Combustion Air Code Requirements

- Dual Secretariats
  - AGA: ASC Z223
  - NFPA: NFPA 54
- ANSI Standard since 1974
- Natural Gas and LP systems and appliances
- Listed appliances require the use of NFGC
- Combustion air - basis for most of U.S. requirements
Combustion Air Code Requirements

Same combustion air requirements is in all model fuel gas installation codes
Combustion Air - General

Section 9.3 - Allows multiple methods

9.3* Air for Combustion and Ventilation.

9.3.1 General.

9.3.1.1 Air for combustion, ventilation, and dilution of flue gases for appliances installed in buildings shall be obtained by application of one of the methods covered in 9.3.2 through 9.3.6. Where the requirements of 9.3.2 are not met, outdoor air shall be introduced in accordance with methods covered in 9.3.3 through 9.3.6.

Exception No. 1: This provision shall not apply to direct vent appliances.

Exception No. 2: Type 1 clothes dryers that are provided with makeup air in accordance with Section 10.4.3.

Does not apply to: Direct Vent Appliances & Clothes Dryers
**Combustion Air - General**

9.3.1.2 Appliances of other than natural draft design and other than category I vented appliances shall be provided with combustion, ventilation and dilution air in accordance with the appliance manufacturer’s instructions.

9.3.1.3 Appliances shall be located so as not to interfere with proper circulation of combustion, ventilation, and dilution air.

9.3.1.4 Where used, a draft hood or a barometric draft regulator shall be installed in the same room or enclosure as the appliance served so as to prevent any difference in pressure between the hood or regulator and the combustion air supply.

9.3.1.5 Where exhaust fans, clothes dryers, and kitchen ventilation systems interfere with the operation of appliances, makeup air shall be provided.
9.3.2 Indoor Combustion Air. The required volume of indoor air shall be determined in accordance with method 9.3.2.1 or 9.3.2.2 except that where the air infiltration rate is known to be less than 0.40 ACH, the method 9.3.2.2 shall be used. The total required volume shall be the sum of the required volume calculated for all appliances located within the space. Rooms communicating directly with the space in which the appliances are installed through openings not furnished with doors, and through combustion air openings sized and located in accordance with 9.3.2.3, are considered a part of the required volume.

9.3.2.1* Standard Method: The minimum required volume shall be 50 ft³ per 1,000 Btu/hr (4.8 m³/kW).

Indoor air supply – Two methods to calculate “required volume”

1 - Unknown/Not-Specified infiltration rate

Method based on 0.50 ACH
2. KAIR Method - must use if 0.40 ACH & lower

Calculations based on ACH and whether the appliance is fan-assisted or has a draft hood

Fan-Assisted found to require less air – no dilution air

Upper ACH limit on use of KAIR method
Combustion Air – Taken from the Indoors

9.3.2.3 Indoor Opening Size and Location. Openings used to connect indoor spaces shall be sized and located in accordance with the following:

(1) *Combining spaces on the same story.* Each opening shall have a minimum free area of 1 in.²/1,000 Btu/hr (2,200 mm²/kW) of the total input rating of all appliances in the space but not less than 100 in.² (0.06 m²). One opening shall commence within 12 in. (300 mm) of the top of the enclosure and one opening shall commence within 12 in. (300 mm) of the bottom of the enclosure. The minimum dimension of air openings shall be not less than 3 in. (80 mm).

(2) *Combining spaces in different stories.* The volumes of spaces in different stories shall be considered as communicating spaces where such spaces are connected by one or more openings in doors or floors having a total minimum free area of 2 in.²/1,000 Btu/hr (4,400 mm²/kW) of total input rating of all appliances.

Combining indoor spaces to meet the required volume is allowed.

Spaces on the same floor:
- Two openings required
- One upper & one lower
- Minimum size of 100 in²

Spaces on different floor:
- One or two openings
- Total size equals on the same floor
Outdoor Air Requirements – Require openings to the outdoors

Opening Options:
- Two openings
- One opening

Two openings:
- One upper & one lower
- Different sizing depending on type

9.3.3 Outdoor Combustion Air. Outdoor combustion air shall be provided through opening(s) to the outdoors in accordance with the methods in 9.3.3.1 or 9.3.3.2. The minimum dimension of air openings shall not be less than 3 in. (80 mm).

9.3.3.1 Two Permanent Openings Method: Two permanent openings, one commencing within 12 in. (300 mm) of the top and one commencing within 12 in. (300 mm) of the bottom, of the enclosure, shall be provided. The openings shall communicate directly, or by ducts, with the outdoors or spaces that freely communicate with the outdoors, as follows:

(1)* Where directly communicating with the outdoors or where communicating to the outdoors through vertical ducts, each opening shall have a minimum free area of 1 in.²/4,000 Btu/hr (550 mm²/kW) of total input rating of all appliances in the enclosure.

