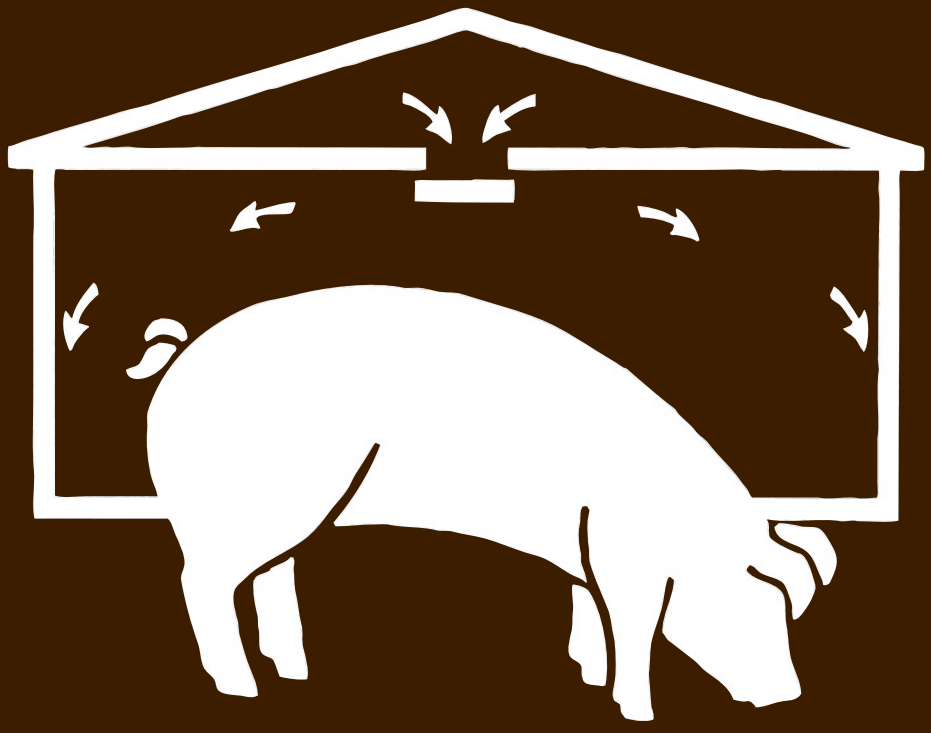
Ventilate Your Swine Nursery Building



IOWA STATE UNIVERSITY
Extension and Outreach

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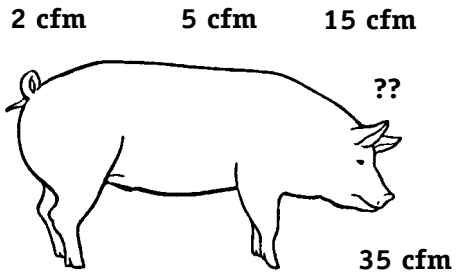
Ventilation systems used in swine nurseries are very similar in design and in management to those used in swine farrowing houses. The need for supplemental heat is the reason such systems are needed in both types of buildings, and the major difference between the two is in the ventilation rate. Generally, for the same number of litters the rate of air exchange is about twice as high for nursery pigs as for sows and litters.

How much air?



How Much Air?

The amount of air needed per pig depends on the temperature and relative humidity of the outside air, the temperature maintained inside, the relative humidity desired within the building, and the moisture produced in the building. The moisture produced is dependent on pig weight and type of floor used. It you want improved air quality, the ventilation rate occasionally will need to be increased more than that needed for moisture control alone.

Table 1 indicates average ventilation needs at various outdoor temperatures in buildings with floors that are totally or partially slotted.

Table 2 gives recommendations for fan selection based on standards formulated by Midwest Plan Service.

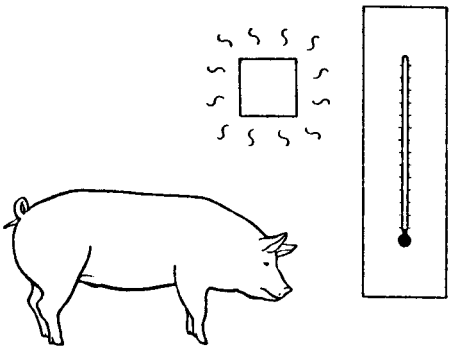
Table 1.

