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Maintenance and Operation of Ventilation Fans for Hog Barns

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Ventilation Equipment

The purpose of this fact sheet is to assist in obtaining good performance from a hog barn ventilation system. Consult the fan manufacturer's literature for recommendations when possible. *Designing* the hog barn ventilation system is explained in other Pork Industry Handbook fact sheets or MWPS-8, Midwest Plan Service, Iowa State University, Ames, Iowa.

Frequently, the ventilation system is blamed for poor performance when actually it was not installed correctly or is not properly operated and maintained. A properly designed and operated fan ventilation system will keep a building reasonably dry and odor levels tolerable in cold weather. At near zero and lower temperatures, supplemental heat will be needed for farrowing barns, nursery barns and grower barns not filled to capacity, because animals cannot warm the necessary fresh ventilation air and also keep the building warm. In hot weather, a ventilation system (along with sprinklers or air coolers) can reduce temperatures and high humidity build-up. Use information from Table 1 and Figure 9 to check equipment capability.

A combination of (1) a small fan and large fans or (2) a small fan and 2-speed fans or (3) variable-speed fans is required to provide the range of air movement capacities needed for the various ventilation conditions in the barn throughout the year. Too large a continuous-operating fan wastes heat and causes drafts. To avoid cold drafts on hogs, install exhaust fans in the wall away from prevailing wind and near the ceiling. Use extra fans inside the barn to circulate the air during hot weather.

Select fans according to their capacity at 1/8 in. static pressure (water gauge) to assure desired air-movement operation of the several fans in the system. Pit fans and other small fans need good operating characteristics to prevent large fans from "outpulling" them and causing air to go backward through the fan. Well-built fans have smooth edges and few corners to catch dirt. Keep in mind

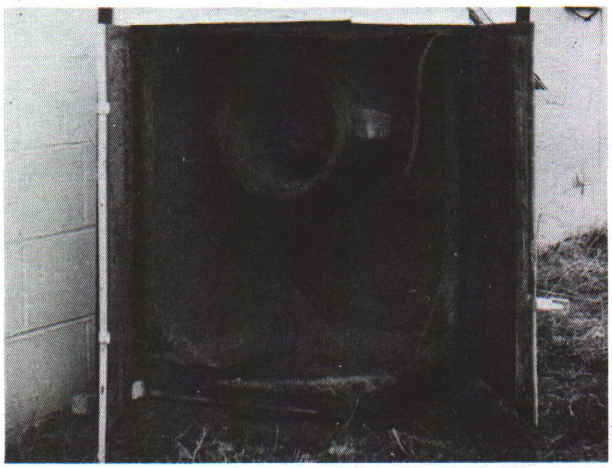

Figure 1. Hog barn fans, especially a continuous-running pit exhaust fan, need frequent cleaning to operate effectively. Dirt on fan blades reduces air movement capacity. Dirt on the motor and wires insulates heat in, causing energy loss and early breakdown.

Figure 2. The hoods and fans on this hog barn were completely rusted and corroded through in about 3 years. Periodic maintenance is required to minimize this kind of deterioration.

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the corrosive conditions in a hog barn. Moisture and manure gases will cause steel to rust, galvanized metal to corrode and copper (thermostats, electric switches and exposed wires) to disintegrate. Most plastics, fiberglass, aluminum, stainless steel or steel that is kept clean and painted should last at least 10 years.

Install fans on separate electrical circuits so that if a fuse should blow other fans can continue to operate. Check circuit voltage at the fan so it is suited to the motor.

No ventilation system can do a good job without good controls.

Because wiring thermostats backwards is an easy mistake to make, check for proper wiring. *Turn the thermostat to a setting lower than air temperature in the building;* if fans turn on, the thermostat is wired correctly.

Figure 3. Repainting a fan housing after it has been cleaned and the bare spots have been primed. Keep a record card on fan maintenance near the fan.

