STANDARD

ANSI/AMCA Standard 220-21

Laboratory Methods of Testing Air Curtain Units for Aerodynamic Performance Rating

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ANSI Accredited Standards Developer

Air Movement and Control Association International

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Contents

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Laboratory Methods of Testing Air Curtain Units for Aerodynamic Performance Rating

1. Purpose

The purpose of this standard is to establish uniform methods for laboratory testing of air curtain units (ACUs) to determine aerodynamic performance in terms of *airflow* rate, ACU outlet air velocity uniformity, electrical power consumption and air velocity projection for rating, guarantee or code compliance purposes.

It is not the purpose of this standard to specify the testing procedures to be used for design, production or field testing.

2. Scope

The scope of this standard covers the performance testing of ACUs.

3. Normative References

The following standard contains provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below.

ANSI/AMCA Standard 210-16, Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating

4. Definitions/Units of Measure/Symbols

4.1 Definitions

4.1.1 Absolute pressure
The value of a pressure when the datum pressure is absolute zero. It is always positive.

4.1.2 ACU
See air curtain unit (ACU).

4.1.3 Air curtain (ACU airstream)
A directionally controlled airstream with a minimum width-to-depth aspect ratio of 5:1. When applied across the entire height and width of an opening, an air curtain reduces the infiltration or transfer of air from one side of the opening to the other and inhibits the passage of insects, dust or debris. For the purposes of this standard, “air curtain” and “ACU airstream” are synonymous.

4.1.4 Air curtain average core velocity (V_{ca})
The average of air curtain core velocities measured along the air curtain width at a defined plane. For the purposes of this standard, measurement planes are defined per Section 8.2.3.

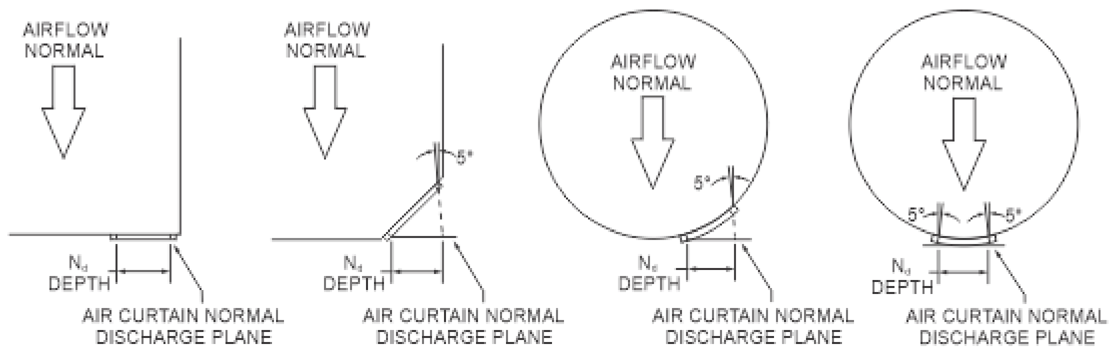
4.1.5 Air curtain average outlet air velocity (V_a)
The airflow rate of an air curtain per unit area of discharge, calculated when the airflow rate is divided by the air curtain discharge area.

4.1.6 Air curtain core velocity (V_{cx})
The maximum air velocity of the air curtain as measured across the air curtain depth at a specified distance from the discharge nozzle. For the purposes of this standard, the measurement test lines (*x*) are defined per Section 8.2.1.

4.1.7 Air curtain discharge angle (θ)
The angle between the ACU normal or plane of the protected opening and the direction in which the airstream leaves the discharge nozzle.

4.1.8 Air curtain discharge area (A_n)
The cross section of the air curtain on the air curtain normal discharge plane. If the ACU discharge nozzle is coplanar with the air curtain normal discharge plane, it shall be equal to the area of the discharge nozzle. If the ACU discharge nozzle is not coplanar with the air curtain normal discharge plane, it shall be equal to the area of the discharge nozzle's projection onto the air curtain normal discharge plane measured from the leading edge of the ACU discharge nozzle to the projection of a 5° line from the trailing edge(s).

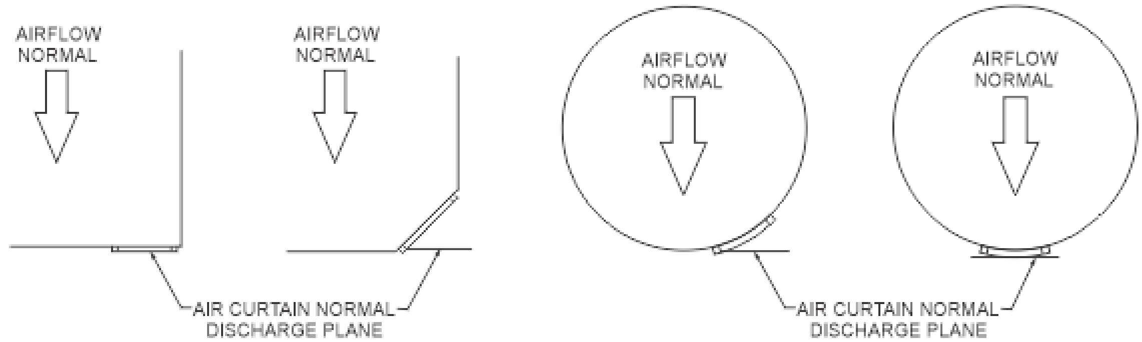
4.1.9 Air curtain depth (N_d)
The short dimension of the air curtain measured on the air curtain normal discharge plane. If the ACU discharge nozzle is rectangular and coplanar with the air curtain normal discharge plane, it shall be equal to the ACU discharge nozzle depth. For coplanar, nonrectangular constructions, it shall be equal to the largest value of the short dimension of the ACU discharge nozzle. For nonplanar constructions, it shall be the depth measured on the air curtain normal discharge plane from the leading edge of the ACU discharge nozzle to the projection of a 5° line from the trailing edge. See Annex A for additional examples.



Note – the grills illustrated in the above examples are not indicative of all constructions and are only used to illustrate the measurement location of the leading and trailing edges of the discharge nozzle.

Figure 4.1—Air Curtain Depth

4.1.10 Air curtain normal discharge plane
The plane perpendicular to the airflow normal (0° discharge angle) created by the cross section of the air curtain. It is located at the leading edge of the ACU discharge nozzle.



Note – the grills illustrated in the above examples are not indicative of all constructions and are only used to illustrate the measurement location of the leading and trailing edges of the discharge nozzle.

Figure 4.2—Air Curtain Normal Discharge Plane

4.1.11 Air curtain unit (ACU)
An air-moving device that produces an air curtain (or boundary of air) where its width is at least five times its depth and the discharge is not intended to be connected to unitary ductwork.

4.1.12 ACU airflow rate (*Q*)
The volume of air that passes through a given area in a unit of time. For the purposes of this standard, the given area is the total of all discharge nozzle areas, measured in accordance with ANSI/AMCA Standard 210.

4.1.13 ACU normal (vector)
A vector declared by the sponsor that identifies the ACU cabinet orientation when it is parallel to the plane of the opening it is protecting.

4.1.14 ACU discharge nozzle
A component or an assembly, which may include adjustable vanes, in the ACU; the assembly or component controls and directs the airstream. For the purposes of this standard, if only one discharge nozzle is present, it is considered the primary discharge nozzle. Discharge nozzles are considered “multiple” when they do not share a common discharge plane. The primary discharge nozzle on a system with multiple discharge nozzles is that which is closest to the plane of the protected opening.

4.1.15 ACU inlet area
The total inside net area of all surfaces where entering airflow first meets the ACU cabinet.

4.1.16 ACU outlet air velocity uniformity (*U*)
An indicator of the consistency of discharge air velocities across the air curtain width, expressed as a percentage. Refer to Section 8.2.4 for calculation of the value.

4.1.17 ACU power rating (*W*)
The amount of power, expressed in kW, consumed by the control (if present) and ACU motor(s) at free-air delivery.

4.1.18 ACU target distance
A distance specified by the test sponsor measured from the centerline of the ACU discharge nozzle depth. For the purposes of this standard, the combination of distances defined per Section 7.2.4.4 and the test sponsor determine the target distance(s).

4.1.19 Air curtain velocity projection
The air curtain average core velocity at specified distances from the ACU discharge nozzle’s leading edge. For the purposes of this standard, the measurement test lines are defined per Section 7.2.4.4.

4.1.20 Air curtain width (N_w)
The long dimension of the air curtain measured on the air curtain normal discharge plane. If the ACU discharge nozzle is rectangular and coplanar with the air curtain normal discharge plane, it shall be equal to the ACU discharge nozzle width. For coplanar, nonrectangular constructions, it shall be equal to the largest value of the long dimension of the ACU discharge nozzle. For nonplanar constructions, it shall be the depth measured on the air curtain normal discharge plane from the leading edge of the ACU discharge nozzle to the projection of a 5° line from the trailing edge. See Annex A for additional examples.

4.1.21 Air density (ρ)
The mass per unit volume of air.

4.1.22 Airflow
A flow of air or an air current, specifically one that passes through a dimensionally defined plane.

4.1.23 Barometric pressure (p_b)
The absolute pressure exerted by the atmosphere at a location of measurement.

4.1.24 Determination
The complete set of measurements for a particular test product point of operation. The measurements must be sufficient to determine all performance variables.

4.1.25 Dry-bulb temperature (t_d)
Air temperature measured by a temperature-sensing device without modification to compensate for the effect of humidity.

