(This foreword is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

FOREWORD
Addendum b corrects and clarifies the method for determining the inlet air density for single- and multiple-nozzle chambers.

Informative Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and strikethrough (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum b to Standard 41.2-2022

Revise Section 9.3.6.1 as shown.

Revise Section 9.3.6.3.4 as shown.

Revise Section 9.3.6.3 as shown.

Revise Section 9.3.6.1 as shown.

9.3.6.1 Measurements. Measurements required for nozzle airflow calculations are as follows:

a. Inlet duct geometrically equivalent diameter $D_E$, m (ft)
b. Nozzle throat diameter $d$, m (ft)
c. Nozzle inlet absolute pressure $p_1$, Pa (in. of water)
d. Nozzle differential pressure $\Delta p = (p_1 - p_2)$, Pa (in. of water)
e. Nozzle inlet dry-bulb temperature $t_1$, °C (F)
f. Nozzle inlet humidity measurement in the form of relative humidity, dew-point temperature, or wet-bulb temperature in compliance with ANSI/ASHRAE Standard 41.64 is required unless dry air is used for the test.

Informative Note: As prescribed in Section 5.3.2.9, obtain nozzle inlet density for dry and moist air from ASHRAE RP-1485 using nozzle inlet absolute pressure, temperature, and humidity.

9.3.6.3.4 Volumetric Airflow Rates for a Single-Nozzle Duct. Single-nozzle duct volumetric airflow rates shall be obtained from Equation 9-21 in SI units or Equation 9-22 in I-P units.

In SI units:

$$Q = C A E \frac{2(\Delta p)}{\sqrt[4]{\rho_1(1 - E \beta^4)}}$$

where

$Q$ = nozzle volumetric airflow rate, m$^3$/s

$C$ = nozzle discharge coefficient, dimensionless

$A$ = nozzle throat area, m$^2$

$\varepsilon$ = nozzle expansibility factor, dimensionless

$\Delta p$ = nozzle differential pressure, Pa

$\rho_1$ = nozzle inlet air density for dry or moist air, kg/m$^3$

$E$ = flow kinetic energy coefficient = 1.043$^7$

$\beta$ = $d/D_h$, dimensionless

Informative Note: The superscript “7” in “1.043$^7$” above is reference number, not an exponent.

In I-P units:

$$Q = 1097.8 C A E \frac{\Delta p}{\sqrt[4]{\rho_1(1 - E \beta^4)}}$$

where

$Q$ = nozzle volumetric airflow rate, cfm

$C$ = nozzle discharge coefficient, dimensionless

$A$ = nozzle throat area, ft$^2$
ε \quad = \quad \text{nozzle expansibility factor, dimensionless}

Δp \quad = \quad \text{nozzle differential pressure, in. of water}

ρ_1 \quad = \quad \text{nozzle inlet air density for dry or moist air, lbm/ft}^3

E \quad = \quad \text{flow kinetic energy coefficient } = 1.043^7, \text{ dimensionless}

β \quad = \quad \frac{d}{D_h}, \text{ dimensionless}

1097.8 \quad = \quad \text{units conversion coefficient, dimensionless}

Informative Note: The superscript “7” in “1.043^7” above is reference number, not an exponent.

Revise Section 9.3.6.3.9 as shown.

9.3.6.3.9 Mass Airflow Rate for a Single-Nozzle Duct. The mass airflow rate for single nozzles shall be obtained from Equation 9-27, where ρ_1 is the nozzle inlet air density for dry or moist air, kg/m³ (lbm/ft³) and Q is the volumetric airflow rate, m³/s (cfm), using Equation 9-21 in SI units or Equation 9-22 in I-P units.

\[ m = ρ_1 Q \quad \text{kg/s (lbm/min)} \quad (9-27) \]

Informative Note: The superscript “7” in “1.043^7” above is reference number, not an exponent.

Revise Section 9.3.6.4.7 as shown.

9.3.6.4.7 Volumetric Airflow Rate for Single- and Multiple-Nozzle Chambers. The volumetric airflow rate for single- and multiple-nozzle chambers shall be obtained from Equation 9-33 in SI units or from Equation 9-34 in I-P units where the area is measured at the plane of the throat taps or nozzle exit for nozzles without throat taps.\(^7\) The denominator in these equations includes the term \((1 - E\beta^4)\). However, \(\beta = 0\) for single- and multiple-nozzle chambers, so \((1 - E\beta^4) = 1\), and Equations 9-32 and 33 become Equations 9-34 and 9-35.