Outside Temperature - °F	Ventilation Rate Cfm/Pig			
	20 lb. Average		40 lb. Average	
	Total Slat	Partial Slat	Total Slat	Partial Slat
100	25	25	35	35
90	20	20	30	30
80	15	15	25	25
70	10	10	20	20
60	5.1	5.1	12	12
50	3.3	3.4	6.2	6.2
40	2.4	3.2	4.0	4.5
30	1.8	3.0	3.1	4.1
20	1.5	2.7	2.7	3.5
10	1.3	2.6	2.5	3.3
0	1.3	2.5	2.4	3.1
-10	1.3	2.5	2.3	3.0
-20	1.3	2.4	2.3	3.0

Table 2. MWPS Ventilation Recommendations

Pig Weight lbs.	Minimum Winter rate cfm	Mild Weather rate cfm	Hot Weather rate cfm
12-30	2	10	25
30-75	3	15	35

Heating Needs



Heating Needs

Nursery age pigs need to be kept warm to avoid stress. Suggested temperatures for nursery age pigs are given in table 3.

Table 3. Suggested Nursery Temperatures

Pig Age (Weeks)	Pig Weight (lbs)	Temperature (°)F
3	12	86-88
4	16	84-88
5	20	82-86
6	24	80-86
7	30	78-84
8	38	76-84
9	46	73-82

Small pigs do not produce enough heat to keep the building temperature at the desired level in cold weather. When selecting a supplemental heater, calculate the amount of heat supplied by the pigs by using a value of 250 BTU per hour per pig.

Heat Losses

In a well insulated building, only 10 to 20 percent of the heat used is lost through the building walls and openings. Eighty to 90 percent is required to heat the incoming ventilation air.

When a building is well insulated, it becomes important to manage the ventilation system to assure adequate air exchange and also to avoid excessive overventilation and the resulting higher fuel bills.

For example, in a 288-head well insulated nursery building with normal ventilation, the equivalent of 450 gallons of LP gas is required for winter heating. If the building was overventilated at the rate of 1/2 cfm per pig all winter, another 300 gallons of LP gas equivalent would be required.

But *underventilation may be even more costly than overventilation*. A disease outbreak or poorer pig performance can result from underventilation with its high humidities and stale air. When you manage the ventilation system to assure good pig performance, you may spend a little more for fuel but you could save a lot more through better pig health.

Winter Ventilation Control

Winter ventilation control is the process of balancing heating and ventilation systems to maintain a suitable environment inside the building. Controls that may be used are:

1. Timer
2. Thermostat
3. Humidistat
4. Variable speed fan control

Timers were more common when small capacity fans were not available. One fan was used for winter ventilation with the timer used to vary the average ventilation

