Residential Ventilation Issues

by Dara Bowser & Bob Allison

Connecting to the Forced Warm Air Return Duct... Which Hardware Can Be Used?

(Part 4 of a series)

In previous articles, we have reviewed the rules for connecting an outside air intake duct to the return of a forced air heating systems. Part 1 of this series (October '94) covered the rules for Outside air connections which are not considered part of the ventilation system. Part 3 of this series (this issue) covers the rules for outside air connections which are part of the ventilation system. Part 2 of the series (December '94) dealt with the underlying reasons for a minimum mixed air temperature when designing these systems. This article will review the available hardware which can be used for these connections.

Simple Duct

This duct leads from the outside of the house to the return air duct of the furnace and conforms to the rules set out in the code for intake height, insulation, etc. It will have been designed by the designer of the heating system who will have made a mixed air calculation, as well as airflow calculations. Ideally, the installer will actually measure the airflow on site and make any adjustments required to meet the design airflow. (Sadly, this is almost never done.)

The basic limitation of this system is the mixed return air temperature. If the minimum 60°F (15.5°C) is to be maintained, the amount of outside air will be limited by the total airflow of the central system and the winter design temperature. The table shows the maximum flow in CFM that could be allowed according to the winter design temperature and the system total airflow. These types of systems will bring in air whenever the forced air fan is operating. If the air is not required (i.e. there are no other exhausting devices operating) house pressurization could result. House pressurization can lead to structural damage from moisture as well as nuisances such as frozen door-locks.

Maximum Outside Airflow (CFM) to Maintain 15.5° C (60°F) Mixed Air Temperature

System Total Airflow CFM	Winter Design Temperature °C (°F)				
	-15 (5)	-20 (-4)	-25 (-13)	-30 (-22)	-35 (-31)
600	77	68	60	54	49
700	90	79	70	63	57
800	103	90	80	72	65
900	116	101	90	81	74
1000	129	113	100	90	82
1100	141	124	110	99	90
1200	154	135	120	108	98
1300	167	146	130	117	106
1400	180	158	140	126	115
1500	193	169	150	135	123

HRAI Technical Commentary Issue #21

On page 64, the chart should have read

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

Floor Area Ft² (Including basement)	Envelope Area Ft²	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.

Please take the time to correct Issue #21

Motorized Damper

Such a device will shut off the intake duct when it is not required. The most popular make is the Hoyme ACA-Pak line which is available at most wholesalers and is made in Alberta. Other brands are available; however, it is not clear if the other brands are suitable for the Canadian climate and will stand up to the condensation and icing which will occur during cold weather. ACA-Pak dampers are available in a variety of styles and can be equipped with end-switches to allow interlock with other fans and/or the furnace.

Bimetal Damper

These dampers are equipped with a bimetal (thermostatic) operator and are installed with a bypass duct to the warm air side of the furnace. When the furnace enters a heating cycle, warm air flows through the bypass, over the bimetal, thus opening the damper. Although some air comes in via the intake pipe between heating cycles, full airflow only occurs when the furnace is in the middle of its heating cycle. In this way, most of the problems which occur due to low return air temperature are avoided. (Low return air temperatures are more of a problem during the "burner off" cycle than during the "burner on" cycle.) Due to their reliance on burner operation, these dampers cannot be used to supply ventilation air or make-up air.

Mixing Boxes

These devices may be manufactured or home-made. One such device is called the "Plusaire". They consist of an outside air connection and a bypass tube connected to a mixing box which is in turn connected to the return air duct of the furnace. Theoretically, this arrangement will result in warming of the incoming air so that problems due to low incoming air temperatures are reduced or eliminated. This would only occur when the furnace burner is in operation, so that the warming effect when the burner is off should be no better than if the outdoor air duct directly to the return air duct. The limits to outside air entry due to low temperature would be the same as for a directly connected duct. (See proceeding table). Additionally, there is no information (that the authors are aware of) that would allow a designer to design ductwork for such a device.

Summary

The simple duct from outside may be appropriate in some situations, although excessive airflow can result in low return air temperatures and house pressurization problems. Such intakes are useful in exhaust-only type systems, but if they are being relied upon to balance the house negative pressure, then an interlock is required between the exhaust fan and the furnace blower and the actual airflow or a depressurization test should be carried out. (See part 3 of this series.)

In other situations, a motorized damper is appropriate, particularly when make-up air is required for an exhausting device such as a dryer or cook-top exhauster. (See Part 3 of this series.)

Bi-metal (thermostatic) actuated dampers will provide additional ventilation during the heating season, but are not useful as part of a ventilation system or to provide make-up air.

"Mixing box" make-up air units provide no apparent improvement over simple intake ducts and are subject to the same rules for mixed air temperature.

Whenever this topic is discussed, the basic principals of "House as a System" apply.

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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