STANDARD

ANSI/AMCA Standard 240-22

Laboratory Methods of Testing Positive Pressure Ventilators for Aerodynamic Performance Rating

An American National Standard
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ANSI Accredited Standards Developer

Air Movement and Control Association International

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Laboratory Methods of Testing Positive Pressure Ventilators for Aerodynamic Performance Rating

1. Purpose

This standard establishes a uniform method of laboratory testing for the determination of the aerodynamic performance of a positive pressure ventilator (PPV) in terms of airflow rate, pressure, air density and rotational speed for performance rating or guarantee purposes.

It is not the purpose of this standard to specify a testing procedure for the design, production or field test of any PPV, nor is it the purpose of the standard to serve as a manual for the construction, validation or calibration of the test facility.

Prior to the original publication of this standard in 1996, PPVs were tested to ANSI/AMCA Standard 210. The scope of ANSI/AMCA Standard 210, however, includes only air moving devices designed with the impeller enclosed within a shroud or housing. Due to variations in the design of PPVs, some could be tested to ANSI/AMCA Standard 210 while others could not. In 1992, AMCA created the AMCA Standard 240 Draft Committee to develop a single method of test applicable to all PPVs.

The test method devised by the committee is substantially the same as the outlet chamber test setup described in ANSI/AMCA Standard 210. The principal difference between ANSI/AMCA Standard 210 and ANSI/AMCA Standard 240 is that in the former, the outlet of the test unit is either mounted directly to the test chamber or connected to a duct that is mounted on the test chamber. In ANSI/AMCA Standard 240, the test unit discharge is directed toward a doorway-sized opening into the test chamber. This setup approximates a real-world application of the equipment and also accounts for entrained airflow.

ANSI/AMCA Standard 240 is a special case of ANSI/AMCA Standard 210. Therefore, a sizeable portion of the standard originates in ANSI/AMCA Standard 210. The later editions replace many sections of text with reference to the parent standard, emphasizing differences over similarities to simplify ANSI/AMCA Standard 240.

2. Scope

This standard uses air as the test gas. Each test shall be limited to one PPV per test. A PPV tested in accordance with this standard shall be freestanding and without a ductwork connection to the test chamber, thereby allowing for the measurement of entrained airflow.

Any item of equipment designed or intended for applications other than positive pressure ventilation is not within the scope of this standard.

The parties to a test, for guarantee purposes, may agree in writing on exceptions to this standard prior to the test. However, only a test that does not violate the mandatory requirements of this standard shall be designated as a test conducted in accordance with this standard.

3. References

3.1 Normative references

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

ANSI/AMCA Standard 210, *Laboratory Methods of Testing Fans for Aerodynamic Performance Rating*, Air Movement and Control Association International Inc., Arlington Heights, IL, USA

3.2 Informative references

ANSI/AMCA Standard 99, *Standards Handbook*, Air Movement and Control Association International Inc., Arlington Heights, IL, USA

4. Definitions/Units of Measurement/Symbols

4.1 Definitions

For the purposes of this standard, the definitions in Section 4.1 apply. All other definitions shall conform to ANSI/AMCA Standard 210, Section 3.

4.1.1 Engine

A drive device that produces power through internal combustion and uses a fuel, such as gasoline.

4.1.2 Height

The vertical distance between the PPV position and the flat, horizontal surface on which the PPV is situated.

4.1.3 Motor

A drive device other than an internal combustion engine, such as an electric motor, water turbine, hydraulic motor, air motor and similar devices.

4.1.4 Nominal voltage of PPV

Rated voltage of battery pack/packs supplied to the PPV.

4.1.5 Positive pressure ventilator (PPV)

A portable fan that can be positioned relative to an opening of an enclosure and cause it to be positively pressurized by discharge air velocity. (ANSI/AMCA Standard 99.) Firefighters principally use PPVs to mitigate the effects of smoke; PPVs also help inflate hot air balloons.

4.1.6 PPV position

The point representing a PPV position in three-dimensional space that is taken as the intersection between the PPV axial centerline and the face of the PPV hub. All measurements pertaining to the PPV must be referenced to this point.

4.1.7 PPV speed
The rotational speed of the PPV impeller.

4.1.8 Runtime
Length of time that a battery-operated PPV operates at maximum speed before automatically shutting off for the first time.

4.1.9 Setback
The horizontal distance between the PPV position and the opening to the test chamber within a vertical plane perpendicular to the plane defined by the chamber opening.

4.1.10 Shall and should
The word "shall" is understood as mandatory and the word "should" as advisory.

4.1.11 Test
A series of determinations for various points of operation of a PPV.

4.1.12 Tilt
The angle between the PPV axial centerline and the horizontal plane.

4.2 Units of measurement
The units of measurement used in this standard shall conform to ANSI/AMCA Standard 210, Annex A.

4.3 Symbols
The symbols listed in Table 1 apply for the purposes of this standard. All others shall conform to ANSI/AMCA Standard 210, Section 4.

Table 1
Symbols and Subscripts

Symbol	Description	SI	I-P
a_j	Variable in polynomial coefficient equation	dimensionless	
A	Current	amperes	
b_j	Variable in polynomial coefficient equation	dimensionless	
f	Frequency	Hz or DC	
G	Variable in polynomial coefficient equation	dimensionless	
h	Height	m	ft
K_j	Polynomial coefficient	dimensionless	
m	Number of samples taken	dimensionless	
n	Number of determinations	dimensionless	
P_s	PPV static pressure	Pa	in. wg
P_{sx}	Static pressure at plane X	Pa	in. wg
Q	PPV airflow rate	m^3/s	ft^3/min
Q_x	Airflow rate at plane X	m^3/s	ft^3/min
Q_f	Airflow rate at free delivery	m^3/s	ft^3/min
s	Setback	m	ft
V	Voltage	volts	
φ	Tilt	degrees	
ρ_0	Atmospheric density	kg/m^3	lbm/ft^3

5. Instruments and Methods of Measurement

In addition to the following, the manufacturer shall adhere to the requirements of ANSI/AMCA Standard 210, Section 5, as applicable.