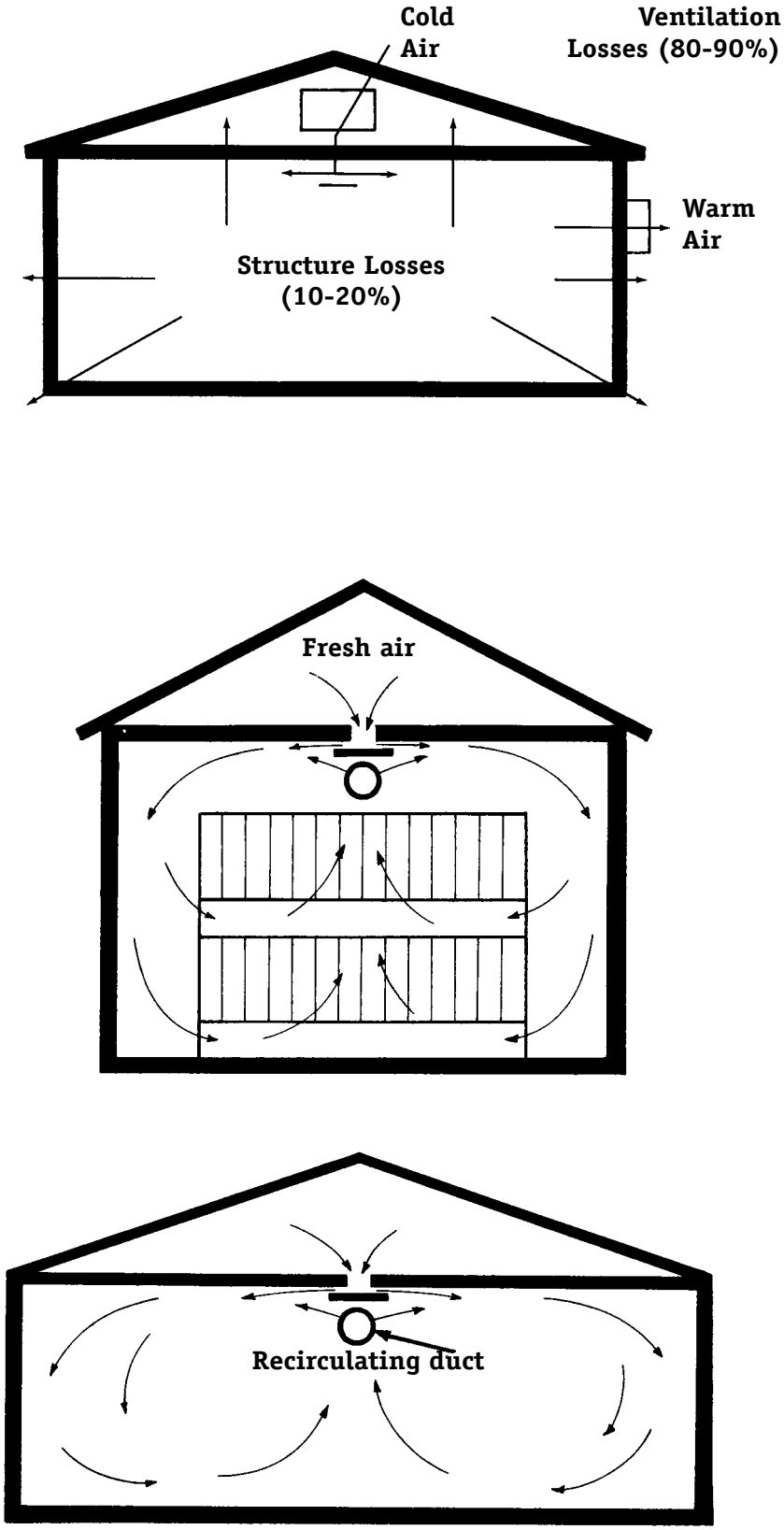


Figure 1.

rate. If a farrowing house needed 1,000 cfm for normal winter ventilation but only 300 cfm for the minimum, a 10-minute timer set to operate 3 minutes out of 10 would provide 300 cfm average ventilation with the 1,000 cfm fan. A continuous, 300 cfm fan provides better air circulation than a 1,000 cfm fan operated intermittently on a timer, so the old method is being replaced in new construction. With the timer system, there were also problems with keeping moist air from rising up through the inlets into the attic when the fan was off.

A **thermostat** is used on the space heater to maintain the desired temperature whenever it is cold enough outside to require supplemental heat. A continuous fan can provide adequate ventilation whenever it is cold enough for the heater to be operating. The thermostat turns the heater on when the inside temperature drops. A fan thermostat turns the fan on when the temperature rises so the second fan thermostat should be set 4 or 5 degrees above the heater thermostat. As it warms up outdoors, heat is no longer needed, but extra ventilation is, so the thermostatically controlled fan operates. With warmer air coming in, the room temperature rises and starts the second fan.

A **humidistat** or humidity control senses relative humidity and should be a good control for ventilation. But the corrosive and dusty environment in swine buildings has discouraged the use of humidistats. It takes careful management and frequent maintenance to keep humidistats operating accurately. A few people do operate them successfully.

Variable speed fan controls have been used with some success in providing a range of capacities with one fan. The air flow can range from full capacity at full speed to 20 percent of capacity at low speeds. Unfortunately, if the fan must operate against strong outside wind pressure at low speeds, the capacity may drop to nearly zero. It may be advisable to use a continuous fan for the minimum ventilation and to use a variable speed fan or one or more constant speed fans for the remaining fan capacity.