In SI units:

\[ Q = \frac{\sum_{i=1}^{N} (C_i \varepsilon_i) \left( \frac{2\Delta p}{\eta_1 (1 - E\beta^4)} \right)}{\varepsilon_i} \quad (9-32) \]

where

\[ Q = \quad \text{volumetric flow rate, m}^3/\text{s} \]

\[ N = \quad \text{number of nozzles in use, dimensionless} \]

\[ C = \quad \text{discharge coefficient, dimensionless} \]

\[ A = \quad \text{nozzle throat area, m}^2 \]

\[ \varepsilon = \quad \text{nozzle expansibility factor, dimensionless} \]

\[ \Delta p = \quad \text{nozzle differential pressure, Pa} \]

\[ \rho_1 = \quad \text{nozzle inlet air density for dry or moist air, kg/m}^3 \]

\[ E = \quad \text{flow kinetic energy coefficient } = 1.043^7, \text{ dimensionless} \]

\[ \beta = \quad 0 \]

Informative Note: The superscript “7” in “1.043^7” above is reference number, not an exponent.

In I-P units:

\[ Q = \frac{1097.8 \left[ \sum_{i=1}^{N} (C_i \varepsilon_i) \right] \left( \frac{\Delta p}{\eta_1 (1 - E\beta^4)} \right)}{\varepsilon_i} \quad (9-33) \]

where

\[ Q = \quad \text{nozzle volumetric flow rate, cfm} \]

\[ N = \quad \text{number of nozzles in use, dimensionless} \]

\[ C = \quad \text{discharge coefficient, dimensionless} \]

\[ A = \quad \text{nozzle throat area, ft}^2 \]

\[ \varepsilon = \quad \text{expansibility coefficient, dimensionless} \]

\[ \Delta p = \quad \text{nozzle differential pressure, (in. of water)} \]

\[ \rho_1 = \quad \text{nozzle inlet air density for dry or moist air, lbm/ft}^3 \]

\[ E = \quad \text{flow kinetic energy coefficient } = 1.043^7, \text{ dimensionless} \]
\[ \beta = 0 \]

1097.8 = units conversion coefficient, dimensionless

**Informative Note:** The superscript “7” in “1.0437” above is reference number, not an exponent.

In SI units:

\[
Q = \left[ \sum_{i=1}^{N} \left( C_i A_i \varepsilon_i \right) \right] \frac{\sqrt{\Delta p}}{\rho_1} \quad (9-34)
\]

where

- \( Q \) = volumetric flow rate, m³/s
- \( N \) = number of nozzles in use, dimensionless
- \( C \) = discharge coefficient, dimensionless
- \( A \) = nozzle throat area, m²
- \( \varepsilon \) = nozzle expansibility factor, dimensionless
- \( \Delta p \) = nozzle differential pressure, Pa
- \( \rho_1 \) = nozzle inlet air density for dry or moist air, kg/m³

In I-P units:

\[
Q = 1097.8 \left[ \sum_{i=1}^{N} \left( C_i A_i \varepsilon_i \right) \right] \frac{\sqrt{\Delta p}}{\rho_1} \quad (9-35)
\]

where

- \( Q \) = nozzle volumetric flow rate, cfm
- \( N \) = number of nozzles in use, dimensionless
- \( C \) = discharge coefficient, dimensionless
- \( A \) = nozzle throat area, ft²
- \( \varepsilon \) = expansibility factor, dimensionless
- \( \Delta p \) = nozzle differential pressure, (in. of water)
- \( \rho_1 \) = nozzle inlet air density for dry or moist air, lbm/ft³
- 1097.8 = units conversion coefficient, dimensionless

**Revise Section 9.3.6.4.8 as shown.**

**9.3.6.4.8 Standard Airflow Rate for Single- and Multiple-Nozzle Chambers.** The standard airflow rate for single- and multiple-nozzle chambers shall be calculated in compliance with Section 4.5 using Equation 9-34 in SI units or Equation 9-35 in I-P units where \( \rho_1 \) = air density for dry or moist air, kg/m³ (lbm/ft³)

\[
\text{Standard cubic metres/second} = \rho_1 Q/1.202 
\quad (9-36)
\]

\[
\text{Standard cubic feet/minute (scfm)} = \rho_1 Q/0.075 
\quad (9-37)
\]