5.1 Manometers and other pressure-indicating instruments

Pressure (except PPV static pressure) shall be measured on a manometer of the liquid column type using inclined legs, vertical legs or any other instrument having a maximum uncertainty of 1% over the maximum observed reading or 1 Pa (0.005 in. wg), whichever is greater.

5.2 Pressure-indicating instrument – PPV static pressure

PPV static pressure shall be measured with a pressure transducer having an accuracy equal to or better than 0.5%, as stated by the manufacturer.

5.3 Other pressure measurement systems

Pressure measurement systems consisting of sensors and indicators other than manometers and static pressure taps may be used for all pressures, except PPV static pressure if the combined uncertainty of the system does not exceed the combined error for an appropriate combination of manometers and static pressure taps. For a system used to determine pressure, the contribution to the combined uncertainty of the pressure measurement shall not exceed that corresponding to 1% of the maximum observed pressure differential reading during a test (indicator accuracy), plus 1% of the actual reading (averaging accuracy). See ANSI/AMCA Standard 210, Section 4.2.5.

6. Equipment and Setup

In addition to the following, the manufacturer shall adhere to the requirements of ANSI/AMCA Standard 210, Section 6, as applicable.

6.1 Setup

The PPV shall be set up for testing as shown in Figure 10.2.

The values for *s, h* and φ are set to simulate the intended application.

6.2 Chamber

A chamber shall be incorporated in the laboratory setup to provide a measurement station and simulate a condition the PPV is expected to encounter in service. The chamber shall meet the proportionality and performance requirements of ANSI/AMCA Standard 210. A chamber may have a circular or rectangular cross-sectional shape. The dimension *M* in the test setup diagram is the inside dimension of a circular chamber or the equivalent diameter of dimensions *a* and *b* where:

$$M = \sqrt{(4ab/\pi)} \qquad \text{Eq. 6.1}$$

The chamber shall have a cross-sectional area at least 10 times the included face area of the PPV impeller.

6.3 Chamber entrance

The entrance to a chamber shall be completely sealed except for a “doorway” opening with a height of 1.90 m (74.8 in.) and a width of 0.97 m (38.2 in.) centered across the entrance plane of the chamber. The tolerance of the doorway shall be +/-1 cm.

A flat, horizontal surface shall extend from the rear of the test unit to the front edge of the chamber entrance. This surface shall be level with the bottom edge of the chamber entrance and shall have a minimum width equal to or exceeding the width of the chamber entrance or the width of the test unit, whichever is greater.

6.4 Fuel

A PPV driven by a gasoline engine shall be tested with standard pump gasoline that has an 87-octane rating and includes no more than 10% methanol. No additional chemicals shall be added.

7. Observations and Conduct of Test

In addition to the following, the manufacturer shall adhere to the requirements of ANSI/AMCA Standard 210, Section 7, as applicable.

7.1 Determinations

To determine the aerodynamic performance of a PPV near free delivery, determinations shall be taken for chamber static pressures (P_{s7}) ranging from 25 Pa (0.1 in. wg) to -25 Pa (-0.1 in. wg). If a chamber static pressure of 25 Pa (0.1 in. wg) cannot be obtained, the highest obtainable static pressure shall be used as the upper limit, and the negative of this value shall be considered the lower limit. Plans shall be made to vary the throttling device so the test points will be well spaced in terms of static pressure. At least 10 determinations shall be taken per test. Half of the determinations shall be taken at a positive static pressure and half shall be taken at a negative static pressure.

7.2 PPV engine test speed

For a PPV powered by an internal combustion engine, the maximum loaded engine revolutions per minute (rpm) the manufacturer allows is the maximum engine rpm allowed during the test. A letter or certificate from the engine manufacturer’s corporate offices shall attest to the maximum loaded rpm for the engine. Only stock or production model engines shall be used for testing.

7.3 Exhaust venting

If a PPV is driven by an internal combustion engine, exhaust fumes shall be vented away from the test area.

Proper precautions shall be taken to minimize the inhalation of fuel or motor exhaust fumes during testing. Any type of fume exhaust system shall be designed so it does not interfere with the airflow in the test area or affect motor performance. The exhaust venting system shall maintain zero static pressure at the exhaust port throughout the test. Figure 10.1 illustrates a fume exhaust setup.

7.4 Battery PPV test procedure

A battery-powered PPV, whether or not additional power supply options exist, shall be tested for airflow performance using a constant voltage direct current (DC) power supply. The constant voltage DC power supply shall be configured to match the nominal voltage that the PPV manufacturer specified. Current supplied shall self-adjust to the PPV load without limitations. All testing of battery-powered PPVs shall be completed at maximum speed.

To connect the constant voltage DC power supply to the PPV, the manufacturer shall provide a method of connecting the positive and negative leads coming from the power supply to the same location as the batteries. No alternate location for ease of testing shall be accepted. The provided connection must accept alligator clips or ring terminals for ease of use. Voltage measured at the connection between the PPV and constant voltage DC power supply must be within 1% of the nominal voltage that the PPV manufacturer specified.

In addition to the airflow test, all battery-powered PPVs must be tested for runtime at maximum speed using the same unit tested for airflow performance. The manufacturer must supply batteries along with an applicable charger. Batteries shall be charged fully based on the manufacturer's instructions. Once the batteries are fully charged and all airflow test configurations for the PPV are complete, the batteries shall be inserted into the PPV unit. The PPV must be placed at least 2 m (6.6 ft) away from obstacles or obstructions when completing the runtime test to ensure no added restrictions are present when the runtime is checked. Run the PPV at maximum speed until it powers off automatically. The laboratory shall record the PPV runtime.

