AIVC

#3625

CSA Preliminary Standard: F326.1-M1989

Residential Mechanical Ventilation Requirements

The long awaited residential ventilation standard has now been issued as a preliminary standard. It describes ventilation requirements for habitable spaces of single family dwellings (as defined by the scope of Part 9 of the National Building Code of Canada) that are self contained with respect to heating, ventilation and air conditioning. This is the first part of a series of standards that will deal with ventilation.

Part 1 covers ventilation requirements. Other parts are still being prepared. These are Part 2: installation requirements (it will include workmanship, materials, equipment, insulation requirements for ductwork, and system design) - in other words the "how to"; and Part 3: compliance methods (how the installer and inspector is to check an installation to see if it meets the requirements of the standard).

Who prepared the Standard?

As with all CSA standards, this one was prepared by consensus. In other words they are developed by a committee to a point where there is majority agreement on the shape of the document. The committee includes persons from all sections of the residential building industry, including ventilation equipment manufacturers, contractors, R-2000 program administrators, building inspectors, government and utility representatives.

The aim in issuing a preliminary document is to give everyone involved in the industry an opportunity to evaluate the requirements. The desire is to get the maximum feedback from the field as to where and what kind of changes should be made. Doing field trials before making a final decision on the standard will, it is hoped, identify any shortcomings with the proposed criteria.

What is the scope of the standard?

CSA F326.1 specifies the requirements for mechanical ventilation systems whose purpose is to provide ventilation air for habitable spaces of single family dwellings. The document applies to detached, semi-detached and row housing, regardless of the type of heating used. While it is not intended for apartments, the ventilation air requirements of these should be similar.

The amount of ventilation and exhaust air specified are meant to deal with contaminants at the rate they are normally generated in dwellings. It is also noted that acceptable indoor air quality requires that the rate of contaminant emission be controlled. Where unusually high rates of emissions occur, or low concentrations limits are specified, other measures may need to be taken.

The assumption has been made that outdoor air is suitable for ventilation. In areas with exceptionally poor outdoor air, other measures beyond the scope of the standard may be required (e.g special filtration and air cleaning, etc.).

In establishing the requirements for mechanical ventilation systems, the house must be considered as a total system. Most houses have a variety of venting equipment that move air in and out of the house. The leakage characteristics of the envelope must be kept in mind.

Factors such as climatic conditions, leakage characteristics, operation of combustion appliances and ventilation equipment will affect indoor/outdoor pressure differences and thus in turn the performance of combustion and ventilation equipment. CSA F326.1 has tried to consider systems as they relate to the whole house, so that ventilation solutions do not create problems elsewhere.

The ventilating effects of uncontrolled air leakage, natural ventilation through open windows, or other openings operated by the residents are not taken into account. In other words, they are not considered to be adequate for fresh air. However, uncontrolled leakage through the building envelope will affect and may augment the ventilation provided by the mechanical system.

The ventilation requirements are not intended to deal with the combustion and dilution air needs of vented combustion appliances. Allowable limits of depressurization that can be put on the whole house (created by running the ventilation system or other exhaust appliances) are spelled out. This has been done to minimize problems due to backdrafting of combustion products.

The air supply needed for fireplace combustion nor the supply of make-up air required to replace that exhausted through the fireplace flue are not considered by this standard. Such requirements are above and beyond those included in the standard. (But that is why the limits on allowable depressurization are spelled out).

The standard defines key terms used in ventilation.

A **Bathroom** is defined as any room containing a toilet, urinal, bidet bathtub or shower.

The **conditioned volume** of the house includes the total interior heated volume including basement, but not garage or crawl space.

Exhaust air is air removed from a space and not reused.

A **Habitable room** is a space designed for human occupancy such as bedroom, den, living, dining, family, recreation room or kitchen. (In other words any room that is not strictly for storage or utility purposes).

Make-up air is outdoor air supplied to replace exhaust air.

Occupied zone is the area between 3" and 5'10" above the floor within an occupied space, and more than 2' away from the wall or fixed air conditioning equipment.

A **utility room** is a room containing laundry or maintenance equipment and materials, or that is used as a workshop.

General Requirements

Mechanical ventilation systems and equipment must be installed in conformance to appropriate sections of Part 6 of the National Building Code.

Ventilation Air Requirements

The ventilation system must be designed so that it can operate on a continuous basis and provide a flow rate that is calculated by taking the sum of individual room requirements (see Table A) or 0.3 air changes per hour based on the conditioned volume of the house (whichever is greater). The ventilation air must be distributed through the dwelling.

TABLE A

CSA F326.1 MINIMUM VENTILATION AIR REQUIREMENTS

Space	Base flow rate	intermittent exhaust	continuous exhaust
Category A			
Master bedroom	10 l/s		
Basement	10		
bedrooms	5		
living room	5		
Dining	5		
Family	5		
Recreation	5		
Other	5		
Category B			
Kitchen	5	50 l/s	30 l/s
Bathroom	5	25	15
Laundry	5	-	-
Utility room	5	-	-

- Ventilation requirements for combination rooms (or open spaces) must be calculated as for individual rooms.
- "Other" does not include spaces such as hallways, landings, storage rooms, vestibules, or access spaces.
- Basement requirements are for unfinished, uncompartmented areas. If walls and doors are installed, then each room is treated separately.

