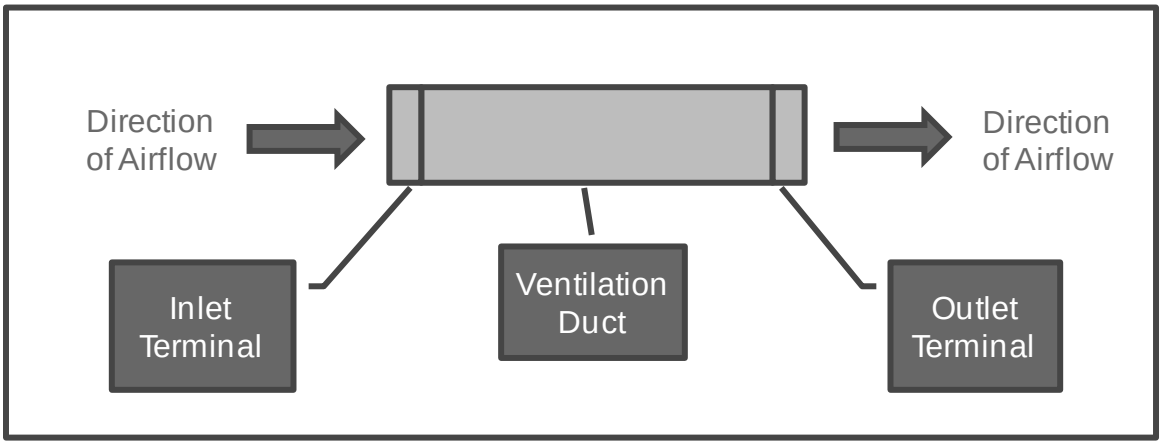
5. Procedure for Measuring Airflow of Mechanical Ventilation Systems

The purpose of this test procedure is to measure the volumetric airflow through a mechanical ventilation system, such as a whole-house ventilation system[23] or a local mechanical exhaust system[24, 25].

The airflow is permitted to be measured at the inlet terminal, per Section 5.1; or at the outlet terminal, per Section 5.2; or mid-stream in the ventilation duct, per Section 5.3.

The inlet terminal is defined as the location where the ventilation air enters the mechanical ventilation system and the outlet terminal is defined as the location where the ventilation air exits the mechanical ventilation system. A diagram of these locations for a generic mechanical ventilation system is shown in Figure 1.

Figure 1: Location of Terminals in Generic Mechanical Ventilation System



5.1. Procedure to Measure Airflow at Inlet Terminal

This Section defines procedures to measure the airflow of a mechanical ventilation system at an inlet terminal. The airflow is permitted to be measured using a Powered Flow Hood (Section 5.1.1); an Airflow Resistance Device (Section 5.1.2); or a Passive Flow Hood (Section 5.1.3).

[23] (Informative Note) For example, an outdoor air duct connected to the return trunk of an HVAC system, an in-line supply fan, an HRV, or an ERV.
[24] (Informative Note) For example, bathroom exhaust fan, kitchen exhaust fan.
[25] (Informative Note) Measuring the ventilation air supplied to corridors of multifamily buildings is beyond the scope of this Standard. However, measuring the flow rate of exhaust or supply systems used for whole house mechanical ventilation in individual dwelling units is within the scope of this Standard.

5.1.1. Powered Flow Hood

5.1.1.1. Equipment Needed

The Equipment listed in this section shall have their calibrations checked at the manufacturer's recommended interval, and at least annually if no time is specified.

5.1.1.1.1. Powered Flow Hood. A device consisting of a flow capture element capable of creating an airtight perimeter seal around the inlet terminal; an Airflow Meter capable of measuring the volumetric airflow through the flow capture element with an accuracy equal to or better than ± 5 % or 5 cfm (2.5 L/s or 0.0025 m^3/s), whichever is greater; and a variable-speed Air-Moving Fan that is capable of moving air through the flow capture element and Airflow Meter.

5.1.1.1.2. Manometer. A device that can measure the static pressure inside the flow capture element relative to the room with an accuracy equal to or better than ± 1% of reading or 0.25 Pa (0.0010 in. H2O), whichever is greater.

5.1.1.2. Procedure to Conduct Airflow Test

5.1.1.2.1. The flow capture element of the Powered Flow Hood shall be placed over the inlet terminal, ensuring that an airtight perimeter seal has been created.

5.1.1.2.2. The variable-speed Air-Moving Fan shall be turned on and the airflow adjusted until, using the Manometer, zero pressure difference (+/- 0.1 Pa (0.0004 in H_2O)) is measured between the flow capture element and the room.

5.1.1.2.3. The average volumetric airflow through the Airflow Meter, measured over at least a 10-second period, shall be recorded, and the variable-speed Air-Moving Fan shall be turned off.

5.1.2. Airflow Resistance Device

5.1.2.1. Equipment Needed

The Equipment listed in this section shall have their calibrations checked at the manufacturer's recommended interval, and at least annually if no time is specified.

5.1.2.1.1. Airflow Resistance Device. A device consisting of a flow capture element that has a known opening area and is capable of creating an airtight perimeter seal around the inlet terminal.

