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Troubleshooting Mechanical Ventilation Systems

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Development and use of mechanical ventilation in swine buildings has resulted in better environment and greater production efficiency. But when a ventilation system fails, problems occur which are easily recognized but often hard to solve.

This guide lists symptoms of several common types of system failure and likely causes. Nearly all of the problems described can be diagnosed by visual observation or with one of several simple tools.

A properly designed and operating livestock ventilation system provides an environment which is desirable for livestock—not people. Farm workers unfamiliar with a properly operating system will often report the building is too cold or the fans are moving too much air. But, in fact, the system may be operating as designed and creating the optimum environment for animal growth. Table 1 presents optimum temperatures and allowable ranges for swine. Information on ventilation rates can be found in PIH-60, "Mechanical Ventilation of Swine Buildings."

Table 1. Temperature optimums and ranges for housed swine.

Animal	Temperature (°F) at animal level	
	Optimum	Desirable limits
Lactating sow	60	50-70
Litter-newborn	95	90-100
Litter 3 weeks old	80	75-85
Pre-nursery (12-30#)	80	75-85
Nursery (30-50#)	75	70-80
Nursery (50-75#)	65	60-70
Growing-finishing	60	50-70
Gestating sows	60	50-70
Boars	60	50-70

Troubleshooting Tools

Several simple tools can greatly aid in system diagnosis. Most can be obtained at relatively low cost from suppliers of ventilation equipment or local heating contractors.

Thermometer

Ventilation systems rely mainly on temperature sensing devices to control air exchange rates. A good thermometer is essential to checking actual conditions and calibrating thermostats which control fans. Thermostats should be calibrated at least twice a year. Thermostat "range" (points at which they turn on and off) should also be checked at the same time.

Sling Psychrometer

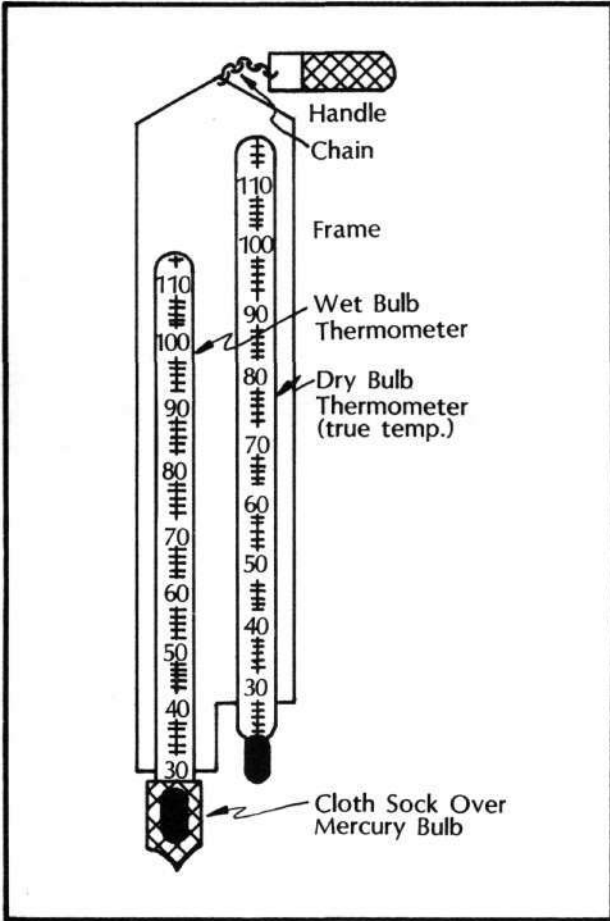
A sling psychrometer consists of 2 thermometers suspended on a chain or sling. The sensing bulb on one thermometer is covered with an absorbent sock which is dipped in water prior to using (Figure 1). The two thermometers are then whirled on a sling in the area being investigated. The two thermometers produce readings known as "wet bulb" and "dry bulb" temperatures. These are used in conjunction with a chart furnished with the psychrometer to give relative humidity.

Winter time relative humidity within mechanically ventilated buildings should be 50-75%. Humidities above 80% will result in excessive moisture condensation on building or equipment components. They may also increase the incidence of disease.

Smoke Generator

Devices which produce dense smoke are used to "see" air patterns within a building. A bee smoker is suitable.

Smokers are useful in locating *dead spots* or *drafty* locations within a building.



Manometer

A manometer measures the difference in atmospheric pressure between the inside and outside of a building (Figure 2). The difference is measured in inches of water column and is referred to as static pressure. Ventilation systems are *designed* to operate at about .04 in. to .08 in. of static pressure. Measured static pressures below this range usually indicate poor distribution of incoming ventilation air. Static pressures above this range mean fans are prevented from delivering their rated air capacity.