4.1.26 Free-air delivery
The point of operation where an ACU operates against zero static gauge pressure.

4.1.27 Gauge pressure
The differential pressure between a reference pressure, such as barometric pressure, and the absolute pressure at the point of measurement. It may be positive or negative.

4.1.28 Point of operation
The point on an ACU performance curve corresponding to a particular airflow rate, pressure and power consumption.

4.1.29 Pressure
Force per unit area.

4.1.30 Pressure loss
A specific case of pressure differential. It is the decrease in pressure caused by friction and turbulence.

4.1.31 Stagnation temperature
The temperature that exists by virtue of the air's internal and kinetic energy. If the air is at rest, the stagnation temperature will equal the static temperature.

4.1.32 Standard air
Air having a density of 1.2 kg/m^3 (0.075 lbm/ft^3), a specific heat ratio of 1.4, a viscosity of 1.819 × 10^{-5} Pa·s (1.222 × 10^{-5} lbm/(ft·s)) and an *absolute pressure* of 101.325 kPa (406.78 in. wg). Air at 20°C (68°F), 50% relative humidity and 101.325 kPa (29.92 in. Hg) has these properties, approximately.

4.1.33 Static pressure
The *pressure* that exists by degree of compression only. If expressed as *gauge pressure*, it may be positive or negative.

4.1.34 Static temperature
The temperature that exists by virtue of the internal energy of the air alone. If a portion of the energy is converted to kinetic energy, the *static temperature* is decreased accordingly.

4.1.35 Test
A series of *determinations* for various points of a device's operation.

4.1.36 Total pressure
The air pressure that exists by virtue of the degree of compression and rate of motion of flowing air. Total pressure is equal to the algebraic sum of the velocity pressure and the static pressure at a point. Thus, if the air is at rest, the total pressure will equal the static pressure.

4.1.37 Velocity (dynamic) pressure (P_v)
Pressure that exists by virtue of rate of motion only.

4.1.38 Wet-bulb depression
The difference between the dry- and wet-bulb temperatures at the same location.

4.1.39 Wet-bulb temperature (t_w)
The temperature measured via a temperature sensor covered by a water-moistened wick and exposed to air in motion. Wet-bulb temperature is a close approximation of the temperature of adiabatic saturation.

4.2 Symbols and subscripts

Symbol	Description	SI Unit	I-P Unit
A_n	Air curtain discharge area	m^2	ft^2
n	Number of data points	---	---
N	ACU fan shaft speed	rpm	rpm
N_d	Air curtain depth	mm	in.
N_w	Air curtain width	mm	in.
p_b	Barometric pressure	Pa	in. Hg
P_s	Static pressure	Pa	in. wg
P_t	Total pressure	Pa	in. wg
P_v	Velocity pressure	Pa	in. wg
Q	ACU airflow rate	m^3/s	cfm
ρ	Air density	kg/m^3	lbm/ft^3
s	Standard deviation	---	---
θ	Air discharge angle	degrees	degrees
t_d	Dry-bulb temperature	°C	°F
t_w	Wet-bulb temperature	°C	°F
U	ACU outlet air velocity uniformity	%	%
V_a	Velocity, average outlet	m/s	fpm
V_{cx}	Velocity, air curtain core, at point X	m/s	fpm
V_{ca}	Velocity, average (air curtain core)	m/s	fpm
W	ACU power rating	W	W
Wc	Input power to control	W	W
Wm	Input power to motor	W	W

5. Instruments and Methods of Measurement

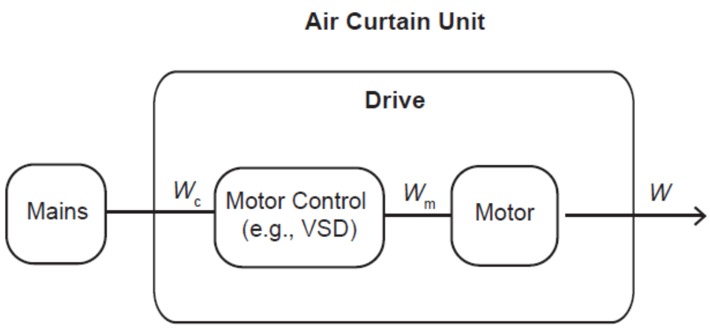
Instruments and methods of measurement shall be in compliance with ANSI/AMCA Standard 210 except where specifically noted.

5.1 Air curtain core velocity measurement

*A*ir curtain core velocity shall be measured with a pitot-static tube and manometer, a hot-wire anemometer or other device that has an accuracy of ±5% of the air velocity being measured. Refer to Section 7.2 for details.

5.2 Power

Power shall be measured with a wattmeter that has a certified accuracy of ±1% of the observed reading. See Figure 5.1.



W shall designate electrical input power; the product of voltage and current; and, in the case of an AC circuit, power factor

Subscripts shall be used in a dynamic sense. For instance,

- W_{mi} indicates a test where motor input power is measured
- W_{cmi} indicates a test where motor control input power is measured

Figure 5.1—Input Power Boundary

6. Equipment and Setups

6.1 Air curtain airflow rate test

The ACU shall be mounted with its inlet(s) sealed to the test chamber in compliance with the requirements of Figure 10.1. The seal shall be adequate to minimize leakage. The primary air discharge nozzle or the nozzle's adjustable vanes shall be set to provide a 15° ± 1° angle as shown in Figure 1B. If the ACU has multiple air discharge nozzles, additional nozzles shall be set to the manufacturer's specifications that meet the requirements dictated by the primary nozzle setting.

6.2 Air velocity projection and ACU outlet air velocity uniformity test

The ACU shall be placed in the testing area in compliance with the requirements of Figure 9.3 so the inlet(s) and outlet discharge nozzle(s) are unrestricted and the air curtain width is perpendicular to the floor. The primary air discharge nozzle or adjustable vanes in the primary air discharge nozzle shall be set to provide a 15° ± 1° air discharge angle as shown in Detail A or B of Figure 1B. Units without an adjustable air discharge nozzle are not required to be angled and shall be mounted so nothing interferes with the airstream for 3000 mm (120 in.). If the ACU has multiple air discharge nozzles, additional nozzles shall be set to the manufacturer's specifications that meet the requirements dictated by the primary nozzle setting.

7. Observations and Conduct of Tests

7.1 Initial conditions
The unit under test shall be energized and operated for not less than 1 min. to allow equilibrium conditions to become established before the first determination.

7.2 Data to be recorded

7.2.1 ACU under test
The following information shall be recorded: manufacturer, trade name, model number, impeller diameter, inlet and outlet areas, number of fans, number of motors and the motor nameplate data.

7.2.2 Test setup
The description of the test setup shall be recorded, including specific dimensions as required per Figures 9.1, 9.2, 9.3, 9.4 and 9.5. Alternately, an annotated photograph of the setup shall be attached to the recorded data.

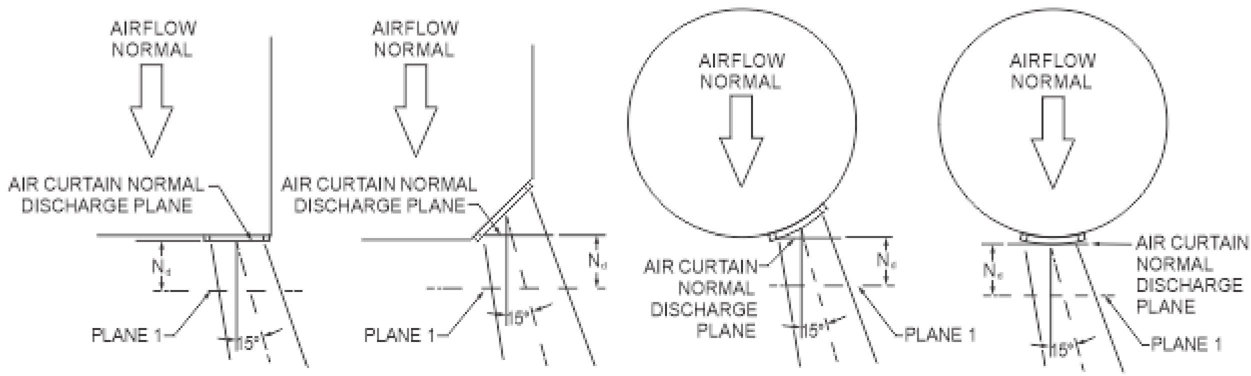
7.2.3 Instruments
The instruments and apparatus used in the test shall be listed. Names, model numbers, serial numbers, scale ranges and calibration information shall be recorded.

7.2.4 Test data

7.2.4.1 Initial and final conditions
Initial and final readings of ambient dry-bulb temperature (t_d), ambient wet-bulb temperature (t_w) and ambient barometric pressure (p_b) shall be recorded for each determination.

7.2.4.2 Airflow rate determination
To establish the airflow rate at free-air delivery, a curve containing a minimum of three determinations is required per ANSI/AMCA Standard 210. See Figures 9.1 and 9.2. The three required determinations include: one determination with the unit working against a pressure of 50 Pa (0.2 in. wg), one against a pressure of 25 Pa (0.1 in. wg) and one against a pressure of 2.5 Pa (0.01 in. wg) or less.