Atmospheric air density noted during testing per Section 7.4 shall differ no more than 1% from the density noted during air performance testing.

8. Calculations

In addition to the following, the manufacturer shall adhere to the requirements of ANSI/AMCA Standard 210, Section 8, as applicable.

8.1 PPV airflow rate

The PPV airflow rate (Q) at test conditions shall be obtained from the equation of continuity:

$$Q = Q_7 = Q_5 \left[\frac{\rho_5}{\rho_7}\right] \qquad \text{Eq. 8.1}$$

8.2 Static pressure as a function of airflow rate

The relationship between PPV static pressure and PPV airflow rate for the range of static pressure tested is represented by the second order polynomial:

$$P_s = K_2 Q^2 + K_1 Q + K_0 \qquad \text{Eq. 8.2}$$

Where the coefficients K_2, K_1 and K_0 are derived from:

$$a_0 = n \qquad \text{Eq. 8.3}$$

$$a_1 = \sum_{i=1}^{n} Q_i \qquad \text{Eq. 8.4}$$

$$a_2 = \sum_{i=1}^{n} Q_i^2 \qquad \text{Eq. 8.5}$$

$$a_3 = \sum_{i=1}^{n} Q_i^3 \qquad \text{Eq. 8.6}$$

$$a_4 = \sum_{i=1}^{n} Q_i^4 \qquad \text{Eq. 8.7}$$

$$b_0 = \sum_{i=1}^{n} P_{si} \qquad \text{Eq. 8.8}$$

$$b_1 = \sum_{i=1}^{n} (Q_i P_{si}) \qquad \text{Eq. 8.9}$$

$$b_2 = \sum_{i=1}^{n} (Q_i^2 P_{si}) \qquad \text{Eq. 8.10}$$

$$G = a_4 a_2 a_0 - a_4 a_1^2 - a_3^2 a_0 + 2a_3 a_2 a_1 - a_2^3 \qquad \text{Eq. 8.11}$$

$$K_2 = (1/G)(a_2 a_0 b_2 - a_1^2 b_2 - a_3 a_0 b_1 + a_2 a_1 b_1 + a_3 a_1 b_0 - a_2^2 b_0) \qquad \text{Eq. 8.12}$$

$$K_1 = -(1/G)(a_3 a_0 b_2 - a_2 a_1 b_2 - a_4 a_0 b_1 + a_2^2 b_1 + a_4 a_1 b_0 - a_3 a_2 b_0) \qquad \text{Eq. 8.13}$$

$$K_0 = (1/G)(a_3 a_1 b_2 - a_2^2 b_2 - a_4 a_1 b_1 + a_3 a_2 b_1 + a_4 a_2 b_0 - a_3^2 b_0) \qquad \text{Eq. 8.14}$$

The value for K_2 must be negative, indicating that the static pressure vs. airflow curve is concave inward. If K_2 is positive, additional determinations should be selected to broaden the range of static pressure for which airflow is determined.

8.3 Airflow rate at free delivery

Figure 10.3 shows graphically the curve defined by the equation in Section 8.2 to the determinations taken in an example test for SI and I-P units, respectively. The free air point of operation is the point where the curve intersects the x axis (P_s = 0).

Mathematically, the PPV airflow rate at free delivery (Q_f) is calculated from:

$$Q_f = \left[\frac{-K_1 - \sqrt{K_1^2 - 4K_0 K_2}}{2K_2}\right] \qquad \text{Eq. 8.15}$$

9. Results of Test and Report

In addition to the following, the manufacturer shall adhere to the requirements of ANSI/AMCA Standard 210, Section 9, as applicable.

9.1 Results

Test results shall include atmospheric data (ρ_0), static pressure (P_{si}) and airflow (Q_i) for each determination taken, static pressure-airflow curve constants (K_0, K_1 and K_2), and airflow at free air delivery (Q_f).

In addition, test results for electrically powered PPVs shall include voltage (V), current (A) and frequency (Hz or DC).

9.2 Report

The laboratory report of an aerodynamic performance test of a PPV shall include identification and description of the test unit (including appurtenances, if any), test results, raw test data, test setup description, list of test instruments used (including calibration) and test personnel. The laboratory shall be identified by name and location.

9.3 Performance curve

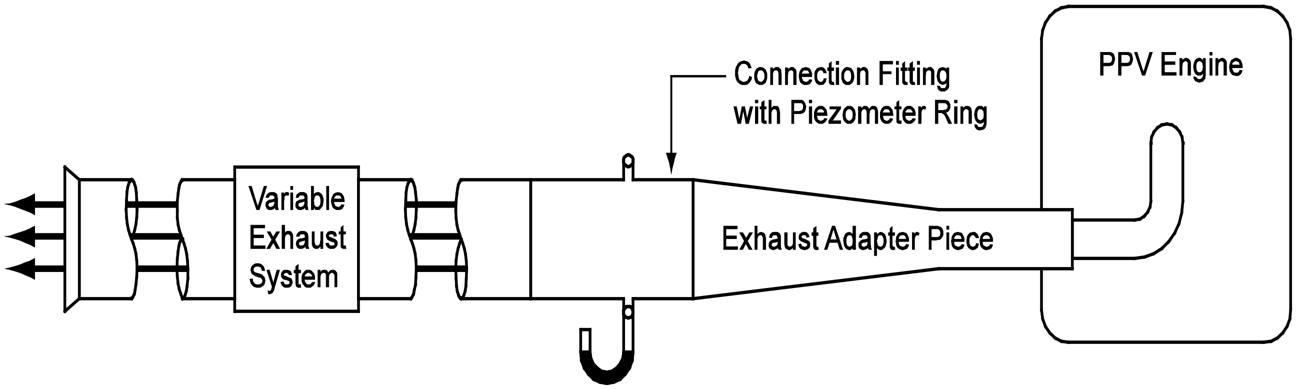
The results of a PPV test shall include a performance curve. Typical performance curves are shown in Figure 10.3. Detailed requirements are given in ANSI/AMCA Standard 210, Sections 9.2.1 through 9.2.5, inclusive.

