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Eagle's Eye on Housing: Chatting with Bill Crist

When I recently Googled start-up procedures for HRVs, downloaded and read several manufacturers' recommendations, I ended up more confused than when I started.

Some Canadian manufacturers include calculating TVC. Several gave instructions to take readings from both sides, intake and exhaust, and balance to the lower reading. If that's the case, why do the TVC calculation? My thought was that you needed to set the exhaust at TVC and then balance the supply to exhaust rates. Seeking an expert opinion, I contacted Bill Crist, who has provided training in ventilation systems for HRAI. Over several weeks, we had the following conversation via e-mail.

FNNBOA : What is the proper use of TVC calculations in balancing HRVs?

BILL: *The TVC (Total Ventilation Capacity) is the high-flow rate, or high-speed capacity, of the ventilation system. If the HRV is intended to meet the TVC requirements, high- speed airflows should be at least 90 per cent of this TVC number. The TVC is calculated based on the number of rooms in the house (rooms such as the master bedroom and basement are allocated 20 CFM each. All other rooms are allocated 10 CFM).*

For example, a three-bedroom house with an undeveloped basement the TVC would be:

Kitchen	*10 CFM*
Living room	*10 CFM*
Dining room	*10 CFM*
Master bedroom	*20 CFM*
Two other bedrooms	*20 CFM*
Bathroom	*10 CFM*
Basement	*20 CFM*
Total:	***100 CFM***

Any additional rooms would be an extra 10 CFM. So, when balancing the HRV, measure 100 cfm (90 CFM min.) on both the supply and exhaust side of the HRV. BUT -- it is very important that the airflows be balanced within 10 per cent. If, say, the exhaust airflow is 100 CFM, but the supply (fresh air) is only 80 CFM, then the exhaust airflow should be reduced to within 10 per cent of the LOWEST airflow. So, in this case, the exhaust airflow should be reduced to 88 CFM.

Ideally, you should look for reasons why the airflow is below 100 CFM and correct this, but regardless, the airflows NEED to be balanced to within 10 per cent.

If they are not balanced, the following problems could arise:

1. *The HRV may not operate efficiently.*

2. *The HRV core(s) may freeze in cold weather (especially if the supply airflow is too high compared to the exhaust airflow).*

3. *The house may be either pressurized OR depressurized beyond safe limits*

In your example, the HRV would be undersized, 80 CFM, and the unit would have to be replaced with a higher-rated fan so as to fall within 10 per cent of TVC. My understanding of TVC is that the fan would have to oversized and then the supply/exhaust brought down to fall within 10 per cent of TVC. However, contractors using the NBC would use bedroom counts and rate the fans as between 44 and 64 CFM, in accordance with 2005 NBC Table 9.32.3.3. The HRV would be oversized, and the supply/exhaust would be brought down to fall within that range, thus the existing HRV is fine.

Other suppliers use house-volume size and have a formula to size the HRV. In that scenario, we need to know the square footage of the house, and heights of ceilings.

FNNBOA: Thanks for responding. As a First Nations Building Officer (FNBO), it is important to know how to size HRVs. What I really wanted to know is: What is the industry standard? Worst-case scenario? You would have to follow manufacturers' recommendations, and the FNBO would have to review each installation individually.

Bill: *Yes, you are right: If the measured ventilation rate is lower than the TVC, then this SHOULD BE CORRECTED. It can sometimes be corrected by better duct design or better duct installation (larger duct sizes, fewer elbows and restrictions etc.), or it may require a larger HRV or supplemental fans to meet the minimum TVC.*

In my opinion, the TVC room count method (CAN/CSA F326) is the most appropriate ventilation standard for your homes. I would recommend that you specify this standard when dealing with HVAC contractors. The house-volume method of calculating the ventilation rates is not commonly used anymore. Where there is high occupancy, the ventilation rate should be increased -- so even the room-count method may be result in under-ventilation if there is higher than average occupancy in the house. If there is a likelihood of higher-than-average occupancy, the designed ventilation rate should be increased accordingly.

It is also my view that issues with ventilation cannot be addressed by Minimum Code Compliance. Ventilation rates, whether using the NBC or the CAN/CSA F386, fail to recognize an over-crowded house. If using the NBC table, the determining factor is the bedroom count, which assumes one person per bedroom, except the master bedroom. The F386 uses a room count but again fails to recognize over-crowding. It would be better to use the National Occupancy Standard, which determines the number of bedrooms needed:

- *No more than two or fewer than one person per bedroom*

- *Parents do not share a room with children*

- *Permanent household members aged 18 or more (except couples) do not share a bedroom*

- *Permanent household members of opposite sex aged 5 or more do not share a bedroom*

FNNBOA: Under this standard, the following family example would require more than three bedrooms, and the ventilation rates would need to be increased.