Air Speed Meters

Several different types of air speed measuring devices are available for use in swine buildings. Inexpensive draft gauges available from heating contractor supply houses can be used to measure the relatively high speed (600-1000 ft. per min.) air entering through inlets and discharges from fans. The slower moving air within the building requires more sophisticated and expensive equipment for measurement.

A producer who is not diagnosing ventilation problems on a continual basis is probably better off using a manometer and a smoker to estimate air flow speeds and patterns.

Figure 1. An inexpensive sling psychrometer can be used to measure wet and dry bulb temperatures which are used to determine relative humidity.

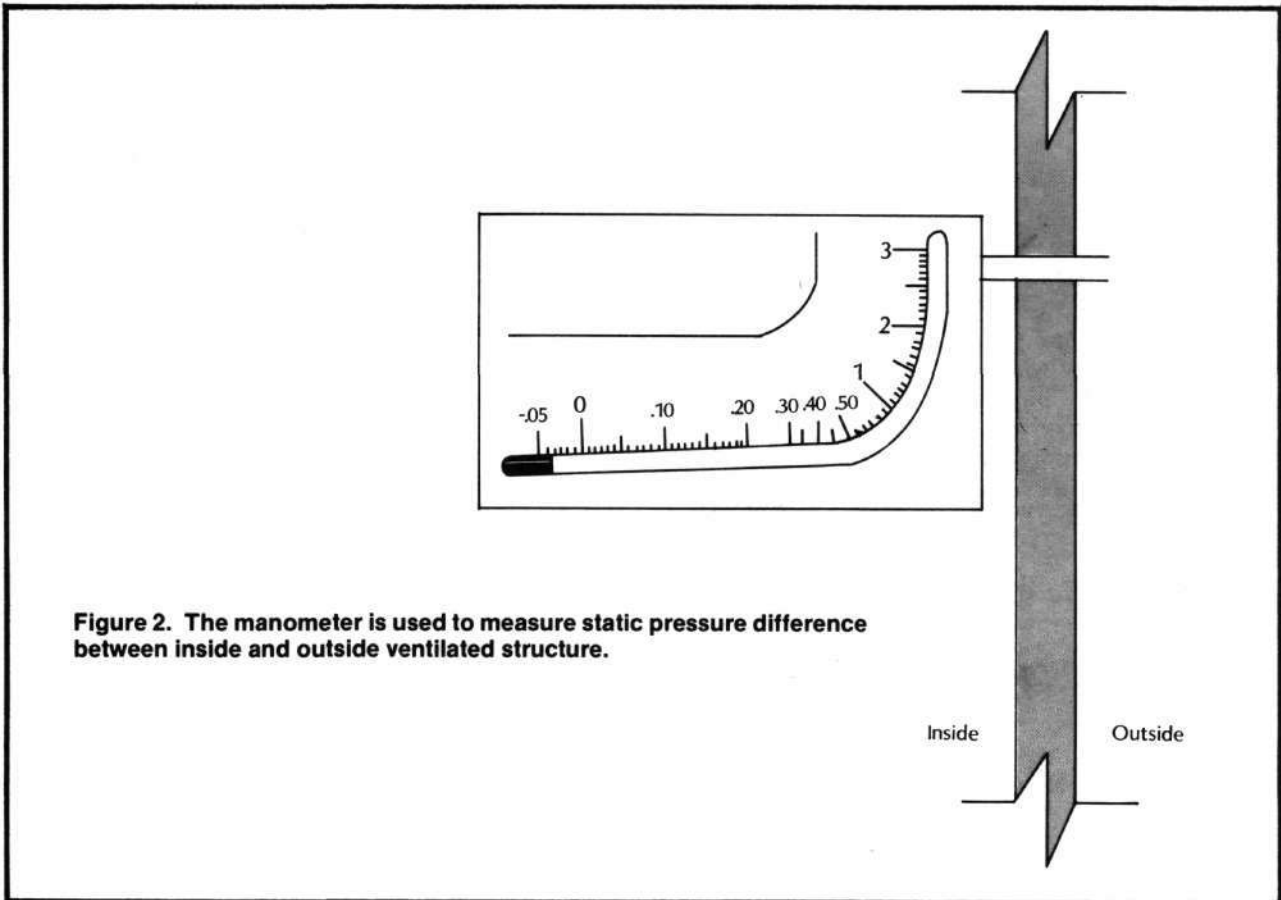


Figure 2. The manometer is used to measure static pressure difference between inside and outside ventilated structure.

Troubleshooting

Listed are symptoms of several common problems encountered with livestock ventilation systems. Each is followed by possible causes.

Symptom: Building colder than desired even though outside temperature is not well below normally expected lows.