Air Distribution Important

Unheated incoming air needs to be evenly distributed throughout the building for several reasons:

1. To avoid chilling the pigs with cold air that has not mixed with the warm inside air.

2. To provide pickup of moisture throughout the building.

3. To reduce the possibility of drafts due to some parts of the building having air flows that are too high.

4. To avoid "dead spots" in the building.

So to provide good distribution, several choices are available.

- Use a continuous slot inlet system, properly adjusted, that provides uniform air flow throughout the length of the building.

- Or install equally spaced individual inlets that use a good baffle arrangement for distribution.

- Or use a duct tube, or other air mixing system to distribute the air.

All cold air should be introduced so it can mix with warm air before it reaches the level of the pigs. This usually means introduction up near the ceiling, directed horizontally so it remains near the ceiling as it mixes. With raised pens it may be possible to direct the air down along the wall and under the pens and not create cool drafts in the pen itself.

Pit Ventilation

Most new nursery buildings are designed so that manure is stored in the building for a short time only.

If manure is stored within your existing slotted pit building, pit ventilation is recommended. Pit ventilation serves several purposes. Its major function is to remove most manure gases before they rise above the slats to the pig level. This improves the environment for both the pigs and the person taking care of them. It also helps to dry slats more quickly and keeps the slats warmer.

Pit ventilation is *most* important at the time of pit agitation prior to pumpout. High concentrates of toxic gases are released during agitation. The best advice is to move the pigs out when agitating.

The most effective pit ventilation is through a duct or tube with properly spaced holes along the entire length of the pit. See Pm-861 *Rigid Plastic Tubes for Pit Ventilation*, for design information.

If fans along the pit are used without a duct, keep the manure level at least a foot below the bottom of the slats. If beams extend very far below the slats, allow sufficient space under them for adequate air flow.

Caution—Some inlet systems move air down between slats and force gases up in other parts of the building. If this is happening, change the direction of the inlet air flow.

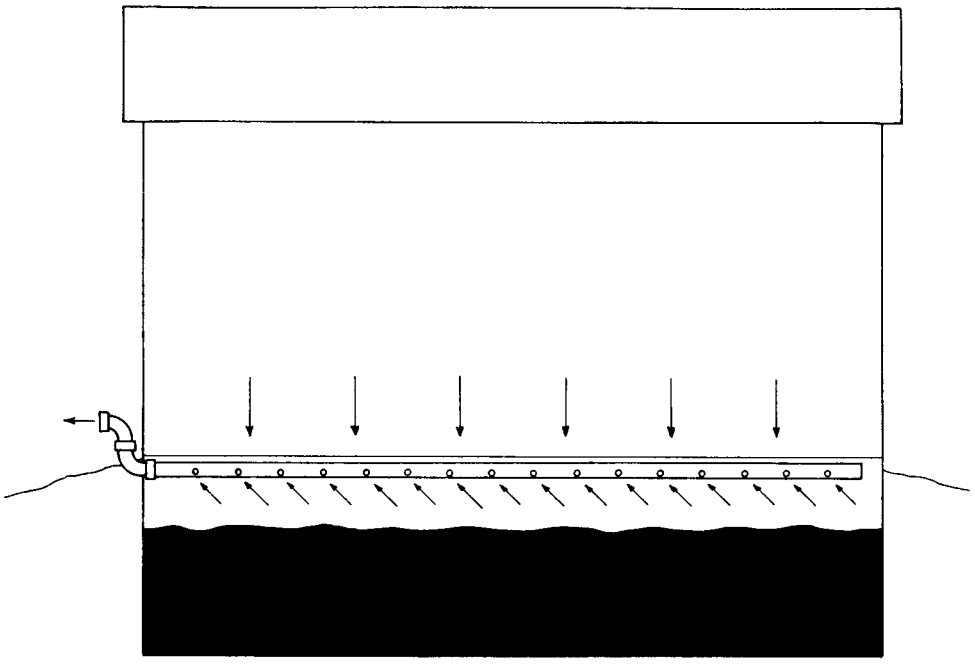


Figure 2. Pit Ventilation

Stratification of Air?

