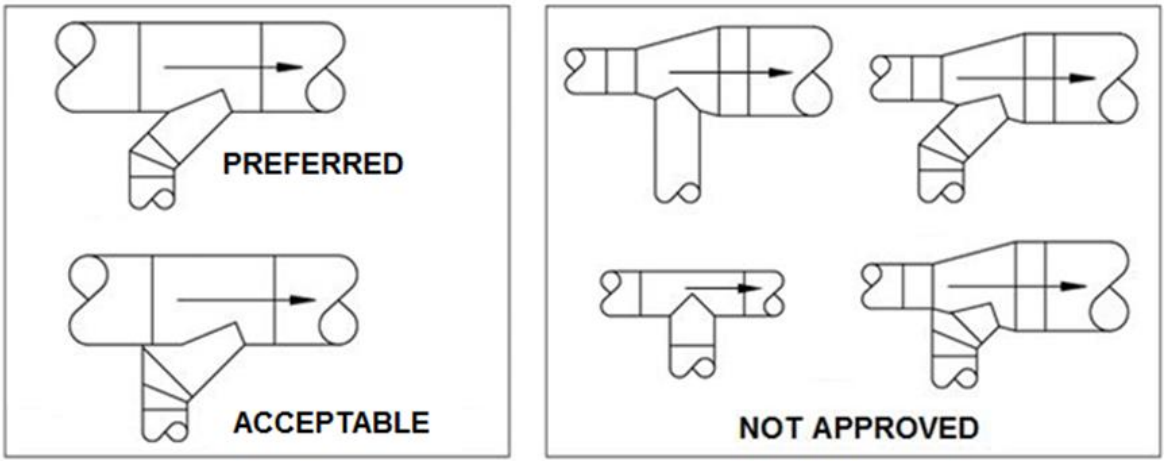


Figure 12: Transition Vent Sections

The vent system should always be pitched up 1/4 inch per foot (21 mm/m) of run towards the vent termination (see Figure 13). This will enable condensate to drain back to the unit for disposal. Low spots in the vent must be avoided. Inspect periodically to ensure correct drainage.

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

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

AERCO Water Heater venting should never be interconnected with other manufacturers' equipment.

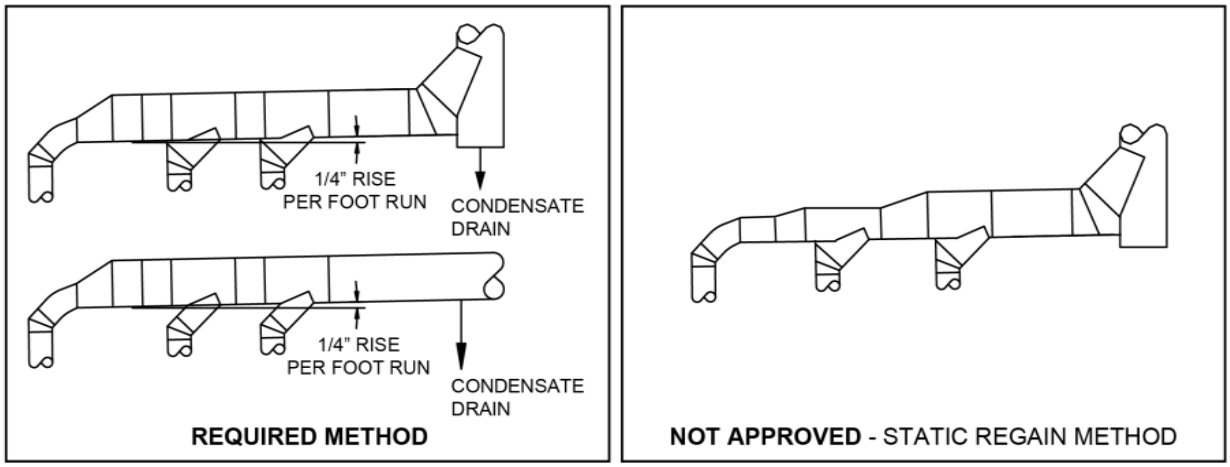


Figure 13: Connection of Unit at End of Vent Main

3.7 Common Vent Condensate Drainage

A condensate drain must be located in the common vent portion of the flue system. The drain must be located to collect condensate flow from the common duct to prevent backflow into the first heater, as shown in Figure 13.

3.8 Combustion Air Duct Pressure Drop Tables

The tables in this section list the pressure drop in ducted combustion air ducts for the Innovation-Edge models at various outside air temperatures and duct diameters.