An acceptable method of controlling single-speed fans is to use a thermostat and a time clock wired in parallel. The *thermostat* is a temperature sensor and will run the fan continuously any time building temperature exceeds thermostat setting. The *time clock* acts as the primary fan control during winter operation. In other words, the time clock serves as the humidity control unit. The time clock should be reset every time there is a major temperature change in outside air. A good rule of thumb is to change the time clock settings whenever the average outside temperature rises or falls 10 degrees F.

Install air inlets so that fresh air thoroughly circulates inside before being exhausted from the barn. Provide about 1 sq. ft. of inlet area for each 1,000 CFM of fan capacity. Allow cold incoming air to be tempered in an attic or other building space before it enters the animal area. This minimizes the effects of wind gusts and severe cold. In hot weather bring fresh air directly into the barn space or through the cooling system.

Maintenance

Ventilation fans, like other mechanical equipment, need periodic maintenance. Consult the fan manual and a dealer about specific cleaning and lubricating directions.

Shut off electric circuits for fans before checking and servicing. Check fuses for a tight fit and wiring for deterioration and good connections.

Check the thermal overload protection for the motor. If a time-delay fuse is used, its ampere capacity should be about 125% of the full-load amperage shown on the nameplate of the motor. Larger sized protection may permit motor burnout. If a reset-button overload protection is used, check that it is not stuck.

Use a vacuum cleaner to simplify cleaning fans and thermostats. Use a stiff-bristled nylon brush to loosen stubborn dirt. A plastic windshield scraper is also useful.

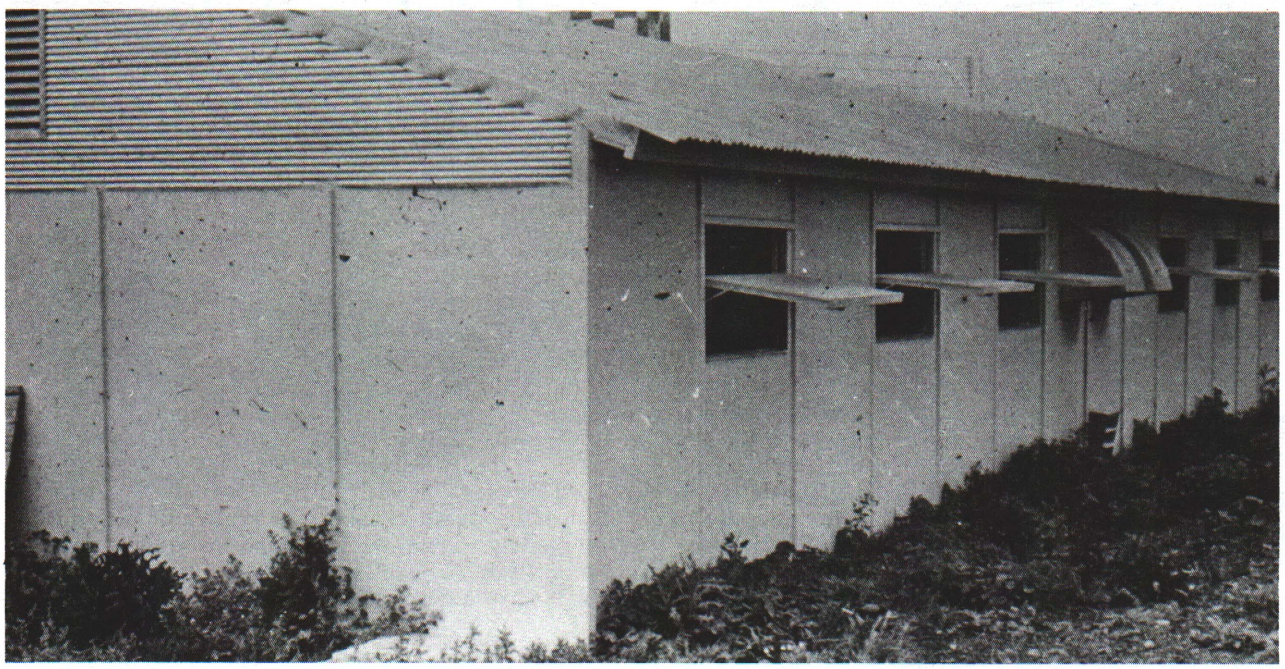

Figure 4. Tip-in wall panels for extra summer air movement. Large openings too near fans allow air to "short-circuit." The attic endwall ventilator and overhang vents remove hot air from the attic.

