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Troubleshooting a Mechanical Ventilation System for Livestock or Poultry Housing

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Ventilation systems are one of the most important components of a livestock or poultry building. Unfortunately, they're often neglected and frequently in need of attention and maintenance. A properly designed and operating ventilation system—like health care, nutrition, and breeding—is a necessary part of a sound livestock or poultry operation.

How much fresh air?

Before you can troubleshoot the ventilation system, you must know what it's designed to accomplish. This means you must calculate the fresh air requirements of the animals or poultry you're currently housing in the building.

Table 1 lists recommended ventilation rates, in cubic feet per minute (cfm) per head or per 1,000 birds. You can calculate the capacity of the system for year-round conditions, using the fresh air values in table 1 and multiplying by the number of animals or poultry you are going to house.

Once you've calculated the air flow rate, select a fan or fans to provide that quantity of air. The selected minimum air flow rate should be ¾ of the calculated building capacity to account for those times when the animal numbers may be lower than building capacity.

Select fans to operate against at least 1/16 inch—but no more than 3/16 inch—of static pressure. You need this pressure difference to move air; if you need pressure to open shutters, etc., add it to this value.

As a fan pushes air from one side of the wall to the other, it creates a pressure difference. Static pressure is the difference between the air pressure outside the building (atmospheric) and inside the building.

Your dealer should have performance data for quality fans. These will show the air flow discharge rate against different pressures (some of the "bargain" fans may not provide performance data). It's difficult to estimate air flow even when you know fan diameter, number of blades, shaft speed, and motor size.

If you can't obtain this information, actual measurement of the air flow is another way to determine existing conditions. It's not easy as it requires special equipment, but it does determine air flow rates.

Regular maintenance

Once you've bought and installed the proper fan or fans for your building, maintenance becomes your major task. Consider this one example: Studies have shown that dust buildup on fan blades, around the housing, and on the louvers can reduce fan efficiency as much as 35%.

Removing dust from the motor lets it run cooler and promotes a longer life (see figure 1). Lubricating louvers or shutters reduces sticking and lowers the pressure required to open. Be cautious when you oil—too much oil will run off and collect unwanted dust and grime. If you use graphite as your lubricant, you can eliminate this problem.

Some fans use belts to convey power from the motor. Your routine maintenance check should include properly aligning the pulleys, checking belt tension, and visually checking the belt itself.

Your control system. Properly operating fans are only as good as the control

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Table 1.—Recommended minimum ventilation rates for livestock[a] and poultry

	Weight (lb)	Ventilation, cfm/hd		
		Cold weather rate	Mild weather rate	Hot weather rate
Sow and litter	400	20	80	500
Prenursery pig	12-30	2	10	25
Nursery pig	30-75	3	15	35
Growing pig	75-150	7	24	75
Finishing pig	150-220	10	35	120
Gestating sow	325	12	40	400
Boar	400	14	50	300
Sheep	1000	25	100	200
Dairy cows	1400	50	170	470
Heifers, 2-12 mo		20	60	130
12-24 mo		30	80	180
Calves, 0-2 mo		15	50	100
Broilers		System capacity, cfm/1000 birds		
		(below 35°F)	(35-75°F)	(over 75°F)
Up to 3 wk		300[b]	600[b]	1000
3-6 wk		1500[b]	3000	5000
5-8 wk		2500[b]	5000	8000
Layers, 4-6 lb		2500[b]	5000	8000
Breeders, 5-9 lb		3000[b]	6000	15000
Turkeys				
Up to 2 lb (up to 4 wk)		600	1250	2500
2-5 lb (4-7 wk)		2000	3000	7000
5-8 lb (7-9 wk)		3500	5000	10000
8-12 lb (9-12 wk)		6000	7500	15000
12-15 lb (12-14 wk)		7500	9500	19000
15-20 lb (up to 18 wk)		8500	12500	25000

[a]Adapted from publications of the Midwest Plan Service, Iowa State University, Ames, Iowa: *Sheep Housing Handbook, Dairy Housing Handbook,* and *Swine and Equipment Handbook*. These rates are for solid-floor systems, which evaporate all the moisture. Slatted-floor, partial slatted-floor, and flushing-waste systems remove some of the moisture (urine and water); therefore, they can use lower cold-weather ventilation rates. All rates shown are actual air-delivery rates. Extra capacity allowance must be made for losses caused by dust on fan blades or louvers or by other air-restricting conditions.