3.8.1 Corrections For Altitude

The table below 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.*

Altitude Correction Table		
Elevation (Feet)	**Elevation (Meters)**	**Altitude Correction Factor**
0	0	1
500	152.4	0.982
1000	304.8	0.964
1500	457.2	0.947
2000	609.6	0.930
2500	762.0	0.913
3000	914.4	0.896
3500	1066.8	0.880
4000	1219.2	0.864

Feet	Meters	
4500	1371.6	0.848
5000	1524.0	0.832
5500	1676.4	0.817
6000	1828.8	0.801
6500	1981.2	0.787
7000	2133.6	0.772
7500	2286.0	0.758
8000	2438.4	0.743
8500	2590.8	0.729
9000	2743.2	0.715
9500	2895.6	0.701
10000	3048.0	0.688

3.8.2 Innovation 600N Combustion Air Duct Pressure Drop Tables

- Values for **Straight Run** are equivalent feet per foot or meters per meter
- Values for **90° Elbow**, **45° Elbow**, and **Ent. Loss** are equivalent feet (equivalent millimeters)

TABLE 5: Innovation 600N MBTU (176 kW) Water Heaters

Inlet Duct & No. Units	Duct Section Type	Outside Air Temperature								
		-30 °F -34 °C	-15 °F -26 °C	0 °F -18 °C	20 °F -7 °C	40 °F 4 °C	60 °F 16 °C	80 °F 27 °C	100 °F 38 °C	120 °F 49 °C
6" Duct Single Unit	Straight Run	0.19	0.2	0.2	0.21	0.21	0.22	0.23	0.24	0.24
	90° Elbow	0.82 (250)	0.86 (262)	0.9 (274)	0.96 (293)	1.02 (311)	1.09 (332)	1.16 (354)	1.24 (378)	1.32 (402)
	45° Elbow	0.60 (183)	0.63 (192)	0.67 (204)	0.71 (216)	0.76 (232)	0.81 (247)	0.86 (262)	0.92 (280)	0.98 (299)
	Ent. Loss	1.27 (387)	1.33 (405)	1.4 (427)	1.49 (454)	1.59 (485)	1.7 (518)	1.81 (552)	1.94 (591)	2.06 (628)
8" Duct Single Unit	Straight Run	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06
	90° Elbow	0.21 (64)	0.22 (67)	0.23 (70)	0.24 (73)	0.26 (79)	0.28 (85)	0.30 (91)	0.32 (98)	0.34 (104)
	45° Elbow	0.16 (49)	0.16 (49)	0.17 (52)	0.18 (55)	0.2 (61)	0.21 (64)	0.22 (67)	0.24 (73)	0.25 (76)
	Ent. Loss	0.40 (122)	0.42 (128)	0.44 (134)	0.47 (143)	0.5 (152)	0.54 (165)	0.57 (174)	0.61 (186)	0.65 (198)
8" Duct Two Units	Straight Run	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.22	0.23
	90° Elbow	0.83 (253)	0.87 (265)	0.92 (280)	0.98 (299)	1.04 (317)	1.11 (338)	1.19 (363)	1.27 (387)	1.35 (411)
	45° Elbow	0.63 (192)	0.66 (201)	0.69 (210)	0.74 (226)	0.79 (241)	0.84 (256)	0.90 (274)	0.96 (293)	1.02 (311)
	Ent. Loss	1.61 (491)	1.69 (515)	1.77 (539)	1.89 (576)	2.02 (616)	2.15 (655)	2.30 (701)	2.45 (747)	2.61 (796)
10" Duct Two Units	Straight Run	0.05	0.05	0.05	0.06	0.06	0.06	0.07	0.07	0.08
	90° Elbow	0.30 (91)	0.31 (94)	0.33 (101)	0.35 (107)	0.37 (113)	0.40 (122)	0.42 (128)	0.45 (137)	0.48 (146)
	45° Elbow	0.23 (70)	0.24 (73)	0.25 (76)	0.27 (82)	0.28 (85)	0.3 (91)	0.32 (98)	0.35 (107)	0.37 (113)
	Ent. Loss	0.66 (201)	0.69 (210)	0.73 (223)	0.77 (235)	0.83 (253)	0.88 (268)	0.94 (287)	1.00 (305)	1.07 (326)

TABLE 5: Innovation 600N MBTU (176 kW) Water Heaters – Continued

Inlet Duct & No. Units	Duct Section Type	Outside Air Temperature								
		-30 °F -34 °C	-15 °F -26 °C	0 °F -18 °C	20 °F -7 °C	40 °F 4 °C	60 °F 16 °C	80 °F 27 °C	100 °F 38 °C	120 °F 49 °C
10" Duct Three Units	Straight Run	0.10	0.1	0.11	0.12	0.12	0.13	0.14	0.15	0.16
	90° Elbow	0.67 (204)	0.7 (213)	0.73 (223)	0.78 (238)	0.84 (256)	0.89 (271)	0.95 (290)	1.01 (308)	1.08 (329)
	45° Elbow	0.51 (155)	0.54 (165)	0.56 (171)	0.6 (183)	0.64 (195)	0.68 (207)	0.73 (223)	0.78 (238)	0.83 (253)

