Measuring airflows

Ventilation systems in New Zealand homes rarely have their airflows measured and adjusted during installation, resulting in poorly ventilated rooms. Using active flow hoods during commissioning could change this.

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VENTILATION has an important impact on living spaces, the most significant being:

- moisture control for building material integrity
- indoor air quality for health.

Building Code requires ventilation

The airtightness of a building indicates how much ventilation will occur simply by wind and temperature differences, without opening windows or doors. The more airtight a building becomes, the less air is exchanged between indoors and outdoors. This decreases the amount of fresh air replacing stale and potentially polluted indoor air.

The Building Code stipulates that ventilation has to be provided for each occupied room in a house. One method for rooms located on an external wall is having a net openable window area that is at least 5% of the floor area.

But are those windows or other openings such as external doors, opened often enough to achieve the goal of providing good indoor air quality?

Poor indoor air quality common

Problems with high moisture levels and the associated poor indoor air quality have been observed in many homes. Although we do not have the stringent European ventilation regulations to comply with, many New Zealand homes have been fitted with some form of ventilation system

Ventilation systems in commercial buildings are maintained with the airflow delivered or extracted from each room through a diffusor or vent. The airflow is then measured and adjusted to suit the needs of the building and its use.

In residential buildings, this is generally not the case. This can potentially cause under or overventilation and result in poor indoor air quality and unnecessary energy loss. Measuring the airflow of the ventilation system should be carried out as part of the commissioning of the system.

So what needs to be considered when measuring airflow through a ventilation system, and what does the accuracy of the result depend on?

Flow hoods measure airflow

There are many different devices and methods used to measure the airflow through vents. Generally, they are referred to as flow hoods, and they can usually measure airflow in both directions. Some devices or methods work well with low measurement uncertainties - less than 10% - while others show systematic errors of 50% and more.

Flow hoods with high uncertainty are not adequate for ensuring ventilation systems are delivering an appropriate amount of fresh air and should not be used.

The measurement device is not the only important thing for the accuracy of the measurement. The method and way it is placed over the vent also affects the accuracy of the measurement.

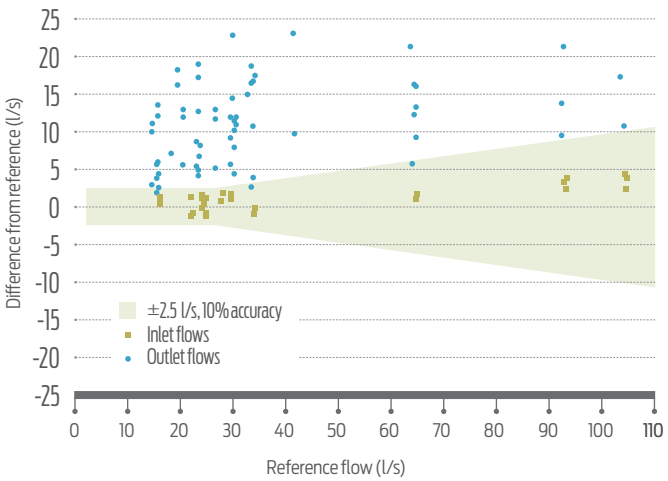

Figure 1: Measurement errors of a non-powered or passive flow hood. The shaded area indicates the acceptable accuracy range.

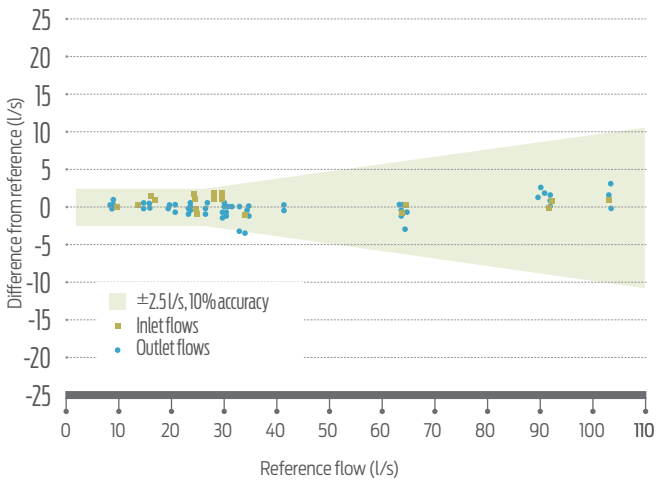

Figure 2: Measurement errors of a powered or active flow hood. The shaded area indicates the acceptable accuracy range.

Ventilation systems are low-pressure systems, and their ductwork characteristics and fan working points are altered when devices are, even temporarily, attached to them. Adding a flow hood causes the pressure in the ventilation system to drop, leading to a lower reading for the flow rate. This pressure drop occurs on both supply and extraction vents. The severity of this effect depends on ventilation system parameters such as ductwork type, fan type and pressure drop in the ductwork.

Active flow hoods more accurate

There are two main categories of flow hoods - powered (active) and non-powered (passive). Passive flow hoods measure the flow that goes through the hood passively. In contrast, active flow hoods track the static pressure and control a fan so that flow through the flow hood matches the flow through the vent, bringing the pressure difference to zero.

Using an active flow hood avoids the systematic flow measurement error caused by the pressure drop the flow hood introduces. For this reason, passive flow hoods should not be used.

The accuracy of the flow measurement also depends to a large degree on the uniformity of the flow that enters the flow hood.

Errors from non-uniform flow

Figures 1 and 2 show lab results obtained under controlled airflow conditions by research teams at Lawrence Berkeley National Lab in the US.

Non-uniformity of incoming flow caused greater measurement errors in a passive flow hood (see Figure 1) than the errors with an active flow hood (see Figure 2).

Non-uniformity can be caused by the duct system itself and by the vent (diffusor/grille). Placement of the flow hood over the vent has also been found to be critical.

Position of flow hood is critical

The biggest measurement errors are caused by off-centre placement of the flow hood over the vent. Often, the operator has little choice as vents are placed too close to the intersection of ceilings and walls or other obstacles.

Some of these problems can be addressed by making the flow that enters the flow hood more uniform with grids and meshes. Devices with these additional components deliver considerably more accurate results.

Measure/adjust during commissioning

When commissioning a ventilation system in a residential building, the performance of the system should be measured and, if necessary, adjusted for an optimal flow rate. Vents placed in the ceiling or walls during installation should be placed in a way that ensures a flow hood can be placed centrally over them.

Given the sensitivity of the air flow measurements using flow hoods, only active flow hoods should be used for measuring either air handler flow or the flow of individual vents.