7.2.4.3 ACU outlet air velocity uniformity
The ACU outlet air velocity uniformity *test* shall be based on air curtain core velocity measurements taken on a minimum of five equally spaced test lines on Plane 1. Plane 1 shall be located at a distance equal to one air curtain depth away from the air curtain normal discharge plane. The test line locations at the two ends of the plane shall be one air curtain depth in from each end of the active nozzle as shown in Figure 3. The remaining test line locations shall be equally spaced, and each space shall not exceed 100 mm (4 in.). The maximum air curtain core velocity readings along each test line within the plane shall be recorded. For ACUs with multiple nozzles, a *test* shall be performed for each respective nozzle.



Note – the grills illustrated in the above examples are not indicative of all constructions and are only used to illustrate the measurement location of the leading and trailing edges of the discharge nozzle.

Figure 7.1—Location of Plane 1

7.2.4.4 Air curtain velocity projection test

The air velocity projection test shall be based on air curtain core velocity measurements taken on a minimum of three planes parallel to the air curtain normal discharge plane as shown in Figure 4. The air curtain core velocities shall be recorded on a minimum of five equally spaced test lines across each plane. The test line locations at the two ends of each plane shall be located one air curtain depth in from each end as shown in Figure 4. The remaining test line locations shall be equally spaced and each space shall not exceed 100 mm (4 in.). Record the maximum air curtain air core velocity reading along the test lines within each plane. For ACUs with multiple nozzles, a test shall be performed for each respective nozzle. If all nozzles *are* designed to be run simultaneously, then all shall be operational for each individual test.

The sponsor of the test shall determine the number of test planes by specifying an ACU target distance or a target minimum average air curtain core velocity.

7.2.4.4.1 ACU target distance method

The ACU target distance shall be a minimum of 1000 mm (40 in.) from the air curtain normal discharge plane or whole multiples thereof.

For an ACU target distance greater than or equal to 3000 mm (120 in.), the air curtain core velocities shall be measured at Plane 2 [1000 mm (40 in.)], Plane 3 [2000 mm (80 in.)] and Plane 4 [3000 mm (120 in.)]. Additional readings shall be taken at consecutively numbered planes located at 1000 mm (40 in.) intervals until the *ACU target distance* is reached.

For an ACU target distance of 2000 mm (80 in.), the air curtain core velocity shall be measured at Plane 2 [1000 mm (40 in.)], Plane 2A [1500 mm (60 in.)] and Plane 3 [2000 mm (80 in.)].

For an ACU target distance of 1000 mm (40 in.), the air curtain core velocity shall be measured at Plane 1A [500 mm (20 in.)], Plane 2 [1000 mm (40 in.)] and Plane 2A [1500 mm (60 in.)].

7.2.4.4.2 Minimum air curtain core velocity method

The test shall be terminated upon measurement and calculation of a value less than or equal to the specified minimum average air curtain core velocity.

The first reading shall be taken at Plane 2 [1000 mm (40 in.)]. If the reading is less than the minimum specified average core velocity, readings shall be taken at Plane 1A [500 mm (20 in.)] and Plane 1 located N_d from the air curtain normal discharge plane (see Figure 3) and the test concluded.

If the first reading is greater than the minimum specified average core velocity, the second reading shall be taken at Plane 3 [2000 mm (80 in.)]. If the second reading is less than the minimum specified average core velocity, the third reading shall be taken at Plane 2A [1500 mm (60 in.)] and the test concluded.

If the second reading is greater than the minimum specified average core velocity, the third reading shall be taken at Plane 4 [3000 mm (120 in.)]. If the third reading is less than the minimum specified average core velocity, the test is concluded.

If the third reading is still greater than the minimum specified average core velocity, additional readings shall be taken at 1000 mm (40 in.) intervals until the minimum core velocity is attained.

8. Calculations

Calculations, except as noted below, shall be in compliance with the requirements of ANSI/AMCA Standard 210.

8.1 Air curtain average outlet air velocity (*V_a*)
The average outlet air velocity shall be the unit *airflow* rate divided by the air curtain discharge area or:

$$V_a = Q/A_n \qquad \text{Eq. 8.1}$$

8.2 Outlet air velocity

8.2.1 Air curtain core velocity (*V_{cx}*)
The maximum air velocities of the airstream shall be obtained by traversing each test line, *x*, as shown in Figure 3 and recording each maximum reading using instrumentation per Section 5.1. If velocity pressure is measured via pitot static tube or other velocity pressure measuring device, use Equation 8.2.1 to calculate V_{cx}:

$$V_{cx} = \sqrt{\frac{2P_v}{\rho}} \qquad \text{Eq. 8.2.1 (SI)}$$

$$V_{cx} = 1097.8\sqrt{\frac{P_v}{\rho}} \qquad \text{Eq. 8.2.1 (I-P)}$$

8.2.2 Standard deviation (*s*)

$$s = \sqrt{\frac{\sum(V_{cx})^2 - \left[\frac{(\sum V_{cx})^2}{n}\right]}{n-1}} \qquad \text{Eq. 8.2.2}$$

Where *n* = number of test points

8.2.3 Air curtain average *core velocity* (V_{ca})

$$V_{ca} = \frac{\sum V_{cx}}{n} \qquad \text{Eq. 8.2.3}$$

8.2.4 ACU outlet air velocity uniformity (U)

The ACU outlet air velocity uniformity of the ACU shall be expressed as a percentage calculated from the average air curtain core velocity, V_{ca}, and standard deviation, *s,* of Plane 1, Figure 3, using:

$$U = 100 - 100\left(\frac{s}{V_{ca}}\right)\% \qquad \text{Eq. 8.2.4}$$

8.3 Air curtain velocity projection

The air curtain velocity projection shall be the average of the air curtain core velocities, V_{cx}, to determine V_{ca} using Equation 8.2.3, for a set of test planes defined in Section 7.2.4.4.

9. Report and Results

The *test* report shall be presented in consistent units. The following information shall be reported: manufacturer, trade name, model number, impeller diameter, inlet and outlet areas, number of fans, number of motors and the motor nameplate data. The ACU airflow rate shall be presented graphically as shown in Figures 9.6 and 9.7.

In addition, the report shall be in compliance with ANSI/AMCA Standard 210, except as noted in Sections 9.1 and 9.2.

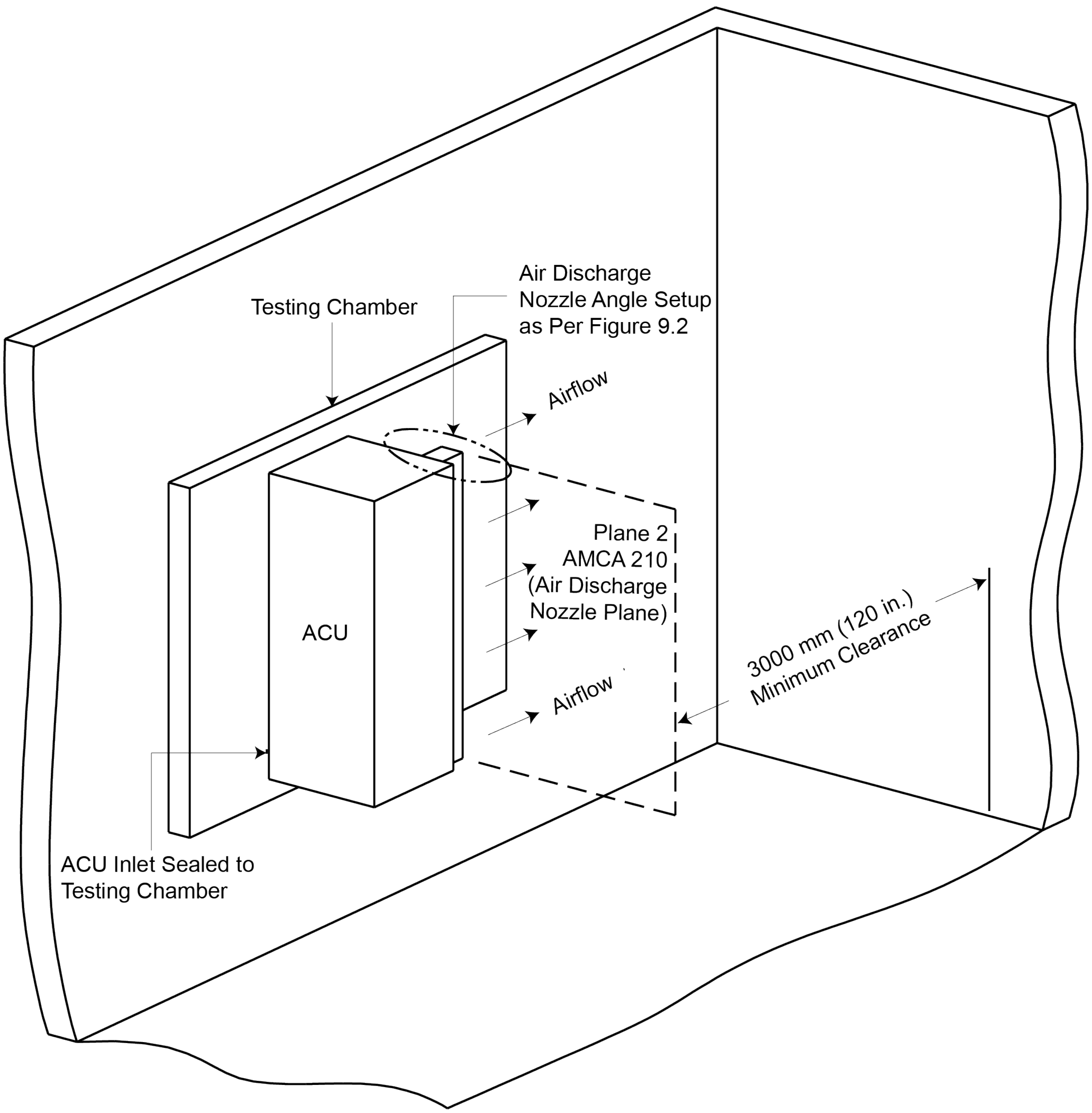
9.1 ACU outlet air velocity uniformity test

The locations and results of the measurements shall be presented in a table with the calculated arithmetic average of the measured results, their standard deviation and uniformity, as shown in Figures 9.8 and 9.9.