9.4 Battery PPV runtime test

According to Section 7.4, an additional test shall be performed for a PPV that is capable of being operated with batteries. To report the test results properly, the following shall be included in the report only for battery-operated PPVs:

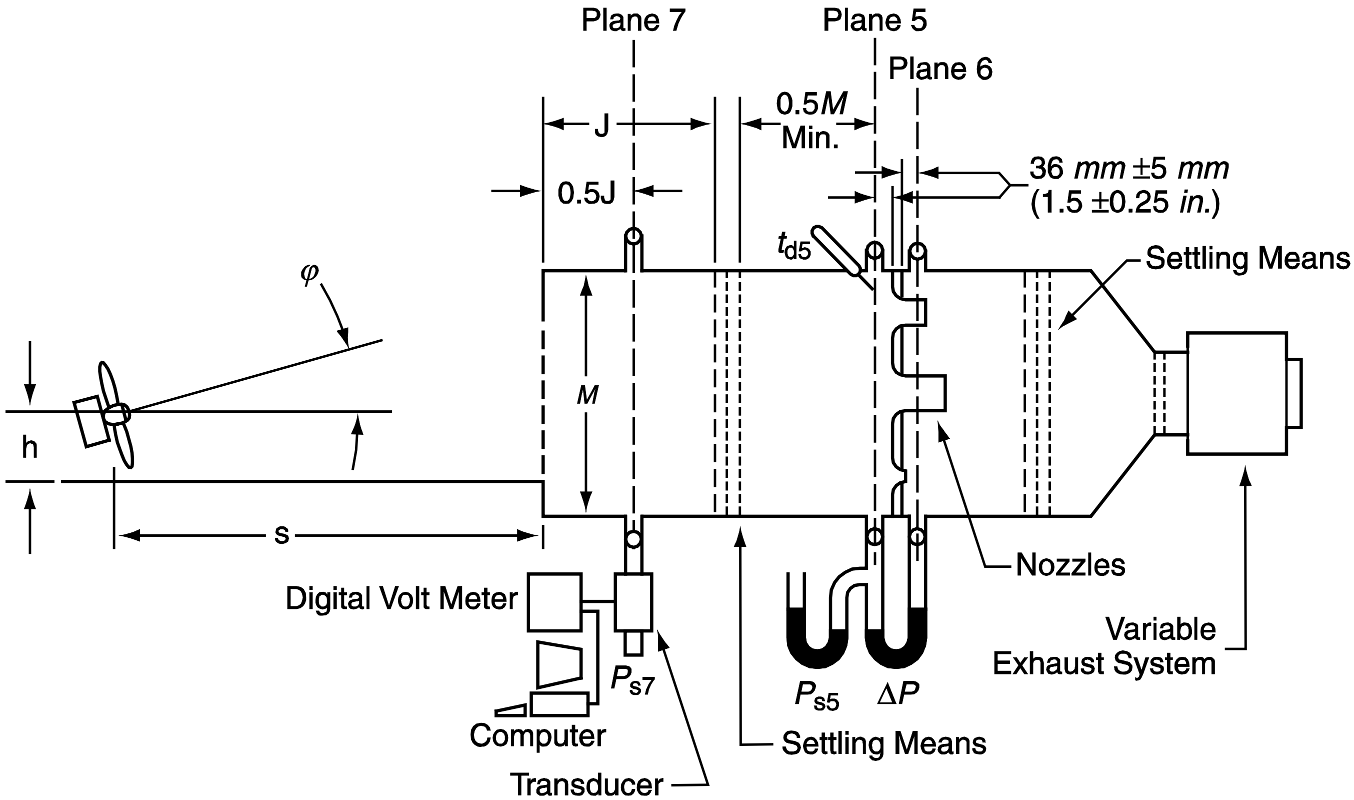
- Battery make and model
- Nominal voltage to the PPV
- Runtime (according to Section 7.4) noted in comment section of the report

10. Figures



Notes:
1. Fume exhaust system is required only for tests run on PPVs that are driven by internal combustion engines.
2. Static pressure measured at connection fittings shall be maintained at zero throughout the test.
3. Fume exhaust shall be vented away from the laboratory in a safe manner.

Figure 10.1 — Laboratory Fume Exhaust Setup



Airflow and pressure formulae:

$Q_5 = \sqrt{2}Y\sqrt{\frac{\Delta P}{\rho_5}\sum CA_6}$ SI Eq. 10.1

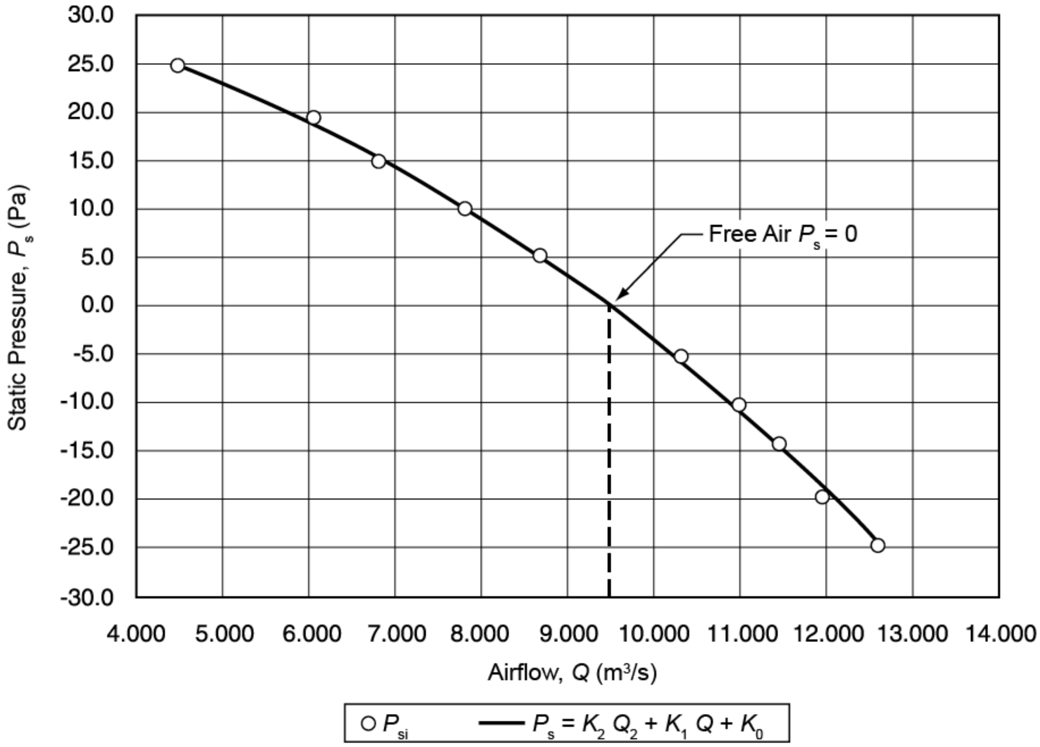
$Q_5 = 1097.8Y\sqrt{\frac{\Delta P}{\rho_5}\sum(CA_6)}$ I-P Eq. 10.2

$Q = Q_7 = Q_5\left[\frac{\rho_5}{\rho_7}\right]$ Eq. 10.3

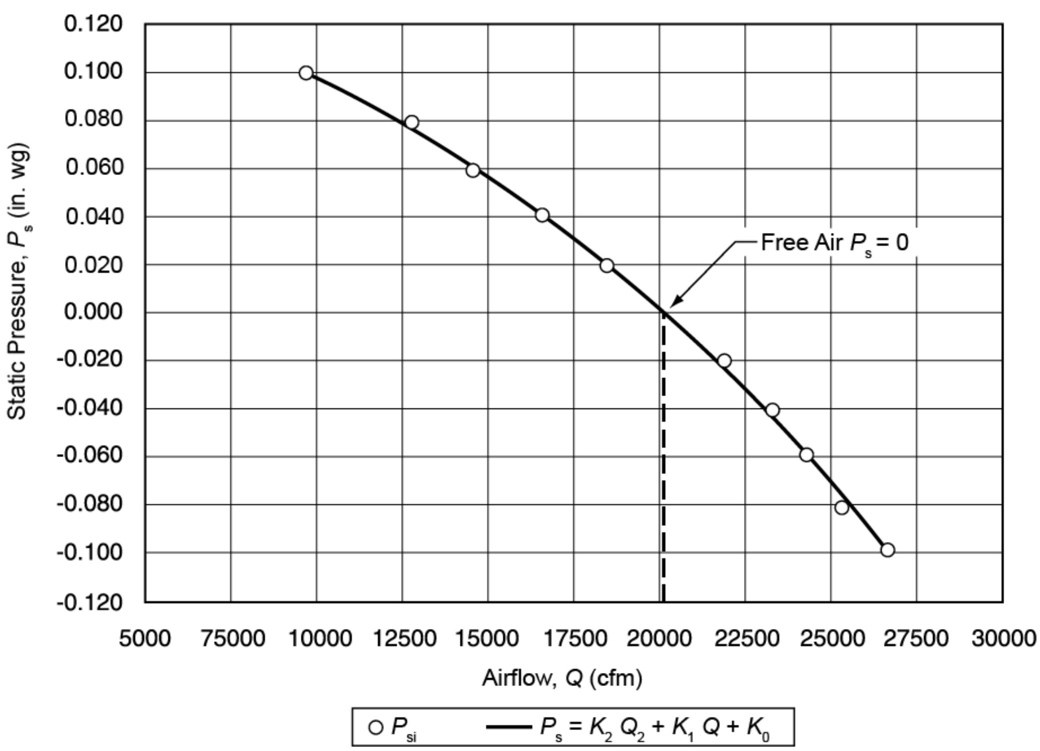
$P_s = P_{s7}$ Eq. 10.4

Notes:
1. Variable exhaust system may be an auxiliary fan or a throttling device.
2. The distance from the exit face of the largest nozzle to the downstream settling means shall be a minimum of 2.5 throat diameters of the largest nozzle.
3. Dimension *J* shall be at least two times the PPV equivalent discharge diameter.
4. Temperature t_{d7} may be considered equal to t_{d5}.

Figure 10.2 — Test Setup



SI



I-P

Figure 10.3 — Airflow vs. Static Pressure Curve

TEST REPORT

Air Movement and Control Association International, Inc.
30 West University Drive, Arlington Heights, Illinois 60004-1893, U.S.A.