Where the system must be shut off (for example during defrost cycle of those HRV's that defrost by shutting off) it must be designed so that the shut off time is not more that 1 hour in any 2 hour period and the average ventilation air flow in any 24 hour period meets the minimum specified.

Base flow rate for rooms

Ventilation is intended to meet fresh air requirements for the occupants, so the amount required is matched to the expected number of occupants. Required air flows are determined based on the number and types of rooms in the house.

CSA F326.1 identifies two types of rooms. **Category A** rooms are living areas, and **Category B** rooms are the service rooms of the house (not normally occupied for extended periods).

The type **B** rooms are the source of moisture and odours. Air removed from bathrooms and kitchens must be exhausted directly to the exterior.

The design of the system must allow air to move from each type **A** room to the return or exhaust port intended to serve it. Service rooms can be supplied directly or by air flowing through from other rooms, provided that there is an unrestricted air path available at all times for air to move into the room. In other words, transfer grilles or undercut doors are necessary if supply comes from adjoining rooms.

Recirculating systems

When the ventilation air is distributed through a central recirculation system (as in a forced air heating system), the ventilation requirement of the living spaces (type **A** rooms) is satisfied where the total air continuously supplied or removed is no less than 20 l/s. For service rooms (type **B**), it is satisfied if total air supplied or removed is not less than 5 l/s.

Kitchens and bathrooms must be exhausted either on a continuous or intermittent basis at a rate of not less than that noted in Table A. Exhaust air must be directed outside, without recirculation. Heat recovery equipment can be used if the leakage from the exhaust to the supply air stream is not more than 5% of the total air stream.

Systems must be designed so that ventilation air is distributed throughout the occupied zone (defined as the area between 3" and 5'10" above the floor and more than 2' from the walls or fixed air conditioning equipment). Short circuiting from supply to return air grilles must be avoided.

Supply air must be introduced in a way or at a temperature that the ventilation air does not create occupant discomfort in the occupied zone.

Where cold air is introduced into the return air plenum of fuel fired appliances, it must be tempered and/or mixed with return air so that the temperature of the air when it reaches the furnace heat exchanger is not less than 12°C. The reason for this is the concern that cooling of the furnace heat exchanger can result in thermal stresses when the burner comes on, and this could lead to early equipment failure, or condensation, corrosion and shortened life span for the equipment.

To avoid condensation on the exterior surfaces of ducts, the ventilation air must be tempered and/or mixed with return air or the ducts must be insulated so that when the outdoor air temperature is at the 2 1/2% winter design temperature, the exterior surface of the ducts is not less than 14°C.

Pressure Design Limits

The ventilation system must be designed so that it does not impose pressures of more than 10 Pascals between inside and outside when operating at the base rate, either positive or negative pressures.

If naturally aspirating combustion appliances (units that take combustion air and dilution from the house, and depend on natural draft to vent products of combustion to the outdoors) are used, the house must not be depressurized by more than 5 pascals. If induced draft appliances are used, the allowable pressure imbalance is 10 pascals.

ABOUT UNITS

The CSA Standard only uses metric units. In order not to create undue confusion or introduce errors, we are using metric units only in this story.

Many are more comfortable with, and still use imperial units. The conversion to cfm (cubic feet per minute) is almost exactly 2:1. In other words,
5 l/s is approx. = 10 cfm

(the exact number is 10.59 cfm)

To determine allowable imbalances, the total air flow that must be considered is the *sum* of the net ventilation flows at the base rate, plus the net exhaust flow from the clothes dryer (75 l/s is the assumed default value) *and* the net exhaust of the two mechanical exhaust devices that provide the greatest exhaust over and above any devices contributing to the base ventilation and the dryer.

If sealed combustion appliances are used (where the combustion takes place in a totally sealed environment), and there are no opening through which combustion gasses can enter the house, the allowable depressurization is the value for which the appliance appliance has been certified or 20 pascals (whichever is less).

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Copies are available from:
Canadian Standards Assoc.
178 Rexdale Blvd.
Rexdale (Toronto), Ont. M9W 1R3

Commentary on CSA F326.1

As with so many codes and regulatory documents, CSA F326.1 is written in a very academic way that takes some effort to untangle what it is really saying. However, the standard is a good first step towards defining ventilation requirements.

The required flows are based on the current assumption that a ventilation air flow of 7.5 l/s (15 cfm) per person is needed to control the contaminants generated by human metabolic processes. For persons at rest, the minimum is about 5 l/s (for control of CO_2 emissions).

For average sized families, the rates of ventilation air will be supplied at a rate of 7.5 l/s per person. An appendix note suggests that if the number of persons to occupy a room is known, the base flow rate should be adjusted to provide a minimum of 5 l/s per person.