[b]At these low air-exchange rates, increase the air mixing or recirculation of the heat inside the structure by using paddle fans, centrifugal fans, or fan-powered convection tube recirculation systems.

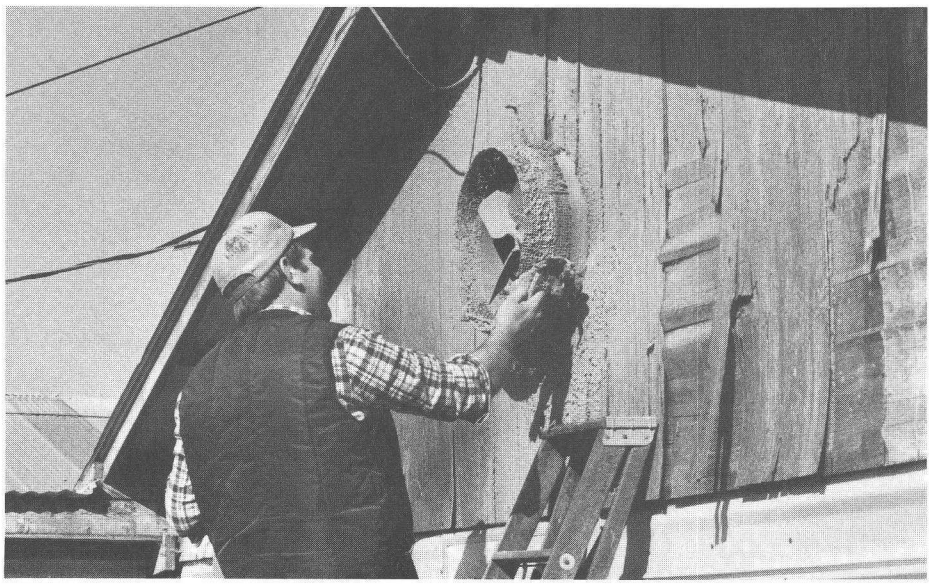

Figure 1.—Regular maintenance to remove dust and to check ventilation fans ensures proper air flow rates.

system. At least annually, check thermostats that start and stop your fans (see figure 2). Disregard the numbers on the thermostat dials and calibrate your controls against an independent thermometer.

Make sure thermostats are out of drafts, away from inlets and heaters—and that they reflect the desired temperature for the livestock in the building.

Inlets are perhaps the most important—and least understood—part of a ventilation system. The ventilation needs in table 1 show that summer rates are 10 to 20 times larger than those recommended for cold weather.

This wide range requires different-sized inlets in summer than in winter to ensure proper distribution of the fresh air in the room without causing drafts.

It's important that inlets uniformly distribute the air throughout the room (figure 3). In the colder weather, this is critical—unwanted drafts can cause health problems. Summer inlets need to provide lots of turbulence to remove heat and cool the animals.

In the winter, we usually ventilate to remove moisture. In winter, the incoming air should blend with the inhouse air to raise its temperature, which increases its moisture-carrying capacity. The inlets should direct the blended air over the floor to allow it to pick up moisture and carry it from the building.

In designing a ventilation system, decide the best inlet location after you've determined the pen layout. For a swine pen in winter (for example), the cool incoming air should blend with the warmer air, and most of the blended fresh air should enter the pen at the dunging end and circulate toward the sleeping area.