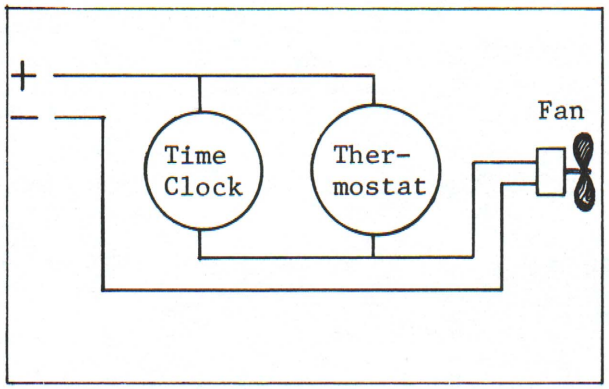

Figure 5. Wire a thermostat and a time clock in parallel in the fan circuit so either control can run the fan without the other control. Keep spare thermostat and time clock for quick replacement when a control fails.

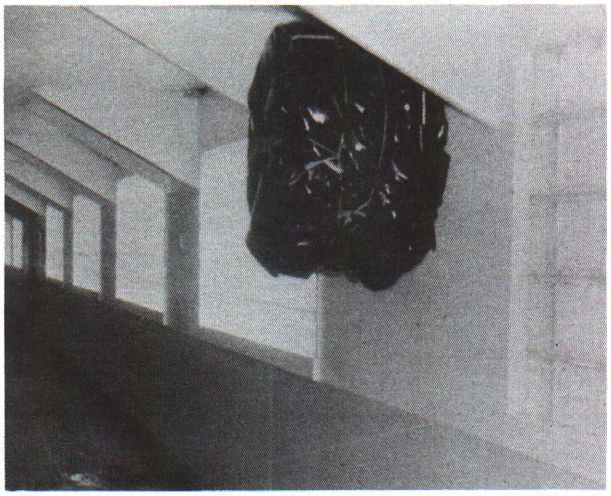

Figure 6. This high-capacity summer fan is shut off and "winterized" with a layer of batt insulation protected by plastic sheeting. This cuts down cold air leakage and frost build-up. Operate other fans every few days to prevent ice and dirt build-up that can stall the fan when it is called upon to operate.

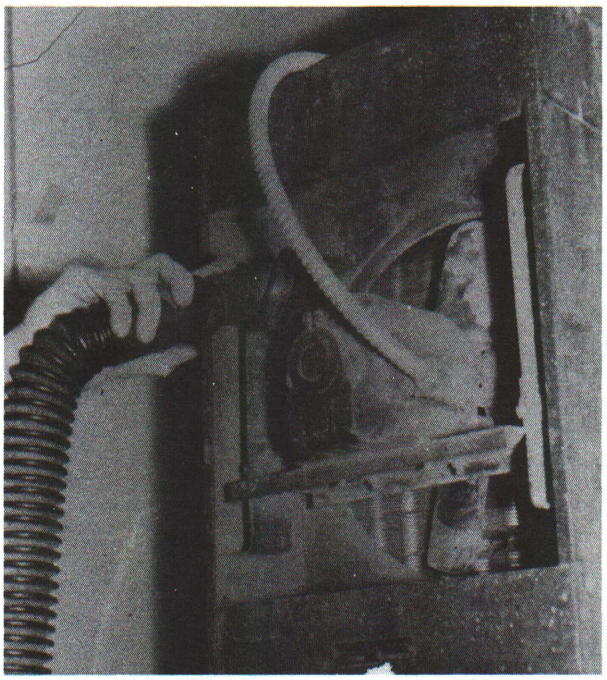

Figure 7. Use a vacuum cleaner and a stiff brush to clean off equipment.