Test Number
761-P04-A1

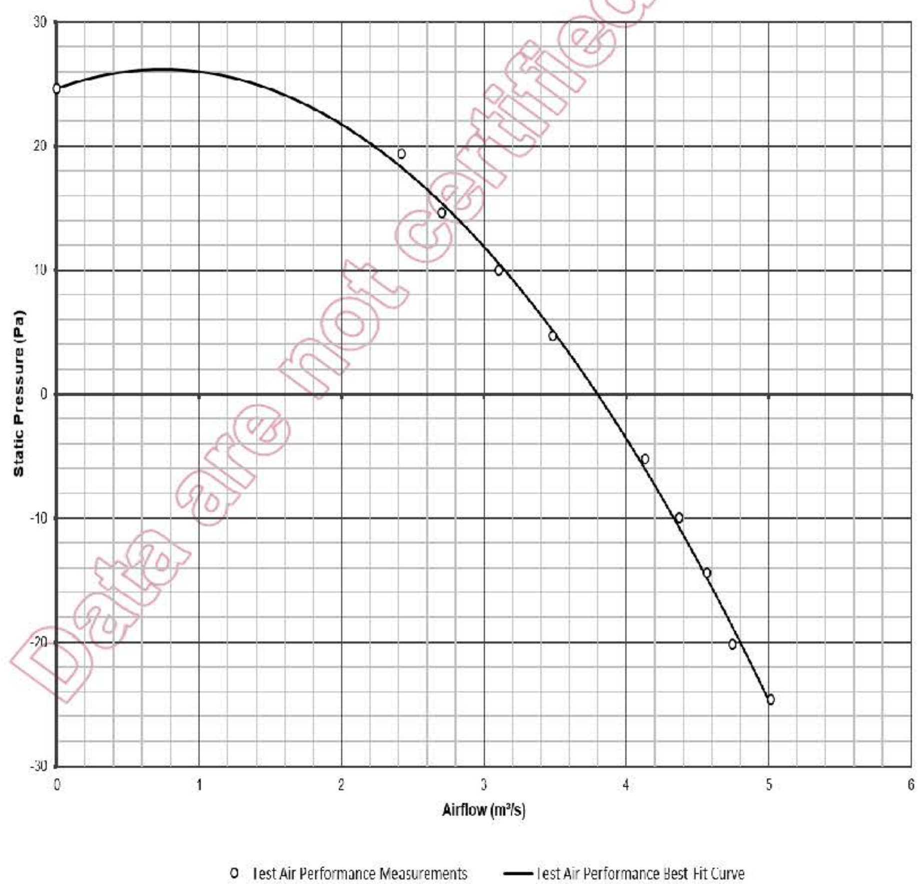
Test Unit:	Positive Pressure Ventilator	Test Purpose:	Contract Test
Manufacturer:	Windmaker 324	Date of Test:	01/01/2021
Trade Name:	Windmaker 324	Client:	Windmaker 324
Model Number:	Windmaker 324	Witness:	None
Impeller Diameter:	610.000 mm	Personnel:	Lab Staff
Inlet Area:	0.315 m²	P_b:	0.03 kPa
Outlet Area:	0.315 m²	Unit System:	SI
PPV Setback, *s*:	3 m	Battery Manufacturer:	Company A
PPV Tilt, ϕ:	11 deg.	Battery Model:	Model Name
PPV Height, *h*:	457 mm	Nominal Voltage to PPV:	Nominal Battery Voltage

Test Method per ANSI / AMCA Standard 240, Figure 2 Setup

Comments: Windmaker, Type D Misting Nozzles

Battery Run Time:

As-Run Results at Standard Air



AMCA Standard 240 - Test Calculations Report, Version 1.2.2

SI

Figure 10.4A — Example Test Report (Page 1 of 3)

TEST REPORT

Air Movement and Control Association International, Inc.
30 West University Drive, Arlington Heights, Illinois 60004-1893, U.S.A.

Test Number
761-P04-A1

Test Unit:	Positive Pressure Ventilator	Test Purpose:	Contract Test
Manufacturer:	Windmaker 324	Date of Test:	01/01/2021
Trade Name:	Windmaker 324	Client:	Windmaker 324
Model Number:	Windmaker 324	Witness:	None
Impeller Diameter:	610.000 mm	Personnel:	Lab Staff
Inlet Area:	0.315 m²	P_b:	0.03 kPa
Outlet Area:	0.315 m²	Unit System:	SI
PPV Setback, *s*:	3 m	Battery Manufacturer:	Company A
PPV Tilt, ϕ:	11 deg.	Battery Model:	Model Name
PPV Height, *h*:	457 mm	Nominal Voltage to PPV:	Nominal Battery Voltage

Test Method per ANSI / AMCA Standard 240, Figure 2 Setup

Comments: Windmaker, Type D Misting Nozzles

Battery Run Time:

Results at Test Conditions:

Det. No.	ρ (kg/m³)	N (rpm)	Q (m³/s)	P_s (Pa)	P_{s_FIT} (Pa)
1	463.14	3499	5.01	-24.62	-24.93
2	463.14	3502	4.74	-20.14	-18.70
3	463.14	3503	4.57	-14.42	-14.81
4	463.14	3506	4.37	-9.95	-10.66
5	463.14	3506	4.13	-5.22	-5.97
6	463.14	3509	3.48	4.72	5.12
7	463.14	3506	3.10	9.95	10.56
8	463.14	3510	2.70	14.67	15.42
9	463.14	3511	2.42	19.40	18.32
10	463.14	3511	0.00	24.62	24.65

Curvefit Results:

$$P_{s\_FIT} = K_2 \cdot Q^2 + K_1 \cdot Q + K_0$$

K_2: -2.803817

K_1: 4.164497

K_0: 24.65356

Airflow at Free Air:

Q_f: 3.80 m³/s

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Figure 10.4B — Example Test Report (Page 2 of 3)

TEST REPORT

Air Movement and Control Association International, Inc.
30 West University Drive, Arlington Heights, Illinois 60004-1893, U.S.A.