9.2 Air velocity projection test

The locations and results of the measurements shall be presented in a table and performance curve meeting the requirements of ANSI/AMCA Standard 210, with the calculated arithmetic average of the measured results, their standard deviation and uniformity for each distance from the air discharge nozzle, as shown in Figures 9.8 through 9.11.

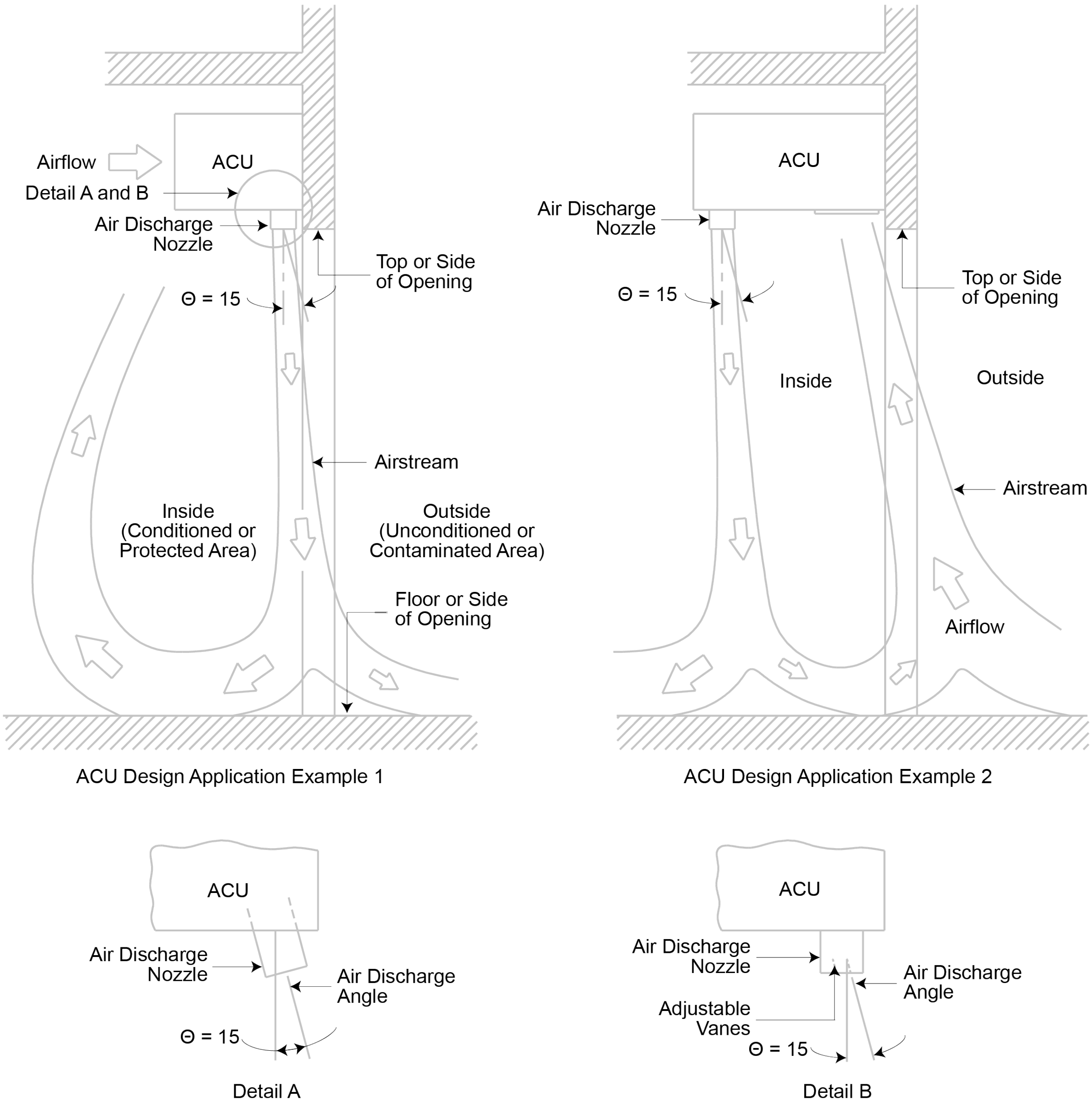
10. Figures



Notes:

1. Unit can be mounted horizontally or vertically.
2. If an ACU has multiple inlets, it shall be mounted so all the inlets are contained within the testing chamber.
3. Air discharge nozzle angle setup shall be per Figure 1B.

Figure 1A — Airflow Rate Test Setup



Definitions:

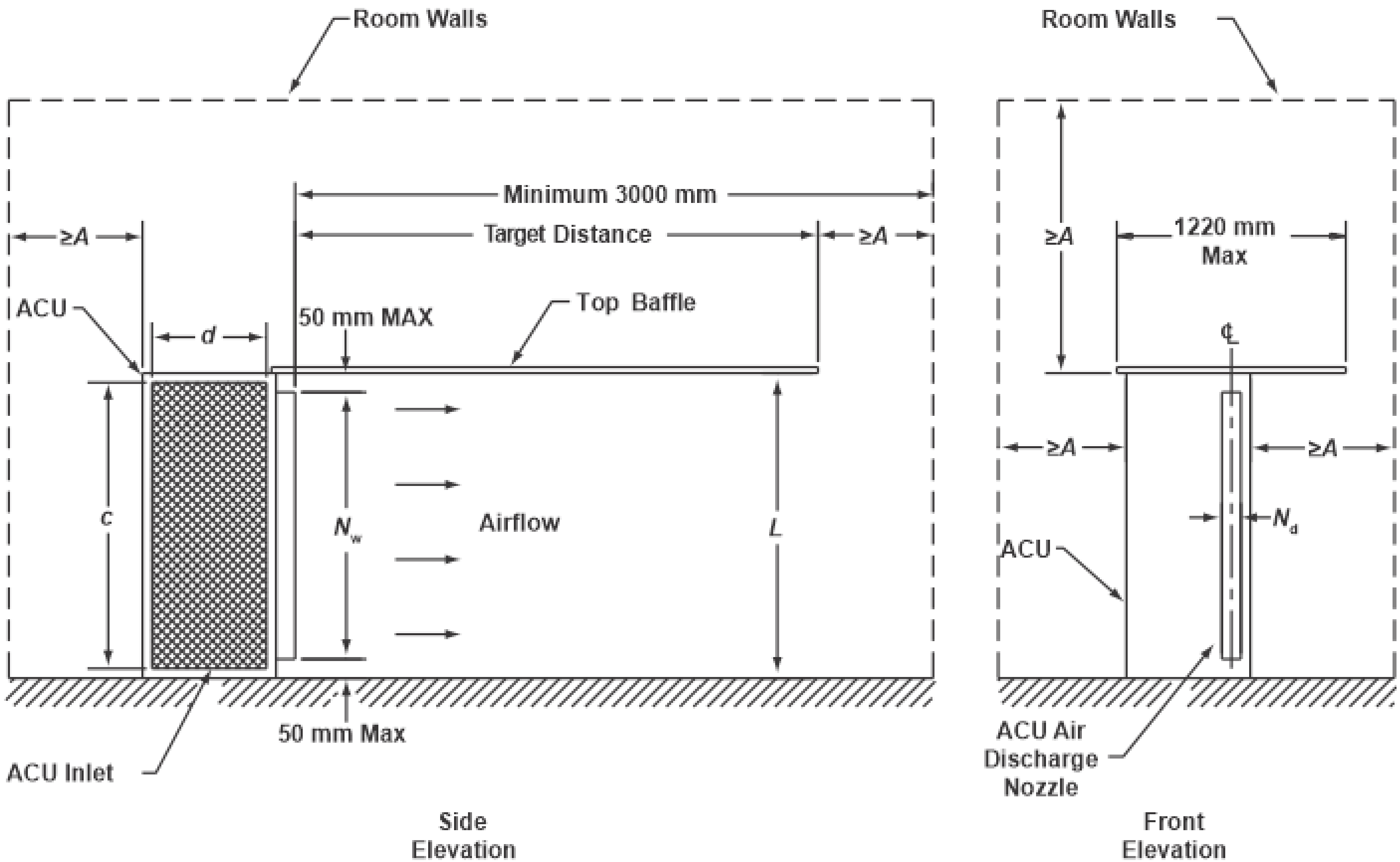
In determining θ, the orientation of the ACU shall be established by the ACU's normal application mounting position. The direction of θ then is defined as a 15° ± 1° angle away from the environment that the ACU is protecting or toward that which normally would be considered the outside.

Units without an adjustable air discharge nozzle are not required to be angled and shall be mounted so nothing interferes with the airstream for 3000 mm (120 in.).

Notes:

1. The examples in Figure 1B are not intended to represent every possible ACU mounting application; they are only to serve as examples of how the direction of Θ shall be determined.
2. For example, the nozzle setup of an ACU designed for outdoor application (not shown) shall be determined by the definition and guidelines illustrated in Figure 1B. Following these criteria yields the direction of Θ to be the same as that shown in Example No. 2 (opposite that shown in Detail A and Detail B).