Figure 8. A pressure-washer being used to clean out the fins of an air heater. Note the fan is removed, as it has an open motor.

Clean aluminum fan blades with a brush and detergent water. Harsh scraping can scratch the blades, causing imbalance and speeding up corrosion. A pressure-washer can be used to clean the fan, housing and hood thoroughly. Be sure that the fan motor has a totally enclosed housing so water and dirt cannot get into the motor windings. Otherwise, take off the motor and clean it separately.

Use oil sparingly on fan and motor bearings. Too much oil attracts dust and soaks into motor windings. Apply a few drops of antifreeze or graphite on back-draft shutter hinges to prevent them from sticking in cold weather.

Leaky roofs and blown snow can wet ceiling insulation, causing it to settle and pack down. Fluffing it up (when dry) and adding insulation over ceiling joists can reduce ceiling condensation problems. Furnace air filters placed over attic vents can be used to stop snow from blowing into attics. Remove these for summer operation.

Attic vents and ceiling fresh-air inlets can become plugged with insulation, plastic sheeting or other debris. These should be checked and opened if necessary to allow air to move through freely, especially during warm weather.

Operation of Fans and Intakes

Ventilation air rates need to vary in a hog barn because of changes in the weather, hogs and ventilation equipment. Outdoor air temperature changes continually. This requires periodic adjustment of fresh air intakes to control drafts. Also more or less air movement is needed because moisture-holding capacity of air varies with temperature.

Hog numbers and their weights are constantly changing; this, too, affects fresh air requirements.

Ventilation fans wear, corrode, get dirty and age—all these reduce their rated output. Air inlets and outlets get

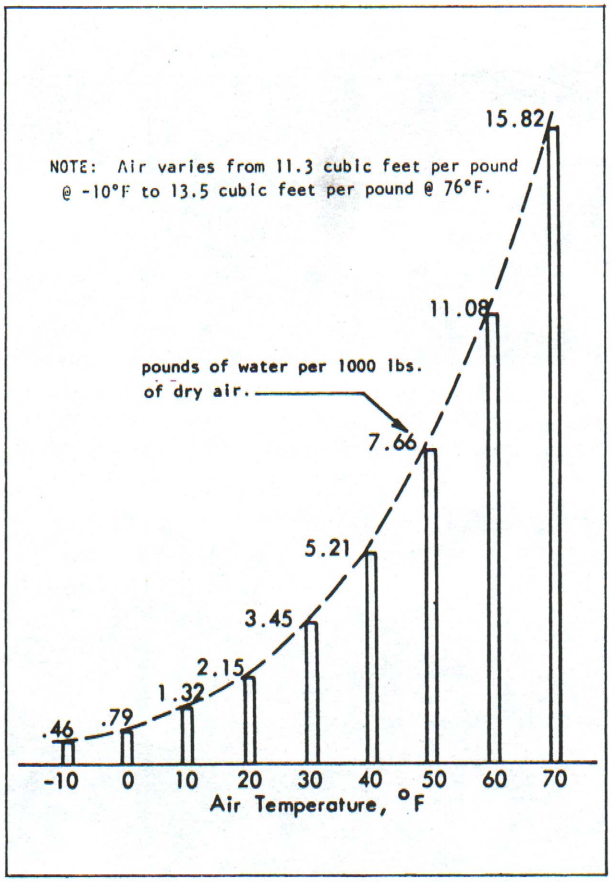

Figure 9. Moisture-holding capacity of air is much higher at warm temperatures. Zero degree air (when warmed) absorbs moisture and dries the building when exhausted outside.