TABLE 5: Innovation 600N MBTU (176 kW) Water Heaters – Continued										
Inlet Duct & No. Units	**Duct Section Type**	**Outside Air Temperature**								
		-30 °F -34 °C	**-15 °F -26 °C**	**0 °F -18 °C**	**20 °F -7 °C**	**40 °F 4 °C**	**60 °F 16 °C**	**80 °F 27 °C**	**100 °F 38 °C**	**120 °F 49 °C**
	Ent. Loss	1.48 (451)	1.56 (475)	1.63 (497)	1.74 (530)	1.86 (567)	1.98 (604)	2.12 (646)	2.26 (689)	2.41 (735)
12" Duct Three Units	Straight Run	0.04	0.04	0.04	0.05	0.05	0.05	0.06	0.06	0.07
	90° Elbow	0.29 (88)	0.31 (94)	0.32 (98)	0.34 (104)	0.36 (110)	0.39 (119)	0.42 (128)	0.44 (134)	0.47 (143)
	45° Elbow	0.23 (70)	0.24 (73)	0.25 (76)	0.26 (79)	0.28 (85)	0.3 (91)	0.32 (98)	0.34 (104)	0.37 (113)
	Ent. Loss	0.72 (219)	0.75 (229)	0.79 (241)	0.84 (256)	0.9 (274)	0.96 (293)	1.02 (311)	1.09 (332)	1.16 (354)
12" Duct Four Units	Straight Run	0.07	0.07	0.08	0.08	0.09	0.09	0.10	0.10	0.11
	90° Elbow	0.52 (158)	0.54 (165)	0.57 (174)	0.61 (186)	0.65 (198)	0.69 (210)	0.74 (226)	0.79 (241)	0.84 (256)
	45° Elbow	0.4 (122)	0.42 (128)	0.44 (134)	0.47 (143)	0.5 (152)	0.53 (162)	0.57 (174)	0.61 (186)	0.65 (198)
	Ent. Loss	1.27 (387)	1.33 (405)	1.4 (427)	1.49 (454)	1.59 (485)	1.7 (518)	1.81 (552)	1.94 (591)	2.06 (628)
14" Duct Four Units	Straight Run	0.03	0.03	0.04	0.04	0.04	0.04	0.05	0.05	0.05
	90° Elbow	0.26 (79)	0.27 (82)	0.29 (88)	0.3 (91)	0.32 (98)	0.35 (107)	0.37 (113)	0.39 (119)	0.42 (128)
	45° Elbow	0.20 (61)	0.21 (64)	0.22 (67)	0.24 (73)	0.25 (76)	0.27 (82)	0.29 (88)	0.31 (94)	0.33 (101)
	Ent. Loss	0.69 (210)	0.72 (219)	0.76 (232)	0.81 (247)	0.86 (262)	0.92 (280)	0.98 (299)	1.04 (317)	1.11 (338)

NOTES: 1) Calculation assumes **125 scfm (3.54 m^3/min)** per heater at full fire rate

2) Units for "Straight Run" pressure drop values are equivalent feet per foot (eq. m/m)

3) Units for "Elbows" and "Ent. Loss" are equivalent feet per item (eq. m/item)

3.8.3 Innovation 800N Combustion Air Duct Pressure Drop Tables

- Values for **Straight Run** are equivalent feet per foot or meters per meter
- Values for **90° Elbow**, **45° Elbow**, and **Ent. Loss** are equivalent feet (equivalent millimeters)

TABLE 6: Innovation 800N MBTU Water Heater

Inlet Duct & No. Units	Duct Section Type	Outside Air Temperature								
		-30 °F -34 °C	-15 °F -26 °C	0 °F -18 °C	20 °F -7 °C	40 °F 4 °C	60 °F 16 °C	80 °F 27 °C	100 °F 38 °C	120 °F 49 °C
6" Duct Single Unit	Straight Run	0.32	0.33	0.34	0.35	0.36	0.37	0.39	0.4	0.41
	90° Elbow	1.44 (439)	1.51 (460)	1.58 (482)	1.69 (515)	1.8 (549)	1.92 (585)	2.05 (625)	2.19 (668)	2.34 (713)
	45° Elbow	1.07 (326)	1.12 (341)	1.17 (357)	1.25 (381)	1.34 (408)	1.42 (433)	1.52 (463)	1.62 (494)	1.73 (527)
	Ent. Loss	2.24 (683)	2.35 (716)	2.47 (753)	2.63 (802)	2.81 (856)	3.00 (914)	3.2 (975)	3.41 (1039)	3.64 (1109)
8" Duct Single Unit	Straight Run	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.10	0.10
	90° Elbow	0.37 (113)	0.39 (119)	0.4 (122)	0.43 (131)	0.46 (140)	0.49 (149)	0.52 (158)	0.56 (171)	0.6 (183)
	45° Elbow	0.28 (85)	0.29 (88)	0.31 (94)	0.33 (101)	0.35 (107)	0.37 (113)	0.4 (122)	0.42 (128)	0.45 (137)
	Ent. Loss	0.71 (216)	0.74 (226)	0.78 (238)	0.83 (253)	0.89 (271)	0.95 (290)	1.01 (308)	1.08 (329)	1.15 (351)
8" Duct Two Units	Straight Run	0.24	0.25	0.26	0.28	0.3	0.32	0.34	0.36	0.39
	90° Elbow	1.47 (448)	1.54 (469)	1.62 (494)	1.73 (527)	1.84 (561)	1.97 (600)	2.1 (640)	2.24 (683)	2.39 (728)
	45° Elbow	1.11 (338)	1.16 (354)	1.22 (372)	1.30 (396)	1.39 (424)	1.48 (451)	1.58 (482)	1.69 (515)	1.8 (549)
	Ent. Loss	2.84 (866)	2.98 (908)	3.13 (954)	3.33 (1015)	3.56 (1085)	3.79 (1155)	4.05 (1234)	4.32 (1317)	4.61 (1405)
10" Duct Two Units	Straight Run	0.08	0.08	0.09	0.09	0.10	0.11	0.11	0.12	0.13
	90° Elbow	0.52 (158)	0.55 (168)	0.58 (177)	0.61 (186)	0.65 (198)	0.7 (213)	0.75 (229)	0.8 (244)	0.85 (259)
	45° Elbow	0.4 (122)	0.42 (128)	0.44 (134)	0.47 (143)	0.5 (152)	0.53 (162)	0.57 (174)	0.61 (186)	0.65 (198)
	Ent. Loss	1.16 (354)	1.22 (372)	1.28 (390)	1.37 (418)	1.46 (445)	1.55 (472)	1.66 (506)	1.77 (539)	1.89 (576)