The values proposed are intended to provide enough ventilation air for typical occupancy situations. The approach being followed here is a good one, as it avoids calling for an arbitrary ratio of house volume. It does this by calling for air flow rates based on the number and type of rooms in the house. It also requires that ventilation air must be distributed throughout the dwelling.

However, a three bedroom house is likely to have a base flow rate of at least 45 l/s (90 cfm) at the suggested ventilation rate of 7.5 l/s per person. This corresponds to the needs of a continuous occupancy by 6 persons!

The assumption that the occupancy is going to match the number of rooms in the house is somewhat arbitrary. Evidence shows us that people are living in increasingly larger dwellings, with more rooms per capita than ever before. Statistics Canada tells us that the average Canadian household size is 2.8 persons (down from 3.9 in 1961). If that is the case, why insist that mechanical ventilation must be continuous at the rate based on the number of rooms or volume of the house?

Is this a case of everyone trying to cover their backsides? Or is there something else on the minds of the committee?

In France ventilation has been a code requirement for many years. Ventilation rates were determined after a statistical analysis was done of the number of occupants in typical dwelling units. The French Code recognizes that in a small portion of housing units (that may be over-occupied), code ventilation requirements may be inadequate.

The issue of air flow requirements is important as ventilation not only provides fresh air, but is also the main way of dehumidifying the home. The humidity in dwellings during the heating season is dependent on the rate of moisture generation, the extent of removal of moist air at its source, and the dehumidifying effect of ventilation.

Because we tend to have large under occupied homes, ventilation of the house at the specified rates can over ventilate the home, and thus dry it excessively. This not only is uncomfortable (generating static shocks) but it is not healthy, since very dry conditions are ideal for bacteria and viruses as well as aggravating respiratory ailments.

The ventilation rates called for are assumed to be enough to maintain the humidity of the house below values at which condensation on the windows becomes excessive. However, this is dependent on the temperatures outside and of the glass, so there may still be times at extreme conditions that either some condensation on the window may have to be tolerated, or the house will be excessively dry.

Another concern with CSA F326.1 is that there is no recognition that occupants may wish to control airflows to levels suitable for comfort. For under-occupied large houses, adequate air flows for adequate ventilation air flows (for safety and health) may well be much lower. A control strategy must be accommodated.

The appendix notes that building materials, systems and furnishings also are a source of contaminants. In dwellings with large rooms there is a possibility that the base flow rate will provide inadequate ventilation to control the level of contaminant from these sources. This is why the minimum ventilation rate has been set at 0.3 air changes per hour.

Why are we creating a standard for ventilating occupant introduced furnishings and activities, when that is such a variable? Is there a standard family profile that was used on which to base this?

If ventilation is meant to provide fresh air (for health and safety) we must also assume that people will not unduly load their house with foul pollutant generating items. If they do, it presumably is the exceptional case, and not the norm. It would make sense to call for optional capacity related to special needs, rather than continuous operation.

There seems to be quite a bit of confusion about the goals. Ventilation is for people emissions and not for the control of emissions generated by the things people put into the house.

Persons who are hypersensitive to specific contaminants will require special measures to be taken. These cannot be mandated in a general standard. Requirements may well have to be exceeded for this type of situation.

While the attempt has been made to recognize that all systems in a house operate as parts of a whole, other standards still don't go far enough to deal with the situation.

A new standard on Design and Construction of Masonry Chimneys and Fireplaces requires that adequate combustion air be supplied directly from outside the dwelling, but does not require that fireplaces be equipped with tight fitting glass doors, which are needed to aerodynamically isolate the house from the fireplace.

A fireplace operating alone or in combination with other exhaust devices could cause depressurization exceeding pressure design requirements, resulting in venting problems for other fuel burning appliances.

The building industry is encouraged to review the CSA F326.1 standard and make comments to the CSA committee.

Richard Kadulski

Is This Why Home Prices have Increased?
(And affordability become the big issue?)

Statistics Canada tells us that in 1961, Canadian homes had an average of 5.3 rooms, and a household of 3.9 people. (Kids were routinely doubled up). The 1986 Census showed that the average dwelling unit has expanded to 5.8 rooms, while the size of household has shrunk to 2.8 people. If the pattern continues, today's kids can expect to have smaller families (if they have any children of their own).

Part of the change of dwelling size has been accounted for by renovations and additions: between 1981 and 1986 the number of houses with 7 or more rooms *increased* by 514,935!

Another shift in the makeup of the population that will be of interest to builders is that life expectancy now averages five years longer than a quarter-century ago. In 1961, life expectancy for females was 74.26 and 68.44 for males, while in 1986 it had increased to 79.78 for females and 73 for males.

Do these statistics mean anything to the builder? Family size and ages are important as they influence space requirements and the type of housing stock required.

Older people have different housing needs than young families. One important feature is the preference for less stairs and levels. We wonder why, if families are getting smaller and the population is aging, do virtually all houses (and even many townhouse units) still have 3 bedrooms? In an earlier era (20 - 30 years ago and earlier) many small 2 bedroom houses were built and served the needs of large families. Perhaps now is the time to consider modifications to home designs we build today.

This may also point the way to dealing with the affordability issue.