Test Number
761-P04-A1

Test Unit:	Positive Pressure Ventilator	Test Purpose:	Contract Test
Manufacturer:	Windmaker 324	Date of Test:	01/01/2021
Trade Name:	Windmaker 324	Client:	Windmaker 324
Model Number:	Windmaker 324	Witness:	None
Impeller Diameter:	610.000 mm	Personnel:	Lab Staff
Inlet Area:	0.315 m²	P_b:	0.03 kPa
Outlet Area:	0.315 m²	Unit System:	SI
PPV Setback, *s*:	3 m	Battery Manufacturer:	Company A
PPV Tilt, ϕ:	11 deg.	Battery Model:	Model Name
PPV Height, *h*:	457 mm	Nominal Voltage to PPV:	Nominal Battery Voltage

Test Method per ANSI / AMCA Standard 240, Figure 2 Setup

Comments: Windmaker, Type D Misting Nozzles

Battery Run Time:

Data at Test Conditions:

Det. No.	t_{d0} (°C)	t_{wo} (°C)	t_{d2} (°C)	t_{d5} (°C)	P_{s5} (Pa)	ΔP (Pa)	t_{d7} (°C)	P_{s7} (Pa)	N (rpm)	V (DC)
1	66.6	46.8	67.8	67.8	-0.10	5.88	67.80	-0.10	3499	12
2	66.6	46.8	67.8	67.8	-0.08	5.26	67.80	-0.08	3502	12
3	66.6	46.8	67.8	67.8	-0.06	4.87	67.80	-0.06	3503	12
4	66.6	46.8	67.8	67.8	-0.04	4.46	67.80	-0.04	3506	12
5	66.5	46.7	67.8	67.8	-0.02	3.98	67.80	-0.02	3506	12
6	66.5	46.7	67.8	67.8	0.02	2.83	67.80	0.02	3509	12
7	66.4	46.7	67.9	67.9	0.04	2.24	67.90	0.04	3506	12
8	66.4	46.7	68.0	68.0	0.06	1.70	68.00	0.06	3510	12
9	66.5	46.7	68.0	68.0	0.08	1.36	68.00	0.08	3511	12
10	66.4	46.7	67.9	67.9	0.10	0.00	67.90	0.10	3511	12

Open Nozzle Diameters (in.):

Det. No.	Open Nozzle Diameters
1	10.0 mm, 10.0 mm, 10.0 mm, 10.0 mm
2	10.0 mm, 10.0 mm, 10.0 mm, 10.0 mm
3	10.0 mm, 10.0 mm, 10.0 mm, 10.0 mm
4	10.0 mm, 10.0 mm, 10.0 mm, 10.0 mm
5	10.0 mm, 10.0 mm, 10.0 mm, 10.0 mm
6	10.0 mm, 10.0 mm, 10.0 mm, 10.0 mm
7	10.0 mm, 10.0 mm, 10.0 mm, 10.0 mm
8	10.0 mm, 10.0 mm, 10.0 mm, 10.0 mm
9	10.0 mm, 10.0 mm, 10.0 mm, 10.0 mm
10	10.0 mm, 10.0 mm, 10.0 mm, 10.0 mm

AMCA Standard 240 - Test Calculations Report, Version 1.2.2

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Figure 10.4C — Example Test Report (Page 3 of 3)

TEST REPORT

Air Movement and Control Association International, Inc.
30 West University Drive, Arlington Heights, Illinois 60004-1893, U.S.A.

Test Number
761-P04-A1

Test Unit:	Positive Pressure Ventilator	Test Purpose:	Contract Test
Manufacturer:	Windmaker 324	Date of Test:	01/01/2021
Trade Name:	Windmaker 324	Client:	Windmaker 324
Model Number:	Windmaker 324	Witness:	None
Impeller Diameter:	24.000 in.	Personnel:	Lab Staff
Inlet Area:	3.400 ft²	P_b:	28.91 in. Hg
Outlet Area:	3.400 ft²	Unit System:	IP
PPV Setback, *s*:	120 in.	Battery Manufacturer:	Company A
PPV Tilt, ϕ:	11 deg.	Battery Model:	Listed Amp Hours
PPV Height, *h*:	18 in.	Nominal Voltage to PPV:	Nominal Battery Voltage

Test Method per ANSI / AMCA Standard 240, Figure 2 Setup

Comments: Windmaker, Type D Misting Nozzles

Battery Run Time:

As-Run Results at Standard Air

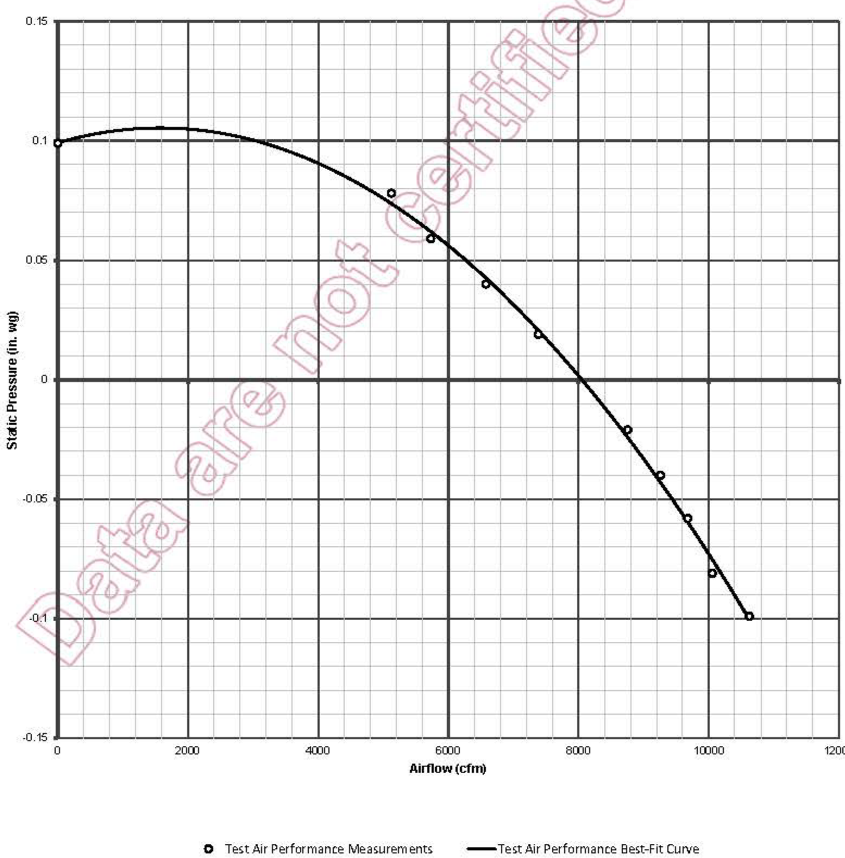

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Figure 10.5A — Example Test Report (Page 1 of 3)

TEST REPORT

Air Movement and Control Association International, Inc.
30 West University Drive, Arlington Heights, Illinois 60004-1893, U.S.A.