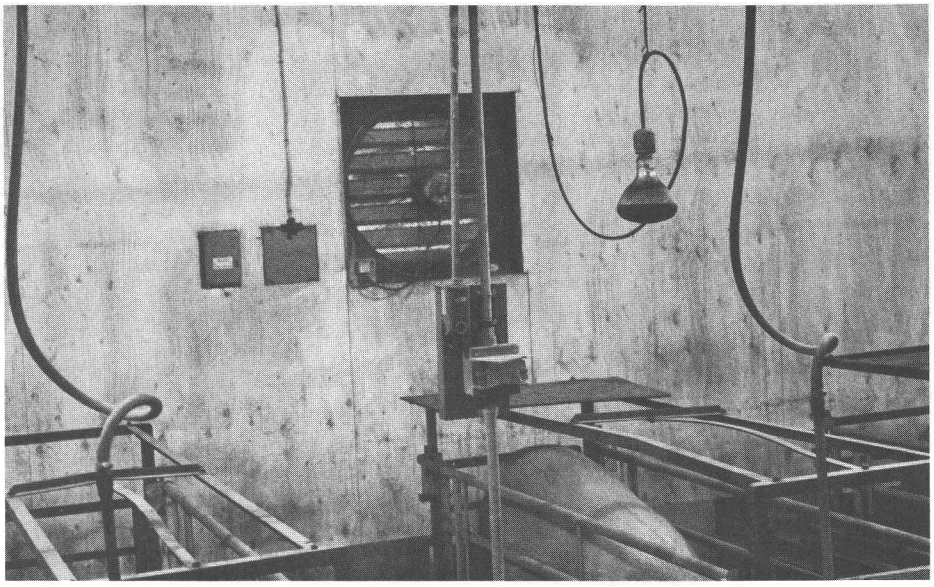

Figure 2.—Check your thermostats at least annually for proper setting. Locate thermostats away from drafts and set them to your desired temperature.

Figure 3.—The use of smoke sticks allows you to follow the air distribution within a room. Inlets play a very important role in proper distribution.

The animals will generally sleep in the best environment (warmest and best air) and dung in the coldest area. This requirement changes as the season changes from winter to warmer weather, and we ventilate for different purposes.

Problems and solutions

Here are a few of the more common problems I've found when reviewing and evaluating ventilation systems—and some solutions.

1. **Excessive odors, ammonia, or high humidity in the room air.** The building is underventilated. Adjust controls to increase the fan speed to move more air. The fan needs to run faster (if yours have a variable speed) or longer (if it's on a timer). The room or building may need additional or larger fan(s). If you have this problem in the winter, your heater will need to run longer to maintain a constant room temperature. This is *the most common ventilation problem* in livestock buildings.
2. **Fan motor is laboring; doors are difficult to open against the static pressure.** Your air-inlet area is inadequate. Open inlet areas into the room or (in some cases) the attic. Inadequate inlet areas may cause air to be pulled into the room through manure gutters or pits—bringing in foul air. This will not only cause odor and health problems in the room, but it will also produce nonuniform air distribution and drafts.
3. **Wet attic or ceiling insulation during the winter.** Inlets are open too wide—they don't properly meter incoming air from the attic into the room, and they're allowing back drafts of building air into attic. This carries unwanted moist air into the attic, where the air cools and moisture condenses. Adjust

inlets by reducing opening to maintain flow only into the room.

4. **Pigs aren't dunging in the proper place, creating a messy pen.** Either your inlets are improperly located, or their openings are the wrong size (a matter either of design or adjustment). There can be several reasons for messy pens, but improper ventilation *is the most common.* Cold air dumping into sleeping area will drive pigs to sleep in another part of the pen.

5. **Heating costs are too high.** Providing heat *is* a cost factor, but your building may be overventilated. Once *you've determined* that the system is providing adequate air, check to see if the minimum flow rate is too high. If it is, reduce the time the fan runs, the number of fans running, or the fan speed. (Trying to reduce your air flow rate by restricting inlet areas will cause high static pressure, and possible drafts in parts of the building.)

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