(2)* Where communicating with the outdoors through horizontal ducts, each opening shall have a minimum free area of 1 in.²/2,000 Btu/hr (1,100 mm²/kW) of total input rating of all appliances in the enclosure.
Combustion Air – Taken from the Outdoors

Single High Opening
- Larger opening size
- Located high

9.3.3.2* One Permanent Opening Method: One permanent opening, commencing within 12 in. (300 mm) of the top of the enclosure, shall be provided. The appliance shall have clearances of at least 1 in. (25 mm) from the sides and back and 6 in. (150 mm) from the front of the appliance. The opening shall directly communicate with the outdoors or shall communicate through a vertical or horizontal duct to the outdoors or spaces that freely communicate with the outdoors and shall have a minimum free area of the following:

1. 1 in.$^2$/3,000 Btu/hr (700 mm$^2$/kW) of the total input rating of all appliances located in the enclosure, and
2. Not less than the sum of the areas of all vent connectors in the space.
Combining indoor volume and outdoor opening is allowed.

Allows smaller outdoor openings based on available indoor volume.

9.3.4 Combination Indoor and Outdoor Combustion Air. The use of a combination of indoor and outdoor combustion air shall be in accordance with the following:

1. **Indoor Openings.** Where used, openings connecting the interior spaces shall comply with Section 9.3.2.3.

2. **Outdoor Opening(s) Location.** Outdoor opening(s) shall be located in accordance with Section 9.3.3.

3. **Outdoor Opening(s) Size.** The outdoor opening(s) size shall be calculated in accordance with the following:
   
   a. The ratio of interior spaces shall be the available volume of all communicating spaces divided by the required volume.
   
   b. The outdoor size reduction factor shall be 1 minus the ratio of interior spaces.
   
   c. The minimum size of outdoor opening(s) shall be the full size of outdoor opening(s) calculated in accordance with Section 9.3.3, multiplied by the reduction factor. The minimum dimension of air openings shall not be less than 3 in. (80 mm).
Combustion air openings serve three main purposes:
1. Provide combustion/dilution air to help ensure complete combustion and proper venting
2. Provide appliance ventilation to help cool controls and components
3. Provide a safety valve in the event of a blocked vent -
   • Upper opening allows spilled flue gases to exit room
   • Bottom opening (or the larger upper in a one opening system) allows sufficient fresh air to enter the room to help ensure complete combustion.
Combustion Air – Other Methods

Other combustion air options allowed:
• Engineered
• Mechanical

9.3.5 Engineered Installations. Engineered combustion air installations shall provide adequate supply of combustion, ventilation and dilution air and shall be approved by the authority having jurisdiction.

9.3.6 Mechanical Combustion Air Supply. Where all combustion air is provided by a mechanical air supply system, the combustion air shall be supplied from outdoors at the minimum rate of 0.35 ft³/min per 1,000 Btu/hr (0.034 m³/min per kW) for all appliances located within the space.

9.3.6.1 Where exhaust fans are installed, additional air shall be provided to replace the exhausted air.

9.3.6.2 Each of the appliances served shall be interlocked to the mechanical air supply system to prevent main burner operation where the mechanical air supply system is not in operation.

9.3.6.3 Where combustion air is provided by the building’s mechanical ventilation system, the system shall provide the specified combustion air rate in addition to the required ventilation air.
Requirements for louver, grilles and screens
• Size based on free opening
• Minimum mesh size
• Mechanical Interlocking
9.3.8 Combustion Air Ducts. Combustion air ducts shall comply with 9.3.8.1 through 9.3.8.8.

9.3.8.1 Ducts shall be constructed of galvanized steel or a material having equivalent corrosion resistance, strength and rigidity.

Exception: Within dwellings units, unobstructed stud and joist spaces shall not be prohibited from conveying combustion air, provided that not more than one fireblock is removed.

9.3.8.2 Ducts shall terminate in an unobstructed space, allowing free movement of combustion air to the appliances.
9.3.8.3 Ducts shall serve a single space.

9.3.8.4 Ducts shall not service both upper and lower combustion air openings where both such openings are used. The separation between ducts serving upper and lower combustion air openings shall be maintained to the source of combustion air.

9.3.8.5 Ducts shall not be screened where terminating in an attic space.

9.3.8.6 Horizontal upper combustion air ducts shall not slope downward toward the source of combustion air.

9.3.8.7 The remaining space surrounding a chimney liner, gas vent, special gas vent, or plastic piping installed within a masonry, metal or factory built chimney shall not be used to supply combustion air.

Exception: Direct vent appliances designed for installation in a solid fuel-burning fireplace where installed in accordance with the manufacturer’s installation instructions.

9.3.8.8 Combustion air intake openings located on the exterior of the building shall have the lowest side of the combustion air intake openings located at least 12 in. (300 mm) vertically from the adjoining finished ground level.
Chapter 11 – Procedures to place appliances in operation

Includes draft check
• 5 minutes after start

Annex G – suggested method
Annex G – Recommended Procedure

Applies to furnaces and boilers
Includes draft testing procedure
Annex G - Basic Draft Test Procedure

Step 1
- Close all doors and windows
- Close fireplace damper
- Operate all air exhausting equipment

Step 2
- Turn on first appliance
- Check burner/flame for proper operation/appearance

Step 3
- Check draft after 5 minutes
  - If OK – Begin Step 4
  - If Not OK – Correct combustion air in accordance with 9.3

Step 4
- Turn on all other appliances located in the same room
- Recheck draft
ANSI Z223.1/NFPA 54 National Fuel Gas Code

- ANSI Standard since 1974
- All listed gas appliances refer to NFGC
- Requirements for use of indoor volume and outdoor air for combustion
- Requires a safety inspections including draft
- Requires make-up air for exhausting air equipment