5.1.2.1.2. Manometer. A device that can measure pressure difference with an accuracy equal to or better than ± 1% of reading or 0.25 Pa (0.0010 in. H2O), whichever is greater.

5.1.2.2. Procedure to Conduct Airflow Test

5.1.2.2.1. The flow capture element of the Airflow Resistance Device shall be placed over the inlet terminal, ensuring that an airtight perimeter seal has been created.

5.1.2.2.2. The opening area of the Airflow Resistance Device shall be adjusted until, using the Manometer, the pressure difference between the flow capture element and the room is between 1 and 8 Pa.

5.1.2.2.3. The average pressure difference (dP) between the flow capture element and the room, measured over at least a 10-second period, shall be recorded.

5.1.2.2.4. Using the average pressure difference, the airflow shall be calculated using the manufacturer's flow conversion table or, for devices without a flow conversion table, the following equations:

$$Airflow\ (CFM) = Opening\ Area\ x\ 1.07\ x\ (dP)^{0.5} \quad (11a)$$

$$Airflow\ (L/s) = Opening\ Area\ x\ 0.078\ x\ (dP)^{0.5} \quad (11b)$$

Where: For Eq. 11a, Opening Area is in in^2 and dP is in Pa
For Eq. 11b, Opening Area is in cm^2 and dP is in Pa

5.1.2.3. Limitations of Procedure. An Airflow Resistance Device is only permitted to be used on mechanical ventilation systems that do not have multiple duct branches.

5.1.3. Passive Flow Hood

5.1.3.1. Equipment Needed

The Equipment listed in this section shall have their calibrations checked at the manufacturer's recommended interval, and at least annually if no time is specified.

5.1.3.1.1. Passive Flow Hood. A device consisting of a flow capture element capable of creating an airtight perimeter seal around the inlet terminal; and an Airflow Meter capable of measuring the volumetric airflow through the flow capture element with an accuracy equal to or better than ± 5 % or 5 cfm (2.5 L/s or 0.0025 m^3/s), whichever is greater.

5.1.3.1.2. Manometer. A device that can measure pressure difference with an accuracy equal to or better than ± 1% of reading or 0.25 Pa (0.0010 in. H2O), whichever is greater.

5.1.3.2. Procedure to Conduct Airflow Test

5.1.3.2.1. The flow capture element of the Passive Flow Hood shall be placed over the inlet terminal, ensuring that an airtight perimeter seal has been created.

5.1.3.2.2. The pressure tubing shall be inserted inside the flow capture element between the Airflow Meter and inlet terminal.

5.1.3.2.3. The pressure difference between the flow capture element and the room shall be measured using the Manometer. If the pressure difference is more than 8 Pa, the procedure shall be terminated and no results recorded.

5.1.3.2.4. If the pressure difference is ≤ 8 Pa (0.03 in H_2O), then the average volumetric airflow through the Airflow Meter, measured over at least a 10-second period, shall be recorded.

5.2. Procedure to Measure Airflow at Outlet Terminal

This Section defines procedures to measure the airflow of a mechanical ventilation system at an outlet terminal. The airflow is permitted to be measured using a Powered Flow Hood (Section 5.2.1) or using a Bag Inflation Device (Section 5.2.2).

5.2.1. Powered Flow Hood. To measure airflow at an outlet terminal using a Powered Flow Hood, Section 5.1.1 shall be followed except with all occurrences of the phrase "inlet terminal" replaced with "outlet terminal".

5.2.2. Bag Inflation Device

5.2.2.1. Equipment Needed

5.2.2.1.1. Bag Inflation Device. A flow capture element capable of creating an airtight perimeter seal around the outlet terminal that is connected to a plastic bag of known volume and holds the bag open[26] (e.g., a lightweight frame made of wood, plastic or metal wire), and a shutter that controls airflow into the bag.

The thickness of the plastic bag shall be selected such that three or more measurements of a single outlet terminal produce results that are within 20% of each other.

The volume of the plastic bag shall be selected such that the bag will completely fill with air from the outlet terminal in the range of 3 to 20 seconds.

5.2.2.1.2. Stopwatch. A stopwatch capable of recording elapsed time +/- 0.1 seconds.

5.2.2.2. Procedure to Conduct Airflow Test

5.2.2.2.1. The bag shall be completely emptied of air and the shutter closed to prevent airflow into the bag.

5.2.2.2.2. The Bag Inflation Device shall be placed over the outlet terminal.

5.2.2.2.3. The shutter shall be rapidly removed and the Stopwatch started.

5.2.2.2.4. The Stopwatch shall be stopped when the bag is completely filled with air from the outlet terminal and the elapsed time recorded.

5.2.2.2.5. The airflow shall be calculated using the following equations:

$$Airflow\ (CFM) = \frac{8 \times Volume}{Elapsed\ Time} \quad (12a)$$

$$Airflow\ (L/s) = \frac{4 \times Volume}{Elapsed\ Time} \quad (12b)$$

Where: Volume = The volume of the plastic bag, in gallons.
Elapsed Time = The time that elapsed until the bag was filled, in seconds.

[26] (Informative Note) For example, a lightweight frame made of wood, plastic or metal wire.