Will the temperature be much warmer in the upper half of the building than in the lower half? Not if the building is well insulated and the ventilation system is operating as it should, with good mixing and no dead spots. There should be no more than 3 to 5° temperature difference between air at the ceiling and the floor in a well insulated and properly ventilated building. A circulating fan will help provide mixing of the air at low winter air flows.

Avoiding Drafts on Top Deck if More Than a Single Deck Is Used

Make sure that no inlet directs high velocity air toward the pigs in the top deck. Introduce the fresh air above the decks and direct it horizontally under the ceiling. This allows time for mixing of the air above the level of the pigs. Keep the air moving very gently. It may be necessary to add a circulation duct or use some type of preheat.

Recirculating Duct

When temperatures are low outside, good distribution of the incoming air is difficult with a baffle inlet system. Because so little air is needed, the baffle must be closed down to a narrow opening. The narrower the opening, the harder it is to get uniform spacing and uniform distribution. Also the air is very dense and has a tendency to drop quickly.

A duct of plastic or wood can be used under a center slot inlet to mix the incoming cold and inside air and keep it moving along the ceiling longer.

Select a circulating fan with a capacity three times the minimum ventilation rate. For example, if the minimum rate is 200 cfm, use a 600 cfm fan for the recirculation duct.

Size the duct at 1 square foot cross-section for each 1,000 cfm of fan capacity. In the example above, 600/1,000 = 0.6 square foot cross section. A 10" diameter tube would provide this.

Locate the holes in the tube at a spacing of 12" or less. It would require 64 holes, 1 1/4" diameter, or 32 sets of holes.

Pre-heating Ventilation Air

Pre-heating air can minimize some of the problems encountered when trying to mix very cold air with indoor air. Pre-heating is possible with heat exchangers, earth tubes, solar heating, or the use of a pre-heat room or chamber.

Heat Exchangers

Heat exchangers or heat reclaimers save fuel and also provide tempering of the incoming air. This reduces the possibility of chilling pigs and eliminates "fogging" at the inlets.

Some heat exchangers can supply all of the winter ventilation needs, which makes winter ventilation management easier. If only minimum ventilation enters through the heat exchanger, then

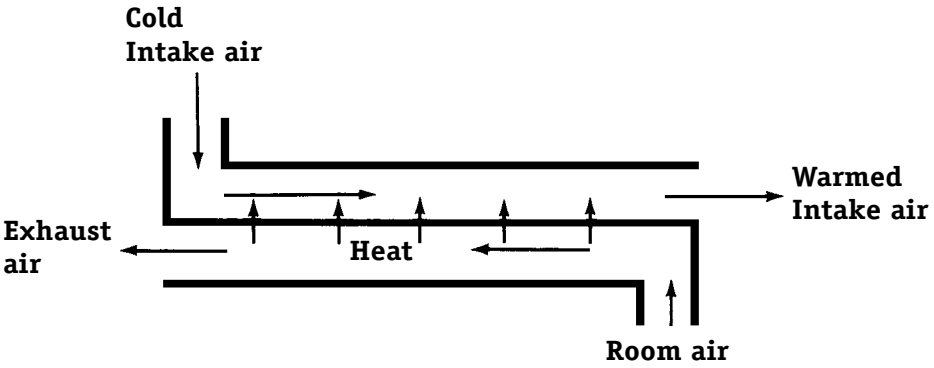


Figure 3. How a Heat Exchanger Works

the winter fan and the opening of the other air inlets must be carefully coordinated with the heat exchanger operation. It may be advisable to have the installer of this type of heat exchanger design the rest of the ventilation system to provide balanced operation.

Earth Tubes

Air can be preheated in cold weather by drawing it through tubes buried 8 feet deep. The same systems can be used to precool air in hot weather.

Solar Heating

A solar collector can be added to the south wall of a nursery building to pre-heat ventilation air.

Separate Preheat Room

To preheat ventilation air, one solution is to construct a room alongside or at one end of the nursery with a space heater installed in the room. When multiple rooms are used, a hallway can be used to temper the air. Set the thermostat in the room about 10°F below the desired room temperature. This may need to be adjusted up or down, depending on the heat produced by the pigs.

Insulation

A well insulated building is important to save fuel, avoid condensation and keep the inside wall surfaces from providing a radiant heat loss felt by the pigs. Try to eliminate windows or keep them to a minimum. Even a double glass window loses 10 times more heat than a well insulated wall.