TABLE 6: Innovation 800N MBTU Water Heater – *Continued*

Inlet Duct & No. Units	Duct Section Type	Outside Air Temperature (°F)								
		-30 °F -34 °C	-15 °F -26 °C	0 °F -18 °C	20 °F -7 °C	40 °F 4 °C	60 °F 16 °C	80 °F 27 °C	100 °F 38 °C	120 °F 49 °C
10" Duct Three Units	Straight Run	0.17	0.18	0.18	0.2	0.21	0.22	0.24	0.25	0.27
	90° Elbow	1.18 (360)	1.23 (375)	1.29 (393)	1.38 (421)	1.47 (448)	1.57 (479)	1.68 (512)	1.79 (546)	1.91 (582)
	45° Elbow	0.9 (274)	0.94 (287)	0.99 (302)	1.06 (323)	1.13 (344)	1.2 (366)	1.28 (390)	1.37 (418)	1.46 (445)
	Ent. Loss	2.62 (799)	2.74 (835)	2.88 (878)	3.07 (936)	3.28 (1000)	3.50 (1067)	3.73 (1137)	3.98 (1213)	4.25 (1295)
12" Duct Three Units	Straight Run	0.07	0.07	0.08	0.08	0.09	0.09	0.10	0.10	0.11
	90° Elbow	0.51 (155)	0.54 (165)	0.57 (174)	0.6 (183)	0.64 (195)	0.69 (210)	0.73 (223)	0.78 (238)	0.83 (253)
	45° Elbow	0.4 (122)	0.42 (128)	0.44 (134)	0.47 (143)	0.5 (152)	0.53 (162)	0.57 (174)	0.6 (183)	0.64 (195)
	Ent. Loss	1.26 (384)	1.32 (402)	1.39 (424)	1.48 (451)	1.58 (482)	1.69 (515)	1.8 (549)	1.92 (585)	2.05 (625)
12" Duct Four Units	Straight Run	0.12	0.12	0.13	0.14	0.15	0.15	0.17	0.18	0.19
	90° Elbow	0.91 (277)	0.96 (293)	1.00 (305)	1.07 (326)	1.14 (347)	1.22 (372)	1.3 (396)	1.39 (424)	1.48 (451)
	45° Elbow	0.71 (216)	0.74 (226)	0.78 (238)	0.83 (253)	0.88 (268)	0.94 (287)	1.01 (308)	1.07 (326)	1.15 (351)
	Ent. Loss	2.24 (683)	2.35 (716)	2.47 (753)	2.63 (802)	2.81 (856)	3.00 (914)	3.20 (975)	3.41 (1039)	3.64 (1109)
14" Duct Four Units	Straight Run	0.05	0.06	0.06	0.06	0.07	0.07	0.08	0.08	0.09
	90° Elbow	0.46 (140)	0.48 (146)	0.50 (152)	0.54 (165)	0.57 (174)	0.61 (186)	0.65 (198)	0.70 (213)	0.74 (226)
	45° Elbow	0.36 (110)	0.37 (113)	0.39 (119)	0.42 (128)	0.45 (137)	0.48 (146)	0.51 (155)	0.54 (165)	0.58 (177)
	Ent. Loss	1.21 (369)	1.27 (387)	1.33 (405)	1.42 (433)	1.52 (463)	1.62 (494)	1.73 (527)	1.84 (561)	1.97 (600)

NOTES: 1) Calculation assumes **166 scfm (4.70 m^3/min)** per heater 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)

3.8.4 Innovation 1060N Combustion Air Duct Pressure Drop Tables

- Values for **Straight Run** are equivalent feet per foot or meters per meter
- Values for **90° Elbow**, **45° Elbow**, and **Ent. Loss** are equivalent feet (equivalent millimeters)