**Revise Section 9.3.6.4.9 as shown.**

**9.3.6.4.9 Mass Airflow Rate for Single- and Multiple-Nozzle Chambers.** The mass airflow rate for single- and multiple-nozzle chambers shall be obtained from Equation 9-38, where \( \rho_1 \) is the nozzle inlet air density for dry or moist air, kg/m³ (lbm/ft³) and \( Q \) is the volumetric airflow rate using Equation 9-34 in SI units or Equation 9-35 in I-P units.

\[
\dot{m} = \rho_1 Q \quad \text{kg/s (lbm/min)} 
\quad (9-38)
\]

**In Normative Appendix F, revise Section F3.1 as shown.**

**F3.1 Measurements.** Measurements required for nozzle airflow calculations are as follows:

a. Inlet duct geometrically equivalent diameter \( D_E \), m (ft)

b. Throat diameter \( d \), m (ft)

c. Inlet absolute pressure \( p_1 \), Pa (in. of water)

d. Differential pressure \( \Delta p = (p_1 - p_2) \), (in. of water)

e. Inlet dry-bulb temperature, \( t_1 \) °C (°F)
f. Inlet humidity measurement in the form of relative humidity, dew-point temperature, or wet-bulb temperature in compliance with ASHRAE Standard 41.6 is required unless dry air is used for the test.

**In Normative Appendix F**, revise Section F4.7 as shown.

**F4.7 Volumetric Airflow Rate for Single- and Multiple-Nozzle Chambers.** The volumetric airflow rate for single- or multiple-nozzle chambers shall be obtained from Equation F-8 in SI units or from Equation F-9 in I-P units where the area is measured at the plane of the throat taps or nozzle exit for nozzles without throat taps.\(^7\) The denominator in these equations includes the term \((1-E\beta^4)\). However, \(\beta = 0\) for single- and multiple-nozzle chambers, so \((1-E\beta^4) = 1\), and Equations F-8 and F-9 become Equations F-10 and F-11.

\[
Q = \left[ \sum_{i=1}^{N} (C_i A_i \varepsilon_i) \right] \frac{2\Delta p}{\rho_1 (1 - E\beta^4)} \text{ m}^3/\text{s} \quad \text{(F-8)}
\]

where
\[
\begin{align*}
Q &= \text{volumetric flow rate, m}^3/\text{s} \\
N &= \text{number of nozzles in use, dimensionless} \\
C &= \text{discharge coefficient, dimensionless} \\
A &= \text{nozzle throat area, m}^2 \\
\varepsilon &= \text{nozzle expansibility factor, dimensionless} \\
\Delta p &= \text{nozzle differential pressure, Pa} \\
\rho_1 &= \text{nozzle inlet air density for dry or moist air, kg/m}^3 \\
E &= \text{flow kinetic energy coefficient} = 1.043^7, \text{dimensionless} \\
\beta &= 0
\end{align*}
\]

**Informative Note:** The superscript “7” in “1.043\(^7\)” above is reference number, not an exponent.

\[
Q = \frac{1097.8 \left[ \sum_{i=1}^{N} (C_i A_i \varepsilon_i) \right] \sqrt{\frac{\Delta p}{\rho_1}}}{\text{ cfm} \quad \text{(F-9)}}
\]

where
\[
\begin{align*}
Q &= \text{nozzle volumetric flow rate, cfm} \\
N &= \text{number of nozzles in use, dimensionless} \\
C &= \text{discharge coefficient, dimensionless} \\
A &= \text{nozzle throat area, ft}^2 \\
\varepsilon &= \text{expansibility factor, dimensionless} \\
\Delta p &= \text{nozzle differential pressure, (in. of water)} \\
\rho_1 &= \text{nozzle inlet air density for dry or moist air, lbm/ft}^3 \\
E &= \text{flow kinetic energy coefficient} = 1.043^7, \text{dimensionless} \\
\beta &= 0 \\
1097.8 &= \text{units conversion coefficient, dimensionless}
\end{align*}
\]