For all but the southern part of the state, an insulation R value of 20 is suggested for the walls and 30 for the ceiling. Use 2 inches of a rigid insulation 2 feet deep for perimeter insulation.

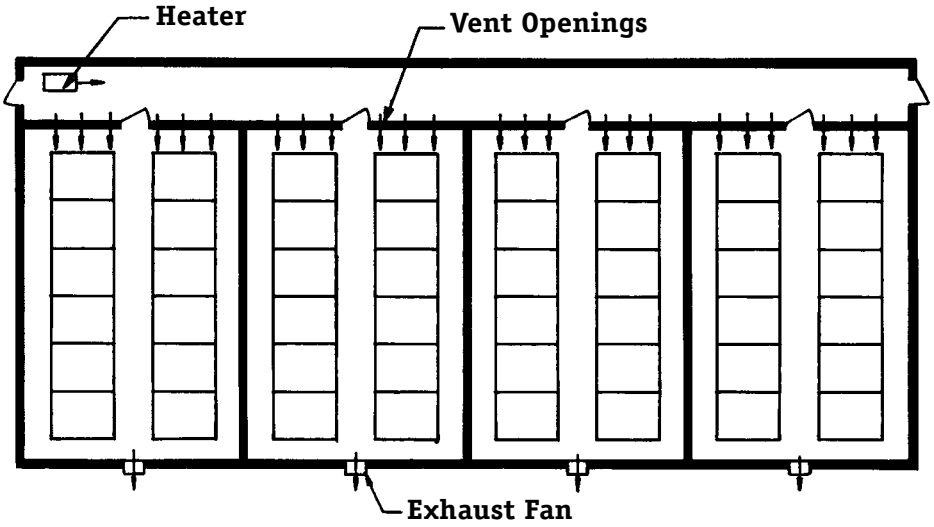


Figure 4. Four Nursery Rooms with Preheat Hallway

Managing Your Ventilation System

Try to get specific written operating instructions from the ventilation system dealer who installs your fan. Since so many variables affect ventilation, you may still need to make minor adjustments occasionally to the system to fit your particular building and animals in it.

Fan Construction Features

Fan blades and housing. Conditions inside a swine building are quite corrosive, so fan blades and housing should be a heavy-gage, corrosion-resistant metal, fiberglass, or plastic.

A totally enclosed motor. This is especially needed for exhaust fans that draw dust-laden air over the motor. An open motor would soon fill with dust and overheat.

Sealed bearings. If a fan motor must be oiled, the job often doesn't get done. Sealed bearings will eliminate the need to maintain a periodic oiling schedule.

Overload protection. Each fan should have its own overload protection. If the manufacturer does not provide this on the motor, a time delay fuse or other protection can be located at the outlet into which the fan motor is plugged.

Shutters (automatic closing). When the fans stop, shutters should close to avoid drafts blowing in through the fan housing. Shutters should be corrosion-resistant and easy to clean.

Wire mesh guard. The fan should also be protected to avoid injury and to keep out birds.

Fan Maintenance

Fans should be checked at least four times a year if operated year around, or twice a year if used only for winter ventilation. If excess dust builds up on the motor, shutters, and blades, they need to be checked more often.

Before touching the fan, unplug the cord or turn off the switch to shut off power to the fan motor. Clean the accumulated dust from the blades and shutters. Clean blades and shutters allow the fan to push more air with less power.

Clean dust and debris off the motor and turn the blade slowly to check the condition of the fan bearing. Check for looseness or noise indicating a worn bearing that needs replacing.

Check the fan shutter to see that it moves freely. Use graphite or a silicone compound to lubricate hinge joints. Don't lubricate with oil because it will collect dust and gum up the joints.

Emergency Ventilation

Plan for as many of the following as you can, in case of a power failure in a closed building:

1. Install a battery-operated alarm that sounds in your home to warn of trouble if power goes off in the hog house.

2. Provide a standby generator to supply power.

3. Install solenoid or other electrically closed doors that open if power goes off.

4. Open all doors and windows manually.

5. Move the hogs outside if you can't open the building sufficiently.

6. Consider a home alarm system that calls others with alarm warning when you are not home.