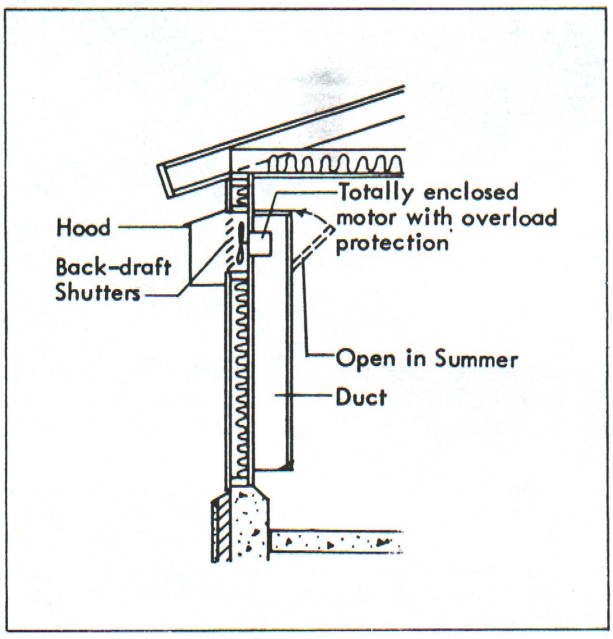

Figure 11. A duct on a continuous-operating exhaust fan can draw some air from the manure pit or near the floor. An adjustable damper in the duct allows control of the continuous airflow that is being exhausted. The duct should be as wide as the fan housing and 12 in. deep with a swing-down door at the top for access to the fan. Keep the door closed in winter and open in summer.

Figure 10. The variable-speed exhaust fan operated at too slow a speed in this farrowing barn. High winds sucked moist air from inside the barn back up through the ceiling inlet into the attic space. There it condensed into frost.

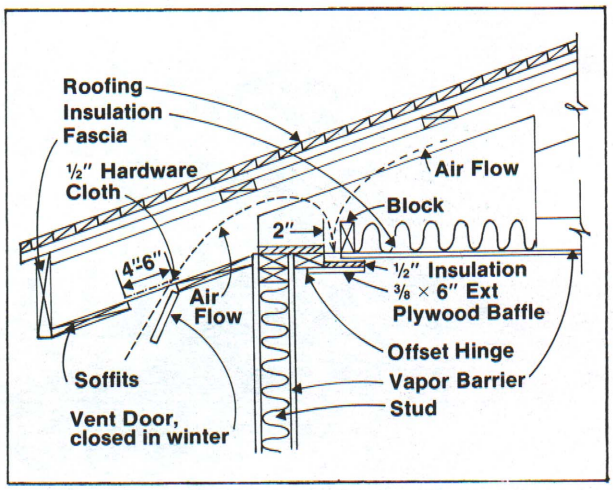

Figure 12. Fresh air, slot inlet for exhaust ventilation system. In cold weather the baffle directs the air along the ceiling toward the exhaust fan in opposite wall to permit mixing of warm and cold air. In summer, adjust the baffle to direct high-speed air toward the floor to better cooling and to allow a maximum of airflow through the inlet.

plugged and building interiors get dirty; these affect inside air circulation.

All these things mean that ventilation systems need to be periodically checked, adjusted and maintained.

Providing a small amount of continuous ventilation (see Table 1) allows a slow but steady change of air. Sporadic, on-off rushes of large volumes of air by a large fan with little or no air movement between times causes too drastic temperature changes with drafts, which causes stress in hogs.

An adjustable baffle-board over the air inlet allows "throttling" the amount of air entering the barn. An air-inlet velocity of 200-700 ft. per minute (about 2-8 mph) is recommended. This speed prevents air from backdrafting and lets cold, fresh air mix well with warm, inside air when directed outward across the ceiling.

