TECH TIP # 2

HARDI
HEATING, AIRCONDITIONING & REFRIGERATION DISTRIBUTORS INTERNATIONAL

One of a series of dealer contractor technical advisories prepared by HARDI wholesalers as a customer service.

How To Size Residential Ventilation Ducts

Many times plans for residential or individual apartment year-round air conditioning systems include the use of a so-called "fresh-air" or ventilation intake. Little design information has been published about sizing these intake ducts. The purpose of this Tech Tip is to illustrate an approach to selecting ventilation rates and sizing the ductwork to carry the design cfm.

The positive introduction of outdoor air into residential type heating-cooling systems can be used to control the indoor humidity and to supply needed makeup air for kitchen and other exhaust fans used to purge the house or apartment of unpleasant odors, cooking or tobacco smoke and excessive heat.

The size of the intake required is dictated by the air quality (cfm) to be handled. The required cfm, in turn, depends on several variables -- the tightness of the building, occupant living habits, and even local codes. We should also consider the *quality* of the outdoor air being introduced. Because of the uncertainty of these variables, the dealer has considerable latitude in their design.

Mechanical ventilation may not be a code requirement for residential type structures. (You should always check local codes to be sure!)

The advent of "lo-cal" construction -- extremely well insulated, well sealed housing units -- may necessitate some type of positive ventilation to control indoor air quality. Much research is being conducted to learn more about the effects of really tight houses on the number and type of air contaminants. Also, an increasing number of air-to-air heat exchangers for residential applications are becoming available to permit the introduction of ventilation air without dramatically increasing fuel consumption.

Ventilation in the amount of from ½ to 1 air change per hour has been popularly recommended. In a heating only situation, it has also been suggested that the ventilation rate plus natural infiltration should total one air change.

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Another approach to selecting a ventilation rate involves the size and number of exhaust fans installed -- the balanced exhaust method.

In some well-built homes or apartments with one or two exposures, natural air infiltration through cracks around doors and windows is insufficient to meet installed exhaust fan air flow rates, yet a free supply of makeup air is essential to the proper operation of these low pressure fans. Since some infiltration occurs in all homes, and it's unlikely that a home will have all of its exhaust fans in operation at one time, an alternate to any flat recommendation is to consider the combination of estimated natural infiltration and positive ventilation necessary to balance the exhaust cfm from the largest fan installed plus one smaller -- e.g., the range hood and one bathroom exhaust.

The value for the natural infiltration rate in cfm or air changes per hour can sometimes be determined from regular heat loss calculations. If not, assume a leakage rate around door and window openings of 0.5 cfm/ft. of crack for a well-built house, 0.75 cfm/ft. for an average or typically constructed building, and 1.0 cfm/ft for a loose house. Measure all the door and window crack lengths and then multiple **half** that value times the leakage rate. (It's assumed that natural infiltration does not occur through all doors and windows in the building at the same time.)

If you prefer you can also estimate natural in-leakage on an air change basis --- ½ house air changes per hour for a tight house, 1 air change per hour for an average house, and from 1½ to 2 air changes per hour for a loose house. For example, an average 12,000 cu. ft. house (1500 square foot) would experience a natural infiltration of 12,000 x 1 x 1/60, or 200 cfm.

Considering this same hypothetical house, if the installed kitchen hood exhausts 190 cfm and a bath fan exhausts 80 cfm, then the net forced ventilation required would be: (190 + 80) - 200, or 70 cfm.

None of the above methods take into account any special needs -- such as a party load.

However selected, once a ventilation rate has been determined, the accompanying table can be used to size the duct that connects the air intake to the return side of the year-round conditioning unit. The listed carrying capacity of each intake duct is based on an assumed design return system static pressure of either 0.05 or 0.10 in. WG, **plus** the reservation that the intake "system" must not exceed a resistance of 100 effective feet of duct (equivalent lengths of all fittings plus the measured length of ductwork).

Since the outdoor intake grille and the fitting joining the intake duct to the return duct system impose 80 equivalent feet by best estimates, the actual measured length of duct between intake and return connection cannot exceed 20 feet using Table 1. And if an elbow is required, the measured length of straight duct cannot exceed 10 feet. If an intake system must exceed these distances by a few feet, use the next larger duct.

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Based on an assumed 0.05 in. WG static pressure, our sample house would need a 6 inch intake to carry 70 cfm.

When installing an intake, don't forget that a vented attic or crawl space makes a good location and often involves a short runoff duct. Also, a damper should be installed in the intake duct so that the owner has some options on adjusting the cfm supplied.

Finally, remember an outside air intake **adds** substantially to the cost of operation --- both on heating and cooling -- so exercise care in design and instruct the owner on the use of ventilation air.

Suggested intake duct sizes, based on the rule that the intake run, including all fittings and intake grille, cannot exceed 100 effective feet (equivalent lengths of fittings plus measured length of straight duct).

TABLE 1

System Design Return Static Pressure			
0.05 in. WG		0.10 in. WG	
Ventilation (cfm)	Duct Size (diameter)	Ventilation (cfm)	Duct Size (diameter)
45	5	35	4
75	6	70	5
110	7	100	6
160	8	160	7
270	9	240	8
290	10	320	9
475	12	440	10