**Informative Note:** The superscript “7” in “1.043\(^7\)” above is a reference number, not an exponent.

\[
Q = \left[ \sum_{i=1}^{N} (C_i A_i \varepsilon_i) \right] \frac{2\Delta p}{\rho_1} \text{ m}^3/\text{s} \quad \text{(F-10)}
\]

where
\[
\begin{align*}
Q &= \text{volumetric flow rate, m}^3/\text{s} \\
N &= \text{number of nozzles in use, dimensionless} \\
C &= \text{discharge coefficient, dimensionless} \\
A &= \text{nozzle throat area, m}^2 \\
\varepsilon &= \text{nozzle expansibility factor, dimensionless} \\
\Delta p &= \text{nozzle differential pressure, Pa} \\
\rho_1 &= \text{nozzle inlet air density for dry or moist air, kg/m}^3
\end{align*}
\]

\[
Q = \frac{1097.8 \left[ \sum_{i=1}^{N} (C_i A_i \varepsilon_i) \right] \sqrt{\frac{\Delta p}{\rho_1}}}{\text{ cfm} \quad \text{(F-11)}}
\]
where

\[ Q = \text{nozzle volumetric flow rate, cfm} \]
\[ N = \text{number of nozzles in use, dimensionless} \]
\[ C = \text{discharge coefficient, dimensionless} \]
\[ A = \text{nozzle throat area, ft}^2 \]
\[ \varepsilon = \text{expansibility factor, dimensionless} \]
\[ \Delta p = \text{nozzle differential pressure, (in. of water)} \]
\[ \rho_1 = \text{nozzle inlet air density for dry or moist air, lbm/ft}^3 \]
\[ 1097.8 = \text{units conversion coefficient, dimensionless} \]

In Normative Appendix F, revise Section F3.1 as shown.

F4.9 Mass Airflow Rate for Single- and Multiple-Nozzle Chambers. The mass airflow rate for multiple-nozzle chambers shall be obtained from Equation F-14, where \( \rho_1 \) is the nozzle inlet air density for dry or moist air in SI units or IP units, and \( Q \) is the volumetric airflow rate in SI units in Equation F-10 in SI units or F-11 in IP units.

\[
\dot{m} = \rho_1 Q \text{ kg/s (lbm/min)}
\] (F-14)
ASHRAE is concerned with the impact of its members’ activities on both the indoor and outdoor environment. ASHRAE’s members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted Standards and the practical state of the art.

ASHRAE’s short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the Standards and Guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive Technical Committee structure, continue to generate up-to-date Standards and Guidelines where appropriate and adopt, recommend, and promote those new and revised Standards developed by other responsible organizations.

Through its Handbook, appropriate chapters will contain up-to-date Standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating Standards and Guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system’s intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE’s primary concern for environmental impact will be at the site where equipment within ASHRAE’s scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.
About ASHRAE

Founded in 1894, ASHRAE is a global professional society committed to serve humanity by advancing the arts and sciences of heating, ventilation, air conditioning, refrigeration, and their allied fields.

As an industry leader in research, standards writing, publishing, certification, and continuing education, ASHRAE and its members are dedicated to promoting a healthy and sustainable built environment for all, through strategic partnerships with organizations in the HVAC&R community and across related industries.

To stay current with this and other ASHRAE Standards and Guidelines, visit www.ashrae.org/standards, and connect on LinkedIn, Facebook, Twitter, and YouTube.

Visit the ASHRAE Bookstore

ASHRAE offers its Standards and Guidelines in print, as immediately downloadable PDFs, and via ASHRAE Digital Collections, which provides online access with automatic updates as well as historical versions of publications. Selected Standards and Guidelines are also offered in redline versions that indicate the changes made between the active Standard or Guideline and its previous version. For more information, visit the Standards and Guidelines section of the ASHRAE Bookstore at www.ashrae.org/bookstore.

IMPORTANT NOTICES ABOUT THIS STANDARD

To ensure that you have all of the approved addenda, errata, and interpretations for this Standard, visit www.ashrae.org/standards to download them free of charge.

Addenda, errata, and interpretations for ASHRAE Standards and Guidelines are no longer distributed with copies of the Standards and Guidelines. ASHRAE provides these addenda, errata, and interpretations only in electronic form to promote more sustainable use of resources.