John Cardinal—Father

Suzanne Cardinal—Mother

Tracy—19

Ken—15

Jim—12

Bob—5

Mary—3

John and Suzanne share a room. Tracy gets her own room. The boys can share a room. Bob and Mary can't share a room, thus Mary gets her own room and Bob shares a room with either Jim or Ken.

Thus the ventilation rates should be based on a five-bedroom house, which is above the minimum standards assumed by both the NBC and F326.

Your thoughts?

BILL: I*n my experience, a "typical" home may have three bedrooms on the main level and the equivalent of three bedrooms in the basement. Based on this, Section 9.32 of the NBC basically states that if the dwelling unit has more than five bedrooms, the ventilation system should comply with CAN/CSA-F326. So, I would recommend that the system be designed to meet F326 AND be sized based on the MAXIMUM number of bedrooms that may be developed in the basement area -- not just the typical three bedrooms on the main floor.*

This would usually result in the following:

Three bedrooms on main floor = 40 CFM

Kitchen, living room, dining = 30 CFM

Minimum of one bath on main = 10 CFM

Three bedrooms on lower level = 30 CFM

One bath on lower level = 10 CFM

Recreation/undeveloped remainder = 10 to 10 CFM

Total Ventilation Capacity (F326) =130 to 140 CFM

This TVC is considered the "minimum amount of outdoor air the ventilation system shall be capable of providing." On a typical 1000 to 1200 ft^2 bungalow, this would translate to 1/3 to 1/2 air change per hour IF THE SYSTEM IS OPERATED AT THE TVC. The bigger issue is making sure that the ventilation system is used properly. This means that it needs to be designed and installed so that the occupants will use it. Often I see these systems shut off when I do a site visit. If the system is designed (with proper controls) so that it is not noisy or uncomfortable AND does not use excessive energy, people will use it -- AND the above rates (CAN/CSA F326) will be adequate. The house should also have a quiet, outside-venting range hood.

In summary:

HRVs should be sized using:

- *CAN/CSA-F326-M, "Residential Mechanical Ventilation Systems,"*
- *NOS to a maximum of three additional bedrooms in basement*

Improperly sized HRVs can result in:

- *poor air exchanges*
- *high humidity levels resulting in mould*
- *uncomfortable homes*

HRVs should be balanced:

- *using F326 to determine exhaust rates*
- *exhaust air must be within 10 per cent of incoming air*

In cold climates, the following considerations should be taken into account:

- *Incoming air may need to be tempered to prevent frost build-up*

In coastal climates the following consideration should be taken into account:

- *An Energy Recovery Ventilator may be better*
- *Consideration should be given to installing de-humidifiers*
- *Interior surface temperatures should be kept above 15 C*

To be effective, HRVs must:

- *be subject to a maintenance regime that includes regular cleaning of filters, ducts and insect screens*

- *be re-balanced every second year, or when there is a change in occupant loads or renovations that add rooms*
- *not be disabled*
- *not be used as the primary fan for removing moist air from bathrooms, kitchens or high moisture areas*

You have itemized some good points. I won't attempt to address them all here, but just a few comments:

1. *I would suggest including a MINIMUM (not maximum) of three bedrooms in the basement. There could be more depending on the size of the basement.*

2. *The HRV exhaust CAN be considered as the PRIMARY exhaust for bathroom; you do not need additional bathroom fans if the exhaust grille and duct from the bathroom to the HRV are sized properly, the HRV is sized properly, AND the controls include a timer or switch in the bathroom that operates the HRV on high speed when needed. The HRV exhaust can also be considered the primary exhaust from the kitchen, but I would recommend ALSO installing an outside-venting range hood, as I mentioned previously. The HRV exhaust grille in the kitchen must have a grease filter, and should be at least four feet away from the range. The range hood will handle "extreme" situations (eg. burnt food, frying-pan smoke), and also times when say canning is being done and excessive humidity is being produced. Otherwise, the HRV exhaust will be the primary exhaust system for the kitchen and will operate continuously. Most occupants will not run the range hood for very long because of the noise.*