TABLE 7: Innovation 1060N MBTU Water Heater Heater

Inlet Duct & No. Units	Duct Section Type	Outside Air Temperature								
		-30 °F -34 °C	-15 °F -26 °C	0 °F -18 °C	20 °F -7 °C	40 °F 4 °C	60 °F 16 °C	80 °F 27 °C	100 °F 38 °C	120 °F 49 °C
6" Duct Single Unit	Straight Run	0.55	0.56	0.57	0.59	0.61	0.63	0.65	0.67	0.69
	90° Elbow	2.53 (771)	2.65 (808)	2.78 (847)	2.97 (905)	3.17 (966)	3.38 (1030)	3.61 (1100)	3.85 (1173)	4.1 (1250)
	45° Elbow	1.87 (570)	1.96 (597)	2.06 (628)	2.2 (671)	2.35 (716)	2.5 (762)	2.67 (814)	2.85 (869)	3.04 (927)
	Ent. Loss	3.94 (1201)	4.13 (1259)	4.34 (1323)	4.63 (1411)	4.94 (1506)	5.27 (1606)	5.62 (1713)	5.99 (1826)	6.4 (1951)
8" Duct Single Unit	Straight Run	0.13	0.13	0.14	0.14	0.15	0.15	0.16	0.16	0.17
	90° Elbow	0.65 (198)	0.68 (207)	0.71 (216)	0.76 (232)	0.81 (247)	0.86 (262)	0.92 (280)	0.98 (299)	1.05 (320)
	45° Elbow	0.49 (149)	0.51 (155)	0.54 (165)	0.57 (174)	0.61 (186)	0.65 (198)	0.69 (210)	0.74 (226)	0.79 (241)
	Ent. Loss	1.25 (381)	1.31 (399)	1.37 (418)	1.46 (445)	1.56 (475)	1.67 (509)	1.78 (543)	1.9 (579)	2.02 (616)
8" Duct Two Units	Straight Run	0.40	0.42	0.45	0.47	0.51	0.54	0.58	0.61	0.65
	90° Elbow	2.58 (786)	2.71 (826)	2.84 (866)	3.03 (924)	3.24 (988)	3.45 (1052)	3.68 (1122)	3.93 (1198)	4.19 (1277)
	45° Elbow	1.95 (594)	2.04 (622)	2.14 (652)	2.29 (698)	2.44 (744)	2.6 (792)	2.78 (847)	2.96 (902)	3.16 (963)
	Ent. Loss	4.99 (1521)	5.23 (1594)	5.49 (1673)	5.86 (1786)	6.25 (1905)	6.66 (2030)	7.11 (2167)	7.59 (2313)	8.09 (2466)
10" Duct Two Units	Straight Run	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.22
	90° Elbow	0.92 (280)	0.96 (293)	1.01 (308)	1.08 (329)	1.15 (351)	1.23 (375)	1.31 (399)	1.40 (427)	1.49 (454)
	45° Elbow	0.7 (213)	0.74 (226)	0.77 (235)	0.83 (253)	0.88 (268)	0.94 (287)	1.00 (305)	1.07 (326)	1.14 (347)
	Ent. Loss	2.04 (622)	2.14 (652)	2.25 (686)	2.4 (732)	2.56 (780)	2.73 (832)	2.91 (887)	3.11 (948)	3.32 (1012)

TABLE 7: Innovation 1060N MBTU Water Heater Heater – *Continued*										
Inlet Duct & No. Units	**Duct Section Type**	**Outside Air Temperature**								
		-30 °F -34 °C	**-15 °F -26 °C**	**0 °F -18 °C**	**20 °F -7 °C**	**40 °F 4 °C**	**60 °F 16 °C**	**80 °F 27 °C**	**100 °F 38 °C**	**120 °F 49 °C**
10" Duct Three Units	Straight Run	0.28	0.30	0.31	0.33	0.35	0.38	0.40	0.43	0.46
	90° Elbow	2.07 (631)	2.17 (661)	2.27 (692)	2.43 (741)	2.59 (789)	2.76 (841)	2.95 (899)	3.14 (957)	3.35 (1021)
	45° Elbow	1.58 (482)	1.66 (506)	1.74 (530)	1.86 (567)	1.98 (604)	2.11 (643)	2.26 (689)	2.41 (735)	2.57 (783)
	Ent. Loss	4.59 (1399)	4.82 (1469)	5.06 (1542)	5.4 (1646)	5.76 (1756)	6.14 (1871)	6.55 (1996)	6.99 (2131)	7.46 (2274)
12" Duct Three Units	Straight Run	0.11	0.12	0.13	0.13	0.14	0.15	0.16	0.17	0.19
	90° Elbow	0.65 (198)	0.68 (207)	0.71 (216)	0.76 (232)	0.81 (247)	0.86 (262)	0.92 (280)	0.98 (299)	1.05 (320)
	45° Elbow	0.49 (149)	0.51 (155)	0.54 (165)	0.57 (174)	0.61 (186)	0.65 (198)	0.69 (210)	0.74 (226)	0.79 (241)
	Ent. Loss	1.25 (381)	1.31 (399)	1.37 (418)	1.46 (445)	1.56 (475)	1.67 (509)	1.78 (543)	1.9 (579)	2.02 (616)
12" Duct Four Units	Straight Run	0.4	0.42	0.45	0.47	0.51	0.54	0.58	0.61	0.65
	90° Elbow	2.58 (786)	2.71 (826)	2.84 (866)	3.03 (924)	3.24 (988)	3.45 (1052)	3.68 (1122)	3.93 (1198)	4.19 (1277)
	45° Elbow	1.95 (594)	2.04 (622)	2.14 (652)	2.29 (698)	2.44 (744)	2.6 (792)	2.78 (847)	2.96 (902)	3.16 (963)
	Ent. Loss	4.99 (1521)	5.23 (1594)	5.49 (1673)	5.86 (1786)	6.25 (1905)	6.66 (2030)	7.11 (2167)	7.59 (2313)	8.09 (2466)
14" Duct Four Units	Straight Run	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.2	0.22
	90° Elbow	0.92 (280)	0.96 (293)	1.01 (308)	1.08 (329)	1.15 (351)	1.23 (375)	1.31 (399)	1.4 (427)	1.49 (454)
	45° Elbow	0.70 (213)	0.74 (226)	0.77 (235)	0.83 (253)	0.88 (268)	0.94 (287)	1.00 (305)	1.07 (326)	1.14 (347)
	Ent. Loss	2.04 (622)	2.14 (652)	2.25 (686)	2.4 (732)	2.56 (780)	2.73 (832)	2.91 (887)	3.11 (948)	3.32 (1012)