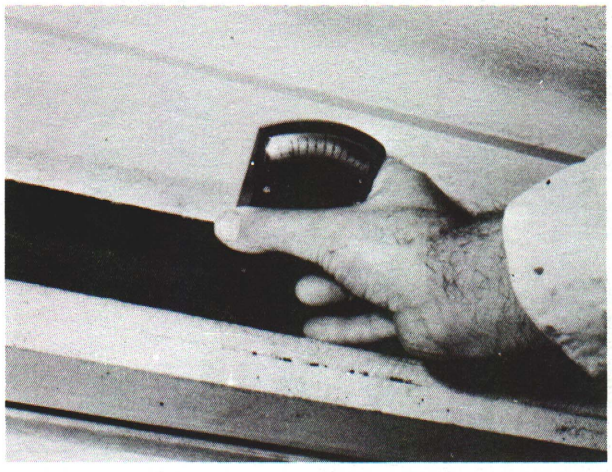

Figure 13. Check incoming air velocity with a velometer. Too slow an air speed allows the wind to reverse and backdraft the regular airflow. Too high an air speed chokes the airflow and wastes energy. Velometers are available from fan dealers, plumbing and heating contractors, or scientific supply stores.

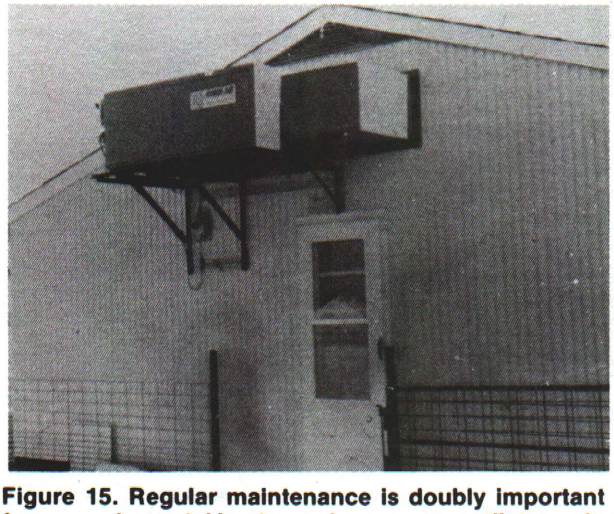

Figure 15. Regular maintenance is doubly important for a supplemental heater and pressure ventilator unit.

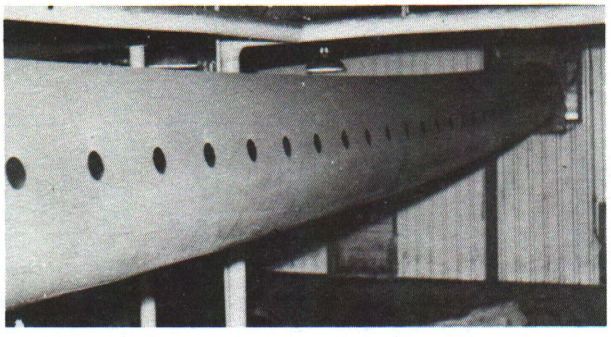

Figure 14. Pressure air ducts will gradually fill with dust and water. This increases the airflow resistance and slows down the ventilation capacity of the system.

Figure 16. Replacing the protective screen over the fan to keep out fingers, pets and debris.

Buildings where animals are the only heat source must be filled to capacity or supplemental heat must be provided so moisture problems will not develop in unoccupied areas during cold weather. Supplemental heat in winter and cooled air in summer needs to mix with the other incoming air where it enters the barn. This allows time for the conditioned air to be completely utilized before it is exhausted from the barn. Direct air into corners and throughout the barn space to promote complete air mixing. For efficiency, ventilation air should travel about 30-40 ft. from inlet to outlet. Shorter distances may not fully use the moisture-holding capacity of the ventilation air in winter.

Natural Ventilation

Swine barns with no fans that use natural air movement require very close manual supervision for good operation.