Figure 1B — Air Discharge Nozzle Angle Setup



Formulae:
A = Two equivalent ACU inlet diameters

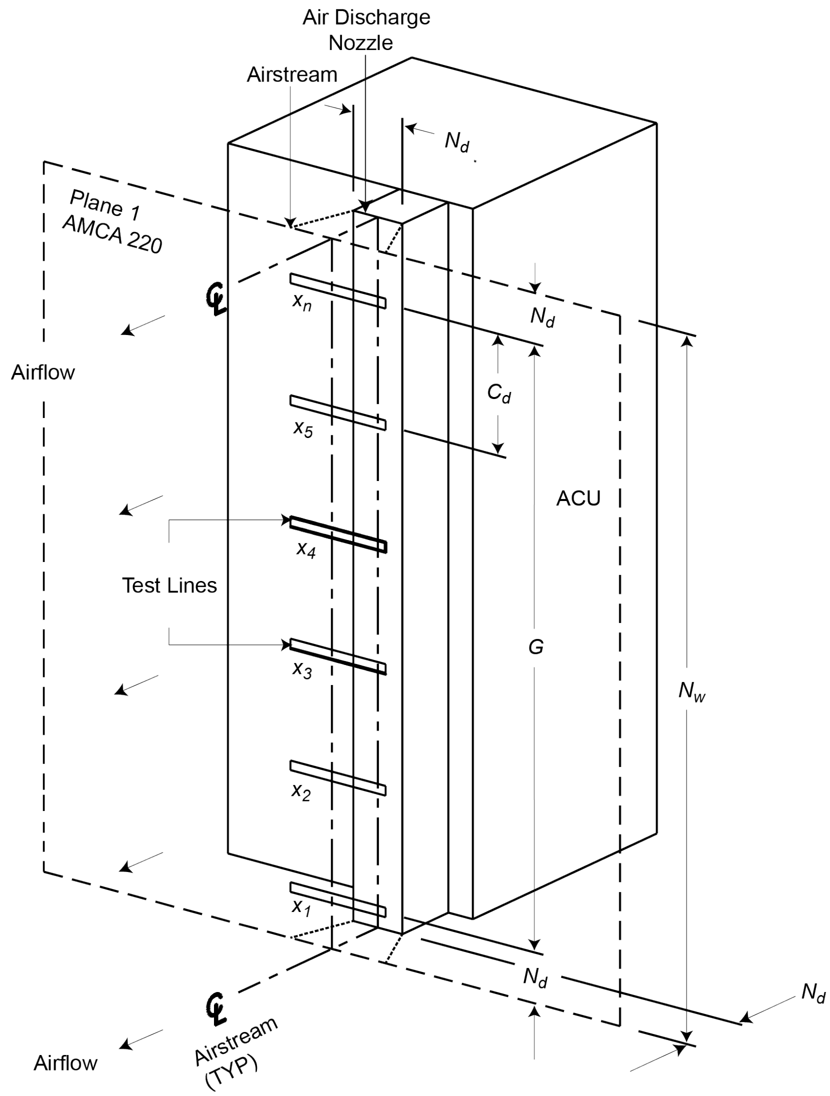
$$A = 4\sqrt{\frac{cd\,*}{\pi}}$$

* For ACUs without a rectangular inlet, substitute the actual value of the inlet area for *cd* in the equation.
* For ACUs with multiple inlets, substitute the sum of all inlet areas for *cd* in the equation.

Notes:

1. See Figures 9.4 and 9.5 for test plane locations.
2. Air discharge nozzle angle setup as noted per Figure 1B.
3. Center baffle(s) over center line of *airflow*.
4. N_d = Air curtain depth
5. N_w = Air curtain width
6. If an ACU has multiple inlets, the nearest surface to each inlet (including the floor) shall be equal to the A value of that inlet. If an ACU must be suspended above the floor, a bottom baffle identical to the top baffle must be used.

Figure 2 — ACU Outlet Air Velocity Uniformity and Air Velocity Projection Test Setup



Formulae:

1. C_d = Test line spacing (See Note 4.)

$$C_d = \frac{G}{n-1} \leq 100\ mm\ (4\ in.)$$

2. V_{ca} = Average air curtain core velocity

$$V_{ca} = \frac{\sum V_{cx}}{n}$$

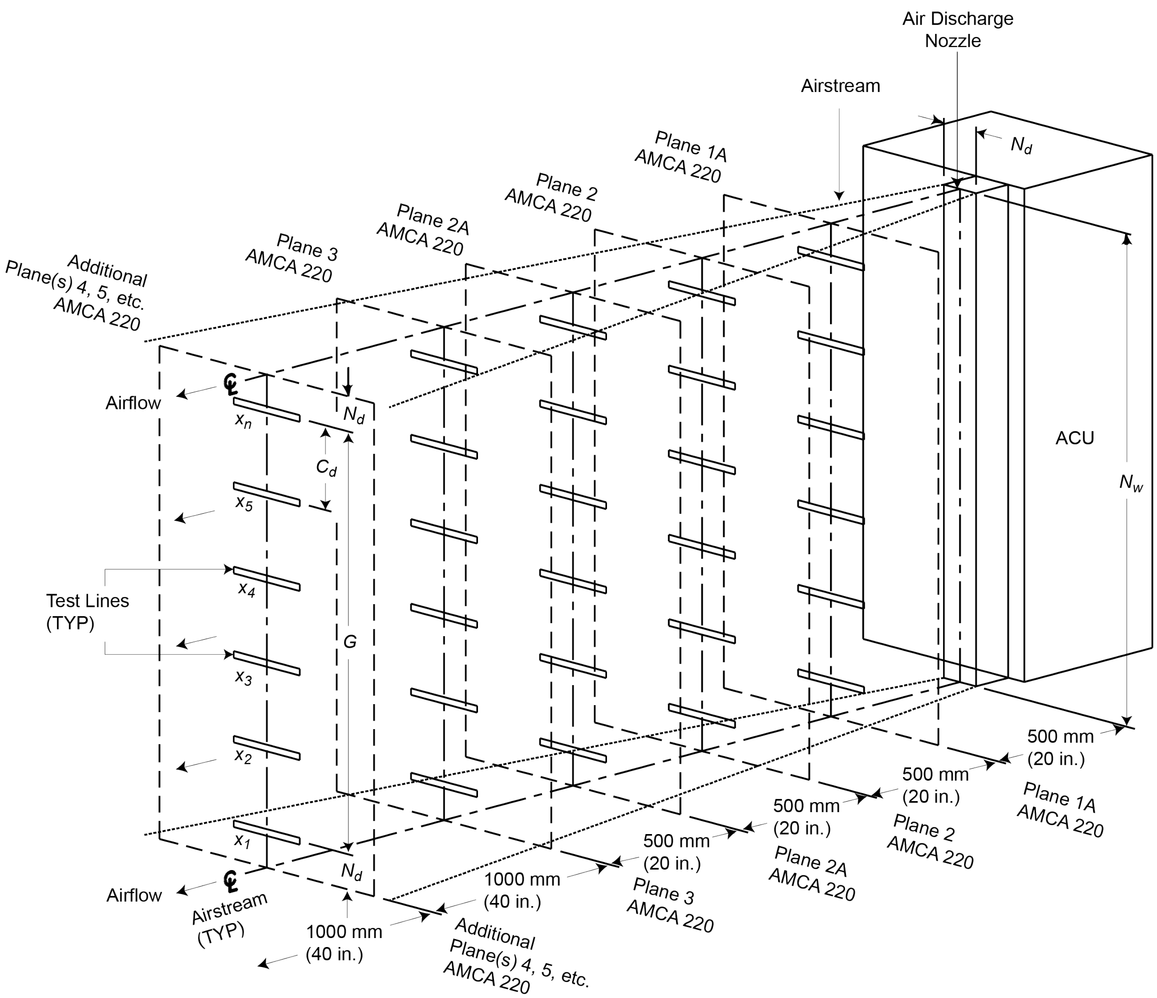
3. s = Standard deviation

$$s = \sqrt{\frac{\sum (V_{cx})^2 - \left[\frac{(\sum V_{cx})^2}{n}\right]}{n-1}}$$

Notes:

1. Air curtain unit setup as per Figure 9.3.
2. Air discharge nozzle angle setup as per Figure 1B.
3. n = Number of test lines (x) (5 minimum)
4. Calculated test line spacing (C_d) shall be less than or equal to 100 mm (4 in.) and rounded to the nearest multiple of 5 mm (1/4 in.).
5. N_d = Air curtain depth
6. N_w = Air curtain width
7. V_{cx} = Core (peak) air velocity along test line x

Figure 3 — ACU Outlet Air Velocity Uniformity Test Lines



Formulae:

1. C_d = Internal test line spacing (See Note 4.)

$$C_d = \frac{G}{n-1} \leq 100\ mm\ (4\ in.)$$

2. V_{ca} = Average air curtain core velocity

$$V_{ca} = \frac{\sum V_{cx}}{n}$$

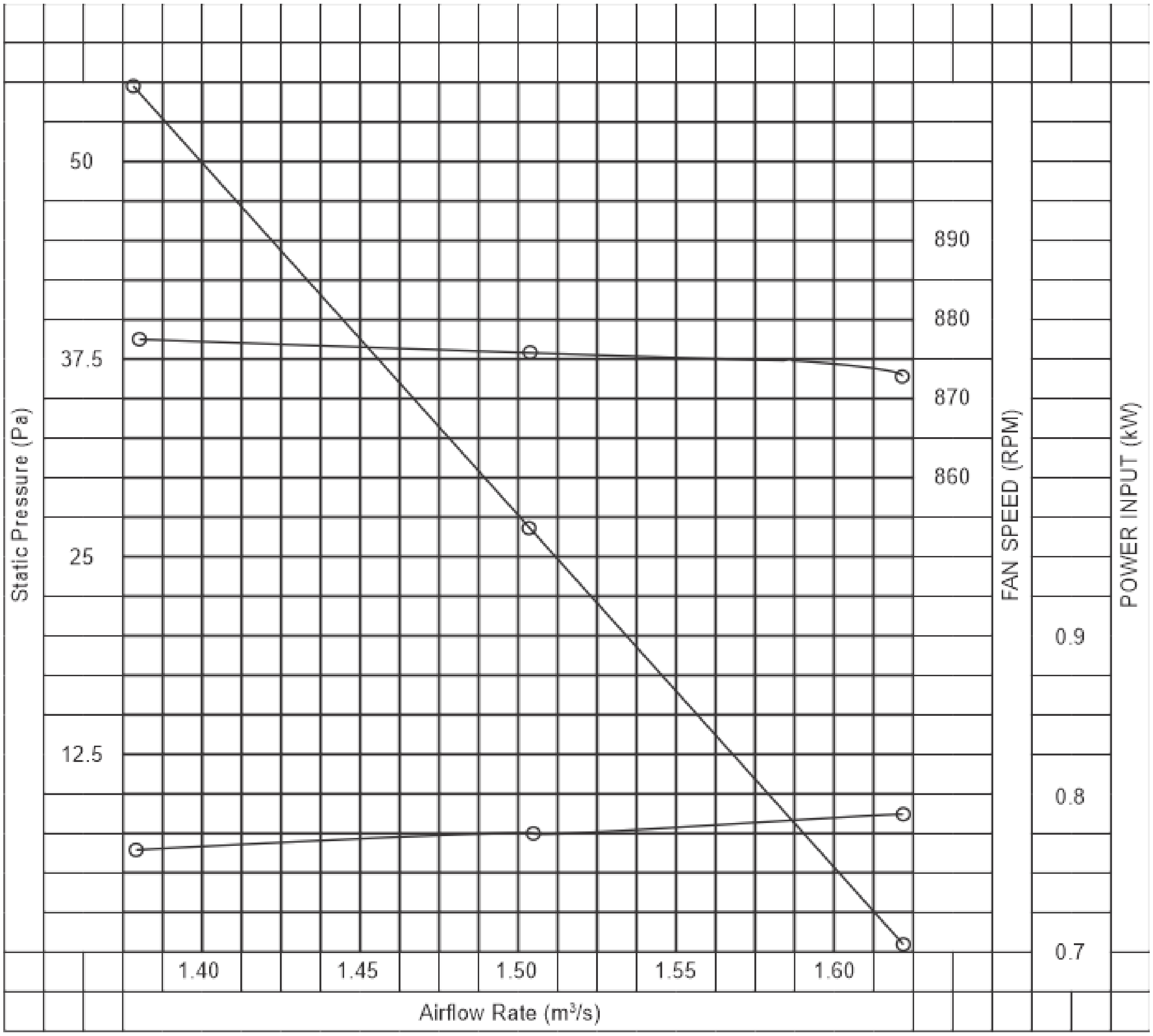
3. *s* = Standard deviation

$$s = \sqrt{\frac{\sum (V_{cx})^2 - \left[\frac{(\sum V_{cx})^2}{n}\right]}{n-1}}$$

Notes:

1. Air curtain unit setup as per Figure 10.2.
2. Air discharge nozzle angle setup as per Figure 10.1B.
3. n = Number of test lines (*x*) (5 minimum)
4. Calculated test line spacing (C_d) shall be less than or equal to 100 mm (4 in.) and rounded to the nearest multiple of 5 mm (1/4 in.).
5. Plane locations shall be accurate to ±25 mm (1 in.).
6. Additional planes shall be spaced every 1000 mm (40 in.).
7. N_d = Air curtain depth
8. N_w = Air curtain width
9. V_{cx} = Core (peak) air velocity along test line *x*

Figure 4 — Air Velocity Projection Test Lines



ACU model: ______________________________

ANSI/AMCA 220 figure: __________

N_D: ______________ mm N_W: _____________mm

ANSI/AMCA 210 Inlet chamber Figure: __________

Free Delivery Conditions:

Air Density: ___________kg/m^3

Airflow Rate: ____________________________m^3/s

Efficiency: ___________ %

Average Velocity: ____________m/s

Input Watts: ____________

TEST NUMBER: _________________________

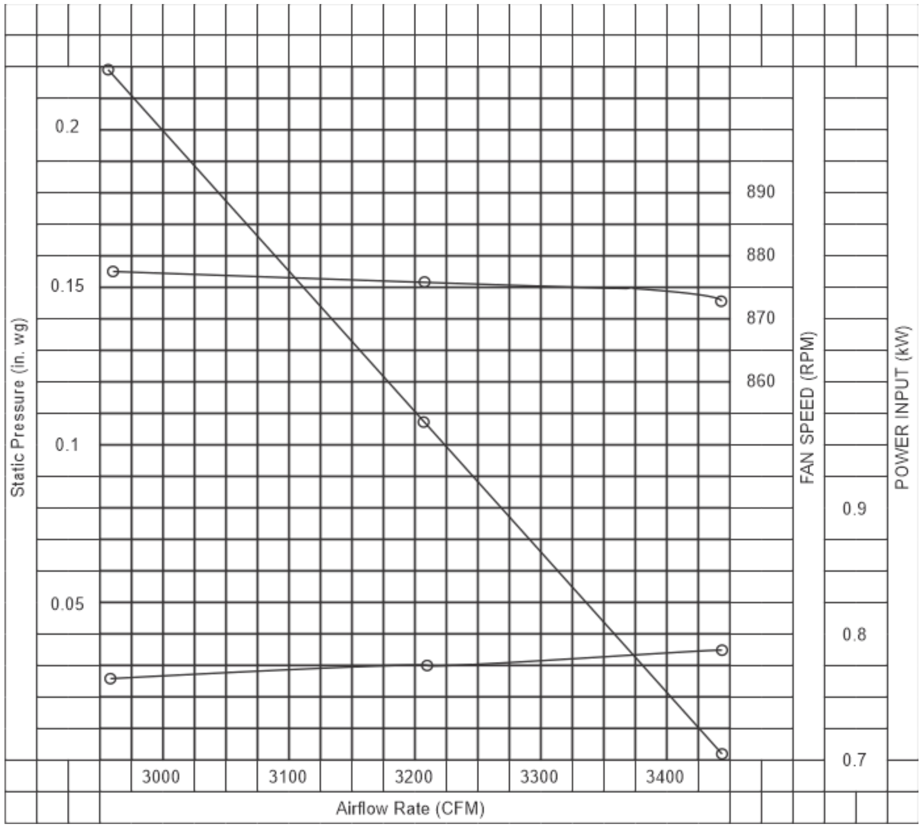
CURVE BY: ____________

LABORATORY: _________________________

DATE: ____________

LOCATIONS: _________________________

Figure 5A — Typical ACU Airflow Rate Performance Curve (SI)



ACU model: ______________________________ ANSI/AMCA 220 figure: __________

N_D: ______________ in. N_W: ______________in. ANSI/AMCA 210 Inlet chamber Figure: __________

Free Delivery Conditions: Air Density: ____________kg/m^3

Airflow Rate: ______________________________cfm Efficiency: ____________ %

Average Velocity: ____________fpm

Input Watts: ____________

TEST NUMBER: ____________________________ CURVE BY: ____________

LABORATORY: ____________________________ DATE: ____________

LOCATIONS: ____________________________

Figure 5B — Typical ACU Airflow Rate Performance Curve (I-P)

MANUFACTURER:	XYZ Inc.		TEST NO:	97722-1A
AIR CURTAIN MODEL:	ABC		TETST DATE:	7/22/97
			BY:	SWS/DAJ

N_d	102	mm	N_w	1219	mm
t_{db}	22.2	°C	t_{wo}	17.8	°C

BAROMETRIC PRESSURE:	96.685	kPa	LABORATORY:	AMCA
AIR DENSITY:	1.133	kg/m³	LOCATION:	Arlington Heights, IL

ANSI/AMCA STANDARD 220 ((Using Pitot-Static Tube)

test line #		PLANE 1		PLANE 2		PLANE 3		PLANE 4	
	DISTANCE	100	mm	1.0	m	2.0	m	3.0	m
	mm from floor	P_v Pa	V_{cx} m/s	P_v Pa	V_{cx} m/s	P_v Pa	V_{cx} m/s	P_v Pa	V_{cx} m/s
1	100.00	178	17.7	28.9	7.14	22.4	6.29	13.7	4.92
2	200.00	159	16.7	24.9	6.63	20.4	6.00	14.9	5.14
3	300.00	274	22.0	37.4	8.13	27.4	6.95	16.2	5.35
4	400.00	224	19.9	41.8	8.59	32.1	7.53	19.4	5.86
5	500.00	155	16.6	44.6	8.87	33.4	7.68	21.2	6.11
6	600.00	126	14.9	58.3	10.14	49.6	9.35	28.6	7.11
7	700.00	155	16.6	45.3	8.94	33.1	7.65	24.4	6.56
8	800.00	209	19.2	42.6	8.67	31.4	7.44	21.4	6.15
9	900.00	349	24.8	36.9	8.07	28.6	7.11	19.9	5.93
10	1000.00	163	17.0	24.4	6.56	21.4	6.15	15.2	5.18
11	1100.00	174	17.5	25.9	6.76	21.9	6.22	14.2	5.01
12									
13									
14									
15									
16									
17									
18									
19									
20									
AVG CORE VEL, V_{ca}		18.45 m/s		8.05 m/s		7.13 m/s		5.76 m/s	
STD.DEVIATION, s		2.86 m/s		1.15 m/s		0.98 m/s		0.70 m/s	
UNIFORMITY, U		85%		86%		86%		88%	