NOTES: 1) Calculation assumes **220 scfm (6.23 m^3/min)** per heater at full fire rate

2) Units for "Straight Run" pressure drop values are equivalent feet per foot (eq. m/m)

3) Units for "Elbows" and "Ent. Loss" are equivalent feet per item (eq. m/item)

3.8.5 Innovation 1350NCombustion Air Duct Pressure Drop Tables

- Values for **Straight Run** are equivalent feet per foot or meters per meter
- Values for **90° Elbow**, **45° Elbow**, and **Ent. Loss** are equivalent feet (equivalent millimeters)

TABLE 8: Innovation 1350N MBTU Water Heater Heater

Inlet Duct & No. Units	Duct Section Type	Outside Air Temperature								
		-30 °F -34 °C	-15 °F -26 °C	0 °F -18 °C	20 °F -7 °C	40 °F 4 °C	60 °F 16 °C	80 °F 27 °C	100 °F 38 °C	120 °F 49 °C
6" Duct Single Unit	Straight Run	0.86	0.88	0.9	0.93	0.96	0.99	1.02	1.05	1.09
	90° Elbow	4.1 (1250)	4.3 (1311)	4.51 (1375)	4.81 (1466)	5.13 (1564)	5.47 (1667)	5.84 (1780)	6.23 (1899)	6.65 (2027)
	45° Elbow	3.03 (924)	3.18 (969)	3.34 (1018)	3.56 (1085)	3.8 (1158)	4.05 (1234)	4.32 (1317)	4.61 (1405)	4.92 (1500)
	Ent. Loss	6.38 (1945)	6.7 (2042)	7.03 (2143)	7.49 (2283)	7.99 (2435)	8.53 (2600)	9.1 (2774)	9.71 (2960)	10.36 (3158)
8" Duct Single Unit	Straight Run	0.21	0.21	0.22	0.22	0.23	0.24	0.24	0.25	0.26
	90° Elbow	0.65 (198)	0.68 (207)	0.71 (216)	0.76 (232)	0.81 (247)	0.86 (262)	0.92 (280)	0.98 (299)	1.05 (320)
	45° Elbow	0.49 (149)	0.51 (155)	0.54 (165)	0.57 (174)	0.61 (186)	0.65 (198)	0.69 (210)	0.74 (226)	0.79 (241)
	Ent. Loss	1.25 (381)	1.31 (399)	1.37 (418)	1.46 (445)	1.56 (475)	1.67 (509)	1.78 (543)	1.9 (579)	2.02 (616)
8" Duct Two Units	Straight Run	0.40	0.42	0.45	0.47	0.51	0.54	0.58	0.61	0.65
	90° Elbow	2.58 (786)	2.71 (826)	2.84 (866)	3.03 (924)	3.24 (988)	3.45 (1052)	3.68 (1122)	3.93 (1198)	4.19 (1277)
	45° Elbow	1.95 (594)	2.04 (622)	2.14 (652)	2.29 (698)	2.44 (744)	2.6 (792)	2.78 (847)	2.96 (902)	3.16 (963)
	Ent. Loss	4.99 (1521)	5.23 (1594)	5.49 (1673)	5.86 (1786)	6.25 (1905)	6.66 (2030)	7.11 (2167)	7.59 (2313)	8.09 (2466)
10" Duct Two Units	Straight Run	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.2	0.22
	90° Elbow	0.92 (280)	0.96 (293)	1.01 (308)	1.08 (329)	1.15 (351)	1.23 (375)	1.31 (399)	1.4 (427)	1.49 (454)
	45° Elbow	0.70 (213)	0.74 (226)	0.77 (235)	0.83 (253)	0.88 (268)	0.94 (287)	1.00 (305)	1.07 (326)	1.14 (347)
	Ent. Loss	2.04 (622)	2.14 (652)	2.25 (686)	2.4 (732)	2.56 (780)	2.73 (832)	2.91 (887)	3.11 (948)	3.32 (1012)

