

HRAI TECHNICAL COMMENTARY

Residential Ventilation Issues

by Dara Bowser & Bob Allison

Outside Air Connections to Warm Air Systems for Make Up Air....Part 6 Rules (Part 3 of a series)

A previous article, (October 1994) discussed the rules for outside air connections to the furnace return air duct for houses with ventilation systems conforming to Section 9.32. In this situation, the ventilation system design would be acceptable *without* the outdoor air connection. The outdoor air connection is considered to be part of the heating system only and the rules which apply to it arise out of the Part 6 requirements for heating systems.

For ventilation system designs according to Part 6, the outdoor air intake connection may or may not be a required part of the ventilation system. *The intake connection is part of the ventilation system if it is required to maintain the pressure balance of the house.* This is often the case when *spillage susceptible combustion appliances* are installed. This article will discuss issues concerning connections which *are* part of the ventilation system design.

F326 Applies in Part 6

When designing a ventilation system according to Part 6, the appropriate reference standard is CSA F326. The standard is referenced in sentence **6.2.1.1.(1)** and is the only standard which meets the intent of sentence **6.2.2.1.(2)**.

Solid Fuel

Although CSA F326 applies equally to solid and non-solid fuel appliances, the rules for solid fuel appliances are usually easier to meet in section 9.32 than in F326. For a new house, an HRV will generally be required to meet the depressurization requirements of F326 however make-up air *may also be required*, especially if a large exhaust appliance installed. Section 9.32 relies on an HRV to provide balanced ventilation and a Carbon Monoxide (CO) detector to provide warning to the occupants in the event of back-spillage caused by a dryer or other large exhaust device. The CO detector avoids the need for a depressurization test and additional make-up air.

Depressurization Limits

If spillage susceptible appliances (solid or non-solid fuel) are installed; F326 requires that the ventilation system not create more than a 5 Pa (pascal) pressure difference when operated in the "*Reference Exhaust Condition*" (REC). The REC is defined as:

- a) the ventilation systems operating at the "Total Ventilation Capacity".
- b) The dryer operating, (or a simulated dryer at 75 L/s. (150 CFM))
- c) any exhaust device operating which has an exhaust capacity of 75 L/s or greater.

Compliance by Calculation

F326 allows a designer to calculate what the probable depressurization will be in advance of construction. The calculation method is set out in the *HRAI Residential Mechanical Ventilation Manual* and is taught in the HRAI Ventilation Design course. Graduates of this course can be recognized by the "DI" prefix on their certification numbers. This calculation requires a good understanding of the air-moving systems, building air leakage and the "*House as a System*". In it's simplest form, this calculation involves:

- a) Calculating the "net exhaust" of the house at the REC. (the difference between the incoming and the outgoing airflows)
- b) picking a "Leakiness Factor" which represents the "leakiness" of the house. (called the "*Normalized Leakage Area*" or NLA).
- c) Multiplying the NLA by the *envelope area* (total surface area) of the house to get the total leakage area (called *Equivalent Leakage Area* or ELA).
- d) Looking up the flow of outside air that would "leak into" the house at a depressurization of 5 Pa, according to the ELA of the house.

The NLA given in the HRAI Manual for new homes is $0.7 \text{ cm}^2/\text{m}^2$. This is a conservative value representing the more air-tight of new homes in Ontario. (It is not possible to use the "average" value, or else the calculation would be wrong 50%

of the time). The following table shows some typical leakage flows at 5 Pa according to house area.

**Maximum Air Leakage @ 5 Pa
Pressure Difference, New House,
HRAI Calculation**

Floor Area Ft ² (including basement)	Envelope Area Ft ²	Air Leakage @ 5Pa CFM
1000	2,500	52
1500	3,750	78
2000	5,000	103
2500	6,250	129
3000	7,500	155
3500	8,750	181
4000	10,000	207

Note: This chart should not be used for calculation as actual house envelope areas can vary significantly from the shape factor assumed for this example.

As an example, a 2,500 ft² house might have a Total Ventilation Capacity of 120 CFM. If the ventilation is provided by an exhaust only ventilation system, the Reference Exhaust Condition (REC) be at least 270 CFM (120 CFM + 150 CFM dryer). 141 CFM of make-up air will be needed to ensure that the house is not depressurized beyond 5 Pa. If an HRV is used to provide the ventilation, the REC will be reduced to 150 CFM but 21 CFM of make up air will still be required because the maximum leakage is only 129 CFM. If large exhaust appliance is installed, even more make-up air will be required.

Depressurization Test

F326 allows a depressurization test to be carried out as an alternative to the calculation. The test is usually more forgiving than the calculation because the house may be leakier than the assumed "leakiness factor". The test is described in the HRAI and OBOA Ventilation Manuals and a standard test report form is available. The test procedure is covered in the HRAI Installers course.

Automatic Damper and Interlock

F326 requires that any opening not required to be open continuously be equipped with an automatic closure. This means that the make-up air inlet must be equipped with an automatic damper,

controlled by an interlock to the device(s) which cause the depressurisation. Equipment which could be interlocked includes; the dryer, large exhaust device(s) and the ventilation fans themselves. When the make-up air inlet is connected to the furnace return, the furnace blower will also have to be interlocked to operate at the proper speed.

The only situation where a make-up air connection to a furnace return would not require an automatic damper is when the make-up air is designed to provide ventilation air for an exhaust fan which is part of the ventilation system. Interlock to the furnace fan would be required in any event.

Summary

Make-up air inlets in houses with Part 9 Ventilation Systems need only conform to the rules for warm air system design.

If the make-up air inlet is part of F326 (Part 6) ventilation design as the result of a calculation or test, it will require an interlock with the depressurizing device and will usually also require an automatic damper.

HRV's will usually be required in F326 designs involving spillage-susceptible equipment, however a depressurization test or calculation (and make up air if required) is also required to account for the exhaust of the dryer and any large exhaust device.

The topic of this article is covered in detail in the 2-day HRAI workshop: "*Residential Ventilation System Design*". (Building Officials should note that the 2-Day OBOA Residential Ventilation Workshop is a prerequisite for the HRAI course.

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