Figure 6A — Sample ACU Outlet Air Velocity Uniformity and Air Curtain Velocity Projection Calculations (SI)

MANUFACTURER:	XYZ Inc.		TEST NO:	97722-1B
AIR CURTAIN MODEL:	ABC		TETST DATE:	7/22/97
			BY:	SWS/DAJ

N_d	4.0	in.	N_w	48	in.
t_{db}	72	°F	t_{wo}	64	°F

BAROMETRIC PRESSURE:	28.55	in. Hg	LABORATORY:	AMCA
AIR DENSITY:	0.0707	lbm/ft^3	LOCATION:	Arlington Heights, IL

ANSI/AMCA STANDARD 220 ((Using Pitot-Static Tube)

test line #		PLANE 1		PLANE 2		PLANE 3		PLANE 4	
	DISTANCE	4.0	in.	40	in.	80	in.	120	in.
	in. from floor	P_v in. wg	V_{cx} fpm	P_v in. wg	V_{cx} fpm	P_v in. wg	V_{cx} fpm	P_v in. wg	V_{cx} fpm
1	4.00	0.714	3483	0.116	1404	0.090	1237	0.055	967
2	8.00	0.637	3290	0.100	1303	0.082	1180	0.060	1010
3	12.00	1.100	4323	0.150	1596	0.110	1367	0.065	1051
4	16.00	0.900	3910	0.168	1689	0.129	1480	0.078	1151
5	20.00	0.624	3256	0.179	1744	0.134	1509	0.085	1202
6	24.00	0.506	2932	0.234	1994	0.199	1839	0.115	1398
7	28.00	0.624	3256	0.182	1758	0.133	1503	0.098	1290
8	32.00	0.840	3778	0.171	1705	0.126	1463	0.086	1209
9	36.00	1.400	4877	0.148	1586	0.115	1398	0.080	1166
10	40.00	0.655	3336	0.098	1290	0.086	1209	0.061	1018
11	44.00	0.700	3449	0.104	1329	0.088	1223	0.057	984
12									
13									
14									
15									
16									
17									
18									
19									
20									
AVG CORE VEL, V_{ca}		3626 fpm		1582 fpm		1401 fpm		1131 fpm	
STD.DEVIATION, s		562 fpm		226 fpm		192 fpm		138 fpm	
UNIFORMITY, U		85%		86%		86%		88%	

Figure 6B — Sample ACU Outlet Air Velocity Uniformity and Air Curtain Velocity Projection Calculations (I-P)

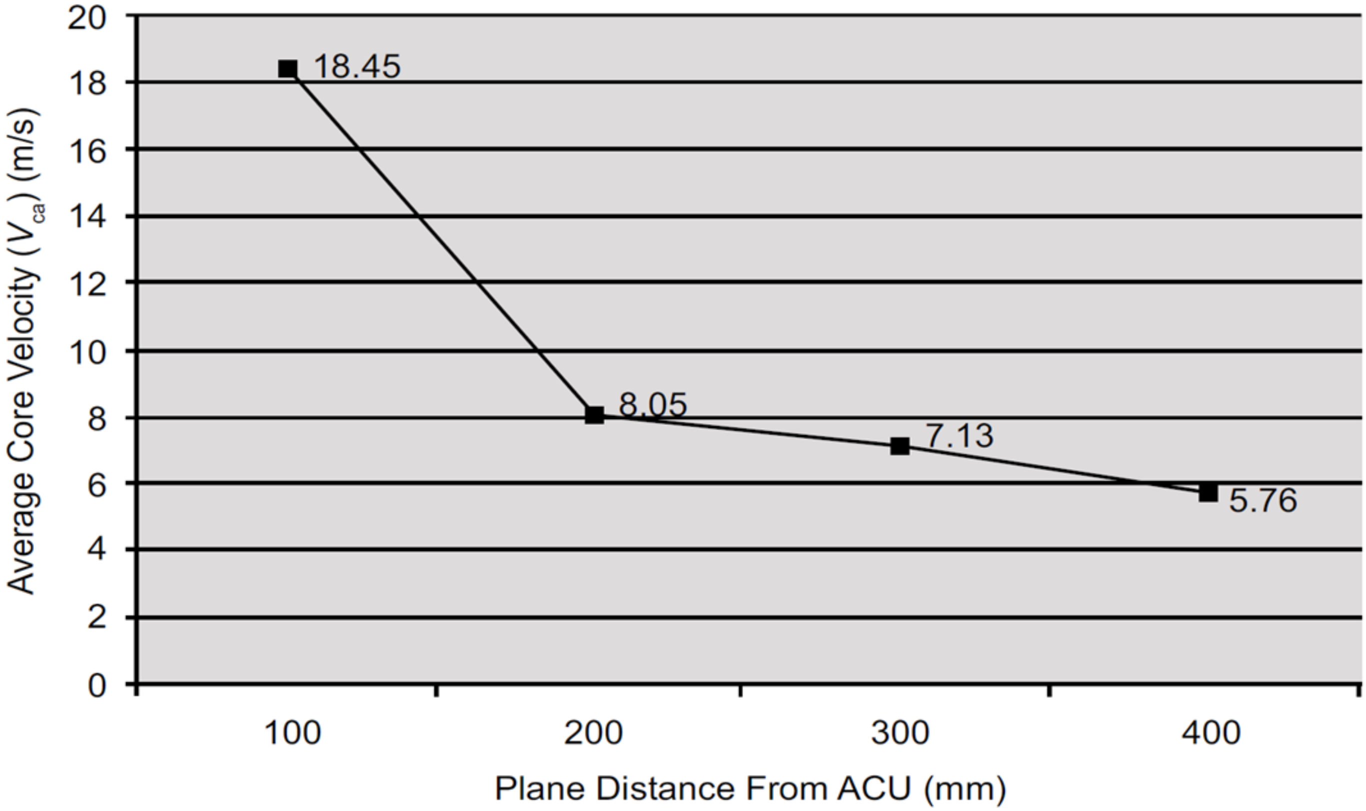


Figure 7A — Sample Air Curtain Velocity Projection Test (SI)

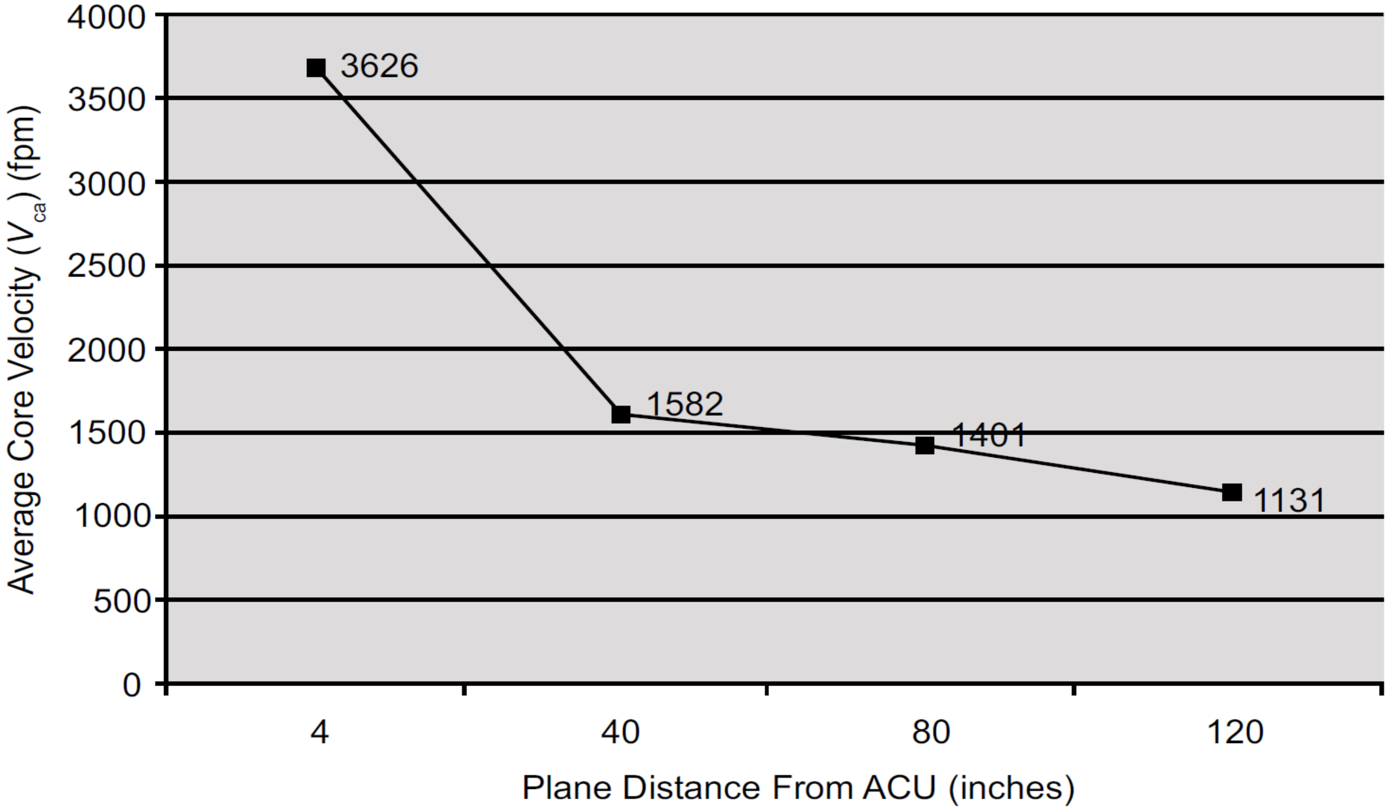


Figure 7B — Sample Air Curtain Velocity Projection Test (I-P)