TABLE 8: Innovation 1350N MBTU Water Heater Heater – *Continued*										
Inlet Duct & No. Units	**Duct Section Type**	**Outside Air Temperature**								
		-30 °F -34 °C	**-15 °F -26 °C**	**0 °F -18 °C**	**20 °F -7 °C**	**40 °F 4 °C**	**60 °F 16 °C**	**80 °F 27 °C**	**100 °F 38 °C**	**120 °F 49 °C**
10" Duct Three Units	Straight Run	0.45	0.47	0.49	0.52	0.56	0.6	0.63	0.68	0.72
	90° Elbow	3.35 (1021)	3.51 (1070)	3.68 (1122)	3.93 (1198)	4.19 (1277)	4.47 (1362)	4.77 (1454)	5.09 (1551)	5.43 (1655)
	45° Elbow	2.56 (780)	2.69 (820)	2.82 (860)	3.01 (917)	3.21 (978)	3.42 (1042)	3.65 (1113)	3.9 (1189)	4.16 (1268)
	Ent. Loss	7.44 (2268)	7.81 (2380)	8.2 (2499)	8.74 (2664)	9.33 (2844)	9.95 (3033)	10.62 (3237)	11.33 (3453)	12.08 (3682)
12" Duct Three Units	Straight Run	0.18	0.19	0.2	0.21	0.22	0.24	0.26	0.27	0.29
	90° Elbow	0.65 (198)	0.68 (207)	0.71 (216)	0.76 (232)	0.81 (247)	0.86 (262)	0.92 (280)	0.98 (299)	1.05 (320)
	45° Elbow	0.49 (149)	0.51 (155)	0.54 (165)	0.57 (174)	0.61 (186)	0.65 (198)	0.69 (210)	0.74 (226)	0.79 (241)
	Ent. Loss	1.25 (381)	1.31 (399)	1.37 (418)	1.46 (445)	1.56 (475)	1.67 (509)	1.78 (543)	1.9 (579)	2.02 (616)
12" Duct Four Units	Straight Run	0.4	0.42	0.45	0.47	0.51	0.54	0.58	0.61	0.65
	90° Elbow	2.58 (786)	2.71 (826)	2.84 (866)	3.03 (924)	3.24 (988)	3.45 (1052)	3.68 (1122)	3.93 (1198)	4.19 (1277)
	45° Elbow	1.95 (594)	2.04 (622)	2.14 (652)	2.29 (698)	2.44 (744)	2.6 (792)	2.78 (847)	2.96 (902)	3.16 (963)
	Ent. Loss	4.99 (1521)	5.23 (1594)	5.49 (1673)	5.86 (1786)	6.25 (1905)	6.66 (2030)	7.11 (2167)	7.59 (2313)	8.09 (2466)
14" Duct Four Units	Straight Run	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.2	0.22
	90° Elbow	0.92 (280)	0.96 (293)	1.01 (308)	1.08 (329)	1.15 (351)	1.23 (375)	1.31 (399)	1.4 (427)	1.49 (454)
	45° Elbow	0.7 (213)	0.74 (226)	0.77 (235)	0.83 (253)	0.88 (268)	0.94 (287)	1 (305)	1.07 (326)	1.14 (347)
	Ent. Loss	2.04 (622)	2.14 (652)	2.25 (686)	2.4 (732)	2.56 (780)	2.73 (832)	2.91 (887)	3.11 (948)	3.32 (1012)

NOTES: 1) Calculation assumes **280 scfm (7.91 m^3/min)** per heater at full fire rate

2) Units for "Straight Run" pressure drop values are equivalent feet per foot (eq. m/m)

3) Units for "Elbows" and "Ent. Loss" are equivalent feet per item (eq. m/item)

3.9 Flue Vent Pressure Drop Tables

The tables below list the pressure drop in flue vents in equivalent feet (eq. ft.) or equivalent meters (eq. m.) for single Innovation-Edge water heaters at various duct diameters. All values are based on the assumption of 140°F (60°C) Water Temperature and 70°F (21°C) Rise at Sea Level.

TABLE 9: Flue Vent Pressure Drop – Innovation 600N MBTU Water Heaters

Flue Vent Diameter in inches (mm)	Flue Velocity in ft./sec. (m/sec.)	Straight Run in eq. ft. / foot (eq. m/m)	90° elbow in eq. ft. (eq. m)	45° elbow in eq. ft. (eq. m)	Exit Loss	
					Horizontal Termination in eq. ft. (eq. m)	Vertical Termination in eq. ft. (eq. m)
4 (101.6)	28.6 (8.7)	2.2 (2.2)	12.1 (3.7)	9 (2.7)	10.6 (3.2)	19.7 (6)
6 (152.4)	12.7 (3.9)	0.3 (0.3)	1.7 (0.5)	1.3 (0.4)	2.1 (0.6)	3 (0.9)
8 (203.2)	7.2 (2.2)	0.1 (0.1)	0.4 (0.1)	0.3 (0.1)	0.7 (0.2)	1.2 (0.4)
10 (254)	4.6 (1.4)	0 (0)	0.2 (0.1)	0.1 (0)	0.3 (0.1)	0.5 (0.2)

* **NOTE**: 4" vent is limited to 80 eq. ft. (24.4 eq. m) total, use for short runs only