To control drafts in open-front barns, install doors or curtains, either manually or automatically controlled. On manually controlled systems, avoid completely closing up the barn. Keep ridge vents or attic louvers open and a continuous slot 1 in. per 10 ft. of building width on the south side.

Clean the automatic opener for doors or curtains and check for accuracy with a reliable thermometer every 6 months. All cables and pulleys should be checked for binding, corrosion, fraying, etc., when control is checked. Lubrication of all cables and pulleys should be done on a regular basis for trouble-free operation and longer life.

Summary

1. A few drops of S.A.E. No. 10 non-detergent oil on fan and motor bearings every 1,000 hours or so of use is usually adequate. Most fan and motor bearings are lubricated and sealed for life and so need not be relubricated. Worn ball bearings can be detected by noisy

operation or a rough "feel" as the shaft is rotated by hand. Keep a chart by each fan to record regular maintenance and lubrication.

2. The space between the fan housing and the wall should be filled with insulation and the housing caulked when in place to reduce air leakage around the fan and possible frost build-up in cold weather.

3. Locate thermostats away from heaters, away from cold airflow, and *not* on an outside wall. A desirable location is near the center of the barn.

4. Air should steadily flow through the barn for ventilation. A rough check on enough airflow is to note how the walk-through door opens and closes. An indicator of poor airflow with an exhaust ventilation system is when the door slams shut when it is pulled open or if it easily swings inward and is hard to push shut again. Provide 1 sq. ft. of fresh air inlet space per 1,000 CFM of exhaust fan capacity. The attic space or plenum space needs this amount of vent inlet space, too.

5. Check insulation if frosting persists in certain areas or damp interior surfaces are a continuous problem. Rodents chew up and pack down insulation.

6. A couple of well-located windows for building lighting are enough. Too many windows allow more heat loss (or gain). Use storm windows to control window condensation.

7. The noise level of fans increases with size and speed of the fan. Diameters larger than about 16 in. and higher speeds than 1,400 rpm may need sound-dampening equipment if noise is a problem. Check fan blades for balance. A tiny stovebolt can be used to add weight on light blades.

8. Back-draft curtains have been used to adjust semi-automatically the amount of air entering through ceiling slot air inlets and to prevent back-drafting of warm air backward through the inlet. Periodically replace these curtains because dirt and aging stiffens them. A manually adjusted baffle board can be installed.

9. Install a warning system or an emergency ventilator that will operate when the electric power fails. Battery-powered units and other systems are available for this purpose.

10. A stand-by generator in operating condition should be available for power during electric outages. Contact your electric power supplier.

Table 1. Summary of design data for hog barn ventilation.

Hog unit	Approximate ventilation rates CFM/hog unit			Barn temperature °F.	Approximate heat production BTU/hr*	Supplemental heat needs BTU/hr			
						Slotted floor		Bed-scraped floor	
	Minimum rate	Normal rate	Hot weather			Cold†	Mild†	Cold†	Mild†
Sow & litter (400 lb.)	20	80	210	60°	2,100			2,000‡	1,400‡
				80°		1,500	1,000		
Pigs									
20-40 lb.	2	15	36	70°	330	275‡	125‡	300‡	150‡
40-100	5	20	48	45°-75°	410	250	100	500	200
100-150	7	25	72	45°-75°	500	250	100	500	200
150-210	10	35	100	45°-75°	600	250	100	500	200
Sow or boar, limit fed									
200-250 lb.	10	35	120	45°-75°	680	250	100	500	200
250-300	12	40	180	45°-75°	760	250	100	500	200
300-500	15	45	250	45°-75°	980	250	100	500	200

*At60°F. temperature. Depending on room temperature approximately 2/3 of this total heat production is sensible heat that is available for warming air, building heat losses and evaporating water.

†Cold or mild climate, respectively. Mild climates seldom colder than 0 degrees F.

‡Provide brooder heat for small pigs in addition to this amount. One BTU equals 3.413 watt.

References upon request from the author.