Annex A
Air Curtain Depth and Width (Informative)

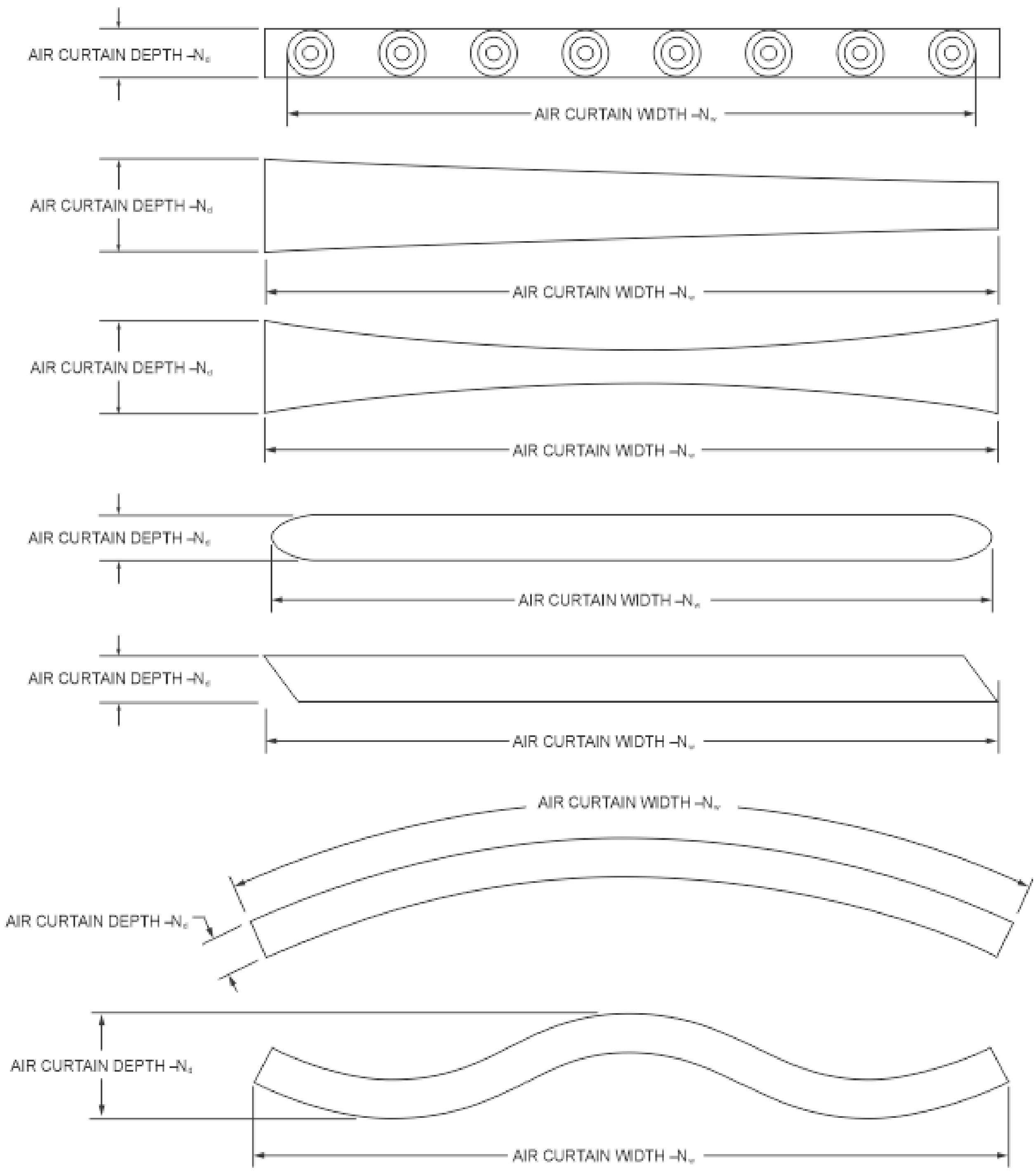


Figure A.1 — Examples of Air Curtain Width and Depth Definitions

Annex B
Air Curtain Discharge Area (Informative)

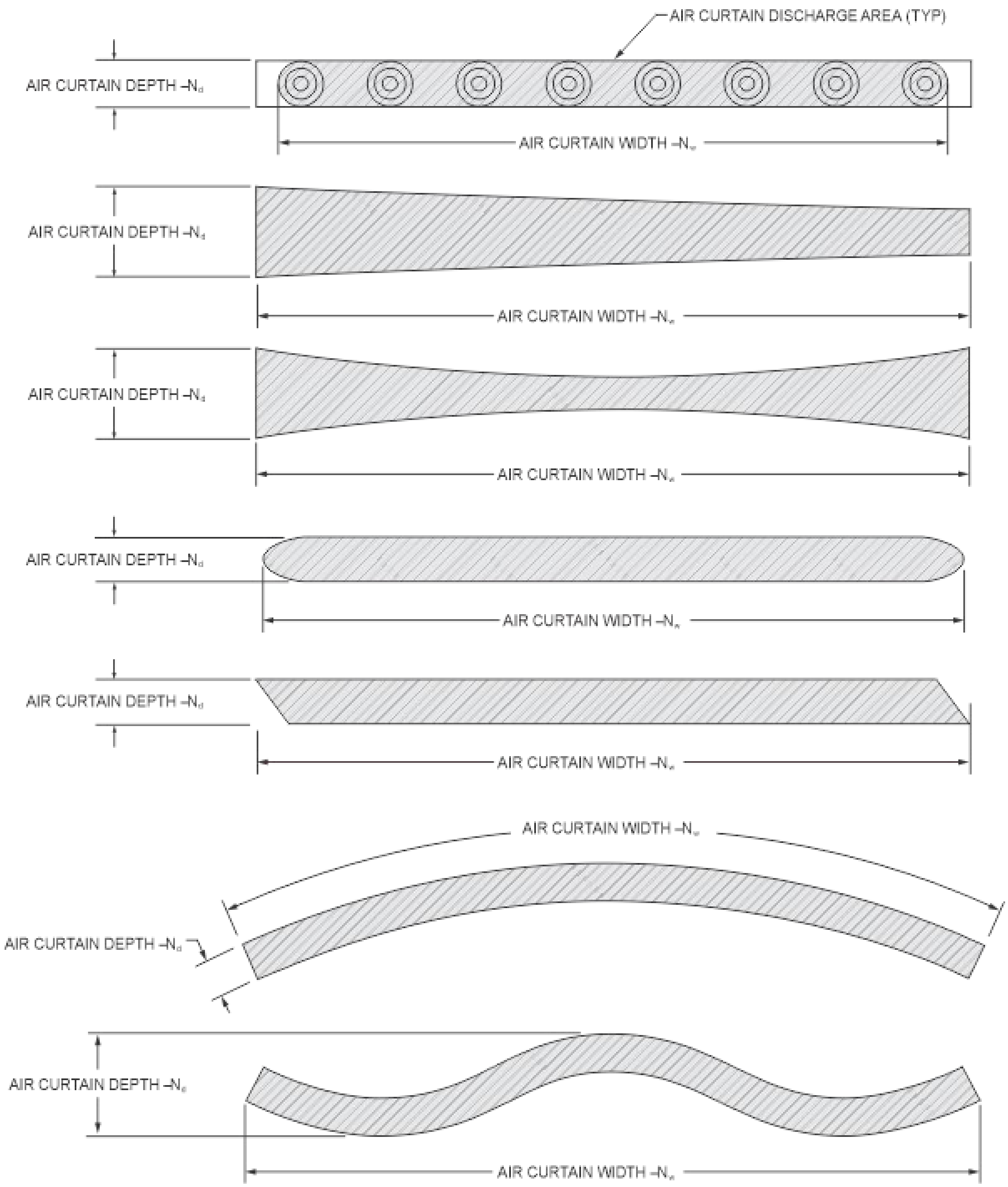


Figure B.1 — Examples of Air Curtain Discharge Areas

Annex C
Uncertainty in Velocity Determination Using Pitot-Static Tube and Manometer (Informative)

Values given in Table C.1 are based on an error equivalent to an indicating column length of 12 Pa (0.05 in. wg) in a vertical manometer having a 1:1 slope ratio.

Table C.1 — Manometer Error

Slope Ratio	Minimum Usable Velocity
1:1	14 m/s (2800 fpm)
2:1	10 m/s (2000 fpm)
5:1	6 m/s (1250 fpm)
10:1	5 m/s (900 fpm)
20:1	3 m/s (630 fpm)

Source: David Johnson, Berner International Corp., 1998

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