TABLE 10: Discharge Flue Vent Pressure Drop – Innovation 800N MBTU Water Heater

Flue Vent Diameter in inches (mm)	Flue Velocity in ft./sec. (m/sec.)	Straight Run in eq. ft. / foot (eq. m/m)	90° elbow in eq. ft. (eq. m)	45° elbow in eq. ft. (eq. m)	Exit Loss	
					Horizontal Termination in eq. ft. (eq. m)	Vertical Termination in eq. ft. (eq. m)
6 (152.4)	17 (5.2)	0.5 (0.5)	3 (0.9)	2.2 (0.7)	3.7 (1.1)	5.3 (1.6)
8 (203.2)	9.5 (2.9)	0.1 (0.1)	0.8 (0.2)	0.6 (0.2)	1.2 (0.4)	2.2 (0.7)
10 (254)	6.1 (1.9)	0 (0)	0.3 (0.1)	0.2 (0.1)	0.5 (0.2)	0.9 (0.3)
12 (304.8)	4.2 (1.3)	0 (0)	0.1 (0)	0.1 (0)	0.2 (0.1)	0.4 (0.1)

TABLE 11: Flue Vent Pressure Drop – Innovation 1060N

Flue Vent Diameter in inches (mm)	Flue Velocity in ft./sec. (m/sec.)	Straight Run in eq. ft. / foot (eq. m/m)	90° elbow in eq. ft. (eq. m)	45° elbow in eq. ft. (eq. m)	Exit Loss	
					Horizontal Termination in eq. ft. (eq. m)	Vertical Termination in eq. ft. (eq. m)
6 (152.4)	21.2 (6.5)	0.7 (0.7)	4.7 (1.4)	3.5 (1.1)	5.8 (1.8)	8.3 (2.5)
8 (203.2)	11.9 (3.6)	0.2 (0.2)	1.2 (0.4)	0.9 (0.3)	1.8 (0.5)	3.4 (1)
10 (254)	7.6 (2.3)	0.1 (0.1)	0.4 (0.1)	0.3 (0.1)	0.8 (0.2)	1.4 (0.4)
12 (304.8)	5.3 (1.6)	0 (0)	0.2 (0.1)	0.1 (0)	0.4 (0.1)	0.7 (0.2)

TABLE 12: Discharge Flue Vent Pressure Drop – Innovation 1350N MBTU Water Heater

Flue Vent Diameter in inches (mm)	Flue Velocity in ft./sec. (m/sec.)	Straight Run in eq. ft. / foot (eq. m/m)	90° elbow in eq. ft. (eq. m)	45° elbow in eq. ft. (eq. m)	Exit Loss	
					Horizontal Termination in eq. ft. (eq. m)	Vertical Termination in eq. ft. (eq. m)
6 (152.4)	28.6 (8.7)	1.3 (1.3)	8.6 (2.6)	6.4 (2)	10.6 (3.2)	15.2 (4.6)
8 (203.2)	16.1 (4.9)	0.3 (0.3)	2.2 (0.7)	1.7 (0.5)	3.4 (1)	6.2 (1.9)
10 (254)	10.3 (3.1)	0.1 (0.1)	0.8 (0.2)	0.6 (0.2)	1.4 (0.4)	2.6 (0.8)
12 (304.8)	7.2 (2.2)	0 (0)	0.3 (0.1)	0.3 (0.1)	0.7 (0.2)	1.2 (0.4)

Example using standard North American units of measure:

1) An installer is trying to figure out if he can save some money by using a 4-inch vent (exhaust) design versus a 6-inch when installing a single Innovation 600N water heater. After laying out the design, he determines he needs the following components:

   a) A 15-foot length of combustion air pipe with one (1) sharp 90° elbow plus (2) two termination 90° elbows.
   b) A 35-foot length of vent pipe and two (2) sharp 90° elbows plus a termination (exit cone or rain cap).

Intake (must use 6-inch):

From **Table 5** for 6-inch piping we will design the inlet for maximum outside air temperatures (100°F):

Max outside air Temp = 100°F

Δp straight pipe = 0.24 ft./ft.

Δp 90° elbow = 1.24 ft./elbow

Δp entrance loss = 1.94 ft.

Intake Δp equivalent feet = 15 ft. x 0.24 ft./ft. + 3 elbows x 1.24 ft./elbow + 1.94 ft. = 10 feet

Vent using 6" pipe (Exhaust):

From **Table 9** for 6-inch piping:

Δp straight pipe = 0.3 ft./ft.

Δp 90° elbow = 1.7 ft./elbow

Velocity cone or Rain cap = 3 ft.

Exhaust Δp equivalent feet = 35 ft. x 0.3 ft./f.t + 2 elbows x 1.7 ft./elbow + 3 ft. = 17 feet

Vent using 4" pipe (Exhaust):

From **Table 9** for 4-inch piping:

Δp straight pipe = 2.2 ft./ft.

Δp 90° elbow = 12.1 ft./elbow

Velocity cone or Rain cap = 19.7 ft.

Exhaust Δp equivalent feet equals:
35 ft. x 2.2 ft./ft. + 2 elbows x 12.1 ft./elbow + 19.7 ft. = **121 feet > 80 feet --FAIL--**

i) Total equivalent feet of intake (6-inch) and vent (6-inch) = **10 ft. + 17 ft. = 27 ft. --OK--**
ii) Total equivalent feet of intake (6-inch) and vent (4-inch) = **10 ft. + 121 ft. = 131 ft. > 80 feet --FAIL--**

Only the 6-inch design is approved. Note that the 4" vent pipe design failed even though the total equivalent feet for the combined intake and vent system was less than 140 feet. The 4 inch vent design exceeded the equivalent 80 foot maximum.