Test Number
761-P04-A1

Test Unit:	Positive Pressure Ventilator	Test Purpose:	Contract Test
Manufacturer:	Windmaker 324	Date of Test:	01/01/2021
Trade Name:	Windmaker 324	Client:	Windmaker 324
Model Number:	Windmaker 324	Witness:	None
Impeller Diameter:	24.000 in.	Personnel:	Lab Staff
Inlet Area:	3.400 ft²	P_b:	28.91 in. Hg
Outlet Area:	3.400 ft²	Unit System:	IP
PPV Setback, *s*:	120 in.	Battery Manufacturer:	Company A
PPV Tilt, ϕ:	11 deg.	Battery Model:	Listed Amp Hours
PPV Height, *h*:	18 in.	Nominal Voltage to PPV:	Nominal Battery Voltage

Test Method per ANSI / AMCA Standard 240, Figure 2 Setup

Comments: Windmaker, Type D Misting Nozzles

Battery Run Time:

Results at Test Conditions:

Det. No.	ρ (lbm/ft³)	N (rpm)	Q (cfm)	P_s (in. wg)	P_{s_FIT} (in. wg)
1	0.0727	3499	10623	-0.099	-0.100
2	0.0727	3502	10054	-0.081	-0.075
3	0.0727	3503	9678	-0.058	-0.060
4	0.0727	3506	9257	-0.040	-0.043
5	0.0727	3506	8752	-0.021	-0.024
6	0.0727	3509	7384	0.019	0.021
7	0.0728	3506	6579	0.040	0.042
8	0.0728	3510	5728	0.059	0.062
9	0.0727	3511	5126	0.078	0.074
10	0.0728	3511	0	0.099	0.099

Curvefit Results:

$$P_{s\_FIT} = K_2 \cdot Q^2 + K_1 \cdot Q + K_0$$

K_2: -2.51E-09
K_1: 7.9E-06
K_0: 0.099146

Airflow at Free Air:

Q_f: 8052 cfm

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Figure 10.5B — Example Test Report (Page 2 of 3)

TEST REPORT

Air Movement and Control Association International, Inc.
30 West University Drive, Arlington Heights, Illinois 60004-1893, U.S.A.

Test Number
761-P04-A1

Test Unit:	Positive Pressure Ventilator	Test Purpose:	Contract Test
Manufacturer:	Windmaker 324	Date of Test:	01/01/2021
Trade Name:	Windmaker 324	Client:	Windmaker 324
Model Number:	Windmaker 324	Witness:	None
Impeller Diameter:	24.000 in.	Personnel:	Lab Staff
Inlet Area:	3.400 ft²	P_b:	28.91 in. Hg
Outlet Area:	3.400 ft²	Unit System:	IP
PPV Setback, s:	120 in.	Battery Manufacturer:	Company A
PPV Tilt, ϕ:	11 deg.	Battery Model:	Listed Amp Hours
PPV Height, h:	18 in.	Nominal Voltage to PPV:	Nominal Battery Voltage

Test Method per ANSI / AMCA Standard 240, Figure 2 Setup

Comments: Windmaker, Type D Misting Nozzles

Battery Run Time:

: Test Conditions:

Det. No.	t_{d0} (°F)	t_{wo} (°F)	t_{d2} (°F)	t_{d5} (°F)	P_{s5} (in. wg)	ΔP (in. wg)	t_{d7} (°F)	P_{s7} (in. wg)	N (rpm)	V (DC)
1	66.6	46.8	67.8	67.8	-0.099	5.883	67.800	-0.099	3499	12
2	66.6	46.8	67.8	67.8	-0.081	5.263	67.800	-0.081	3502	12
3	66.6	46.8	67.8	67.8	-0.058	4.873	67.800	-0.058	3503	12
4	66.6	46.8	67.8	67.8	-0.040	4.455	67.800	-0.040	3506	12
5	66.5	46.7	67.8	67.8	-0.021	3.979	67.800	-0.021	3506	12
6	66.5	46.7	67.8	67.8	0.019	2.828	67.800	0.019	3509	12
7	66.4	46.7	67.9	67.9	0.040	2.243	67.900	0.040	3506	12
8	66.4	46.7	68.0	68.0	0.059	1.700	68.000	0.059	3510	12
9	66.5	46.7	68.0	68.0	0.078	1.362	68.000	0.078	3511	12
10	66.4	46.7	67.9	67.9	0.099	0.000	67.900	0.099	3511	12

Open Nozzle Diameters (in.):

Det. No.	Open Nozzle Diameters
1	10.0110 in., 10.0110 in.
2	10.0110 in., 10.0110 in.
3	10.0110 in., 10.0110 in.
4	10.0110 in., 10.0110 in.
5	10.0110 in., 10.0110 in.
6	10.0110 in., 10.0110 in.
7	10.0110 in., 10.0110 in.
8	10.0110 in., 10.0110 in.
9	10.0110 in., 10.0110 in.
10	10.0110 in., 10.0110 in.

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Figure 10.5C — Example Test Report (Page 3 of 3)

RESOURCES

AMCA Membership Information
http://www.amca.org/member

AMCA International Headquarters and Laboratory
www.amca.org

AMCA White Papers
www.amca.org/whitepapers

Searchable CRP Database of AMCA Certified Products
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