Possible causes:

1. Fan and/or furnace controls are set at too low a temperature or thermostats are not sensing correctly. This results in excessive amounts of cold air being pulled into the building. Locate a thermometer next to the sensing unit on the thermostat and see whether the fan is being turned on at the proper temperature. Check heater to see if it is operating properly.
2. Building is not properly insulated. Minimum levels should be R12-20 for sidewalls and R20-30 for ceiling. The higher levels are associated with colder climates in northern states.
3. Animal density is low. If the building is not full, there may not be enough heat produced to make the ventilation system work properly.
4. Air inlets are open too wide. This allows excessive heat to escape from the building when the fans shut off. It can also cause drafts on animals located near the inlet and prevents good mixing of incoming air with room air.
5. Insulation is wet. A vapor barrier may not have been used or may be installed on the wrong side of the insulation. The vapor barrier always should be located on the warm side of the insulation. Look first for this problem in the ceiling insulation which usually is accessible from the attic space. Excessive condensation on interior surfaces is also an indication of no insulation or a reversed vapor barrier. Ceiling insulation sometimes becomes saturated because there is not adequate ventilation in the attic space above the insulation.

Symptom: Building too warm.

Possible causes:

6. Temperature settings on fan controls and/or furnace are too high or thermostats need recalibration.
7. Insufficient fan capacity was installed for the number and size of animals housed.
8. Fans are not delivering rated capacity because of dirt accumulation on fan shrouds and shutters. These should be cleaned at least once a month.
9. Air inlet is too small or clogged with dirt. Screens to keep birds out of the air intakes frequently become plugged with dust and other airborne particles. Be suspicious of inlet restrictions if the fans suck you inside the building when you open the door, or if static pressure differential exceeds .1 in.
10. Any unusual obstructions within 6-8 ft. of either the intake or exhaust side of the fan will reduce its capacity. Ventilating fans are not positive displacement air pumps. Any obstruction placed in the path of the air flow can greatly reduce fan capacity.

Symptom: Excessive moisture in building; air feels damp and heavy (relative humidity above 80%).

Possible causes:

11. There is not enough ventilation. An unusually warm temperature will be the tip-off. May be due to overcrowding of building.

12. There is too much ventilation. Tip-off will be cool temperature. Air is not being allowed to warm up enough to pick up moisture. Check thermostat settings against actual temperature.
13. Waterers or other parts of the plumbing system leak.
14. Gas heaters designed for external venting are unvented. A by-product of burning gas is water vapor. If not vented directly to the outside, it will increase moisture levels within the building. This occurs most often in farrowing houses which do not have large amounts of absorbent litter material.
15. Diseased livestock are in the building. Diseases which produce diarrhea-like symptoms add substantially to the moisture load which the ventilation system must handle. In some cases, the deterioration in environmental conditions may be the first indication of a disease outbreak.

Symptom: Excessive condensation on interior surfaces of building.

Possible causes:

16. Extremely cold outside weather causes ventilation systems to operate at minimum levels for extended periods of time. This will correct itself when weather warms up.
17. Windows are single-glazed only. Adding storm windows or introducing fresh air leakage at the top edge of the window by opening it about 1/8 in. will frequently take care of this problem. **Caution:** Too much additional opening may reduce static pressure and disrupt air distribution.
18. Also, see causes 2, 5, 11, 12, 13, 14 and 15.

Symptom: Excessive drafts and/or hot spots at different locations within the structure.

Possible causes:

19. The inlet system may be poorly adjusted. Inlets need to be adjusted at least 4 times a year to accommodate the variation in ventilation rates between winter, spring, summer and fall. In addition, many buildings will require some "trial and error" adjustments to different sections of the inlet in order to obtain a completely balanced system.
20. The air flow pattern is short-circuited. Air flow of fans and inlets is *in balance* in a satisfactory ventilation system. An open window or door will upset this balance and result in poor distribution of ventilating air. Static pressures lower than .04 in. are good indicators of this problem.
21. Fan capacity is insufficient. Also, see causes 7, 8, 9 and 10.

Symptom: Fans not working.

Possible causes:

22. Fuse or circuit breaker is tripped or faulty.
23. Thermal protection in fan motor tripped. In a system which has been operating satisfactorily, this may be due to dirt and dust accumulation on the motor.
24. The thermostat is defective.
25. The fan motor is defective or improperly wired.

Symptom: Controls not working properly.

Possible causes:

26. Controls are defective.
27. Controls are not properly calibrated.
28. Sensing units for controls are not properly located. Sensing units should be located where they will mea-

sure and respond to true room conditions. A good location is near the center of the building at a height which is just out of animal reach and shielded from incoming air and heater outlets.

29. Controls are improperly wired.

Symptom: Excessive fuel costs in a properly designed and insulated building with supplemental heat.

Possible causes:

30. Controls are improperly adjusted. Heating system controls may be set too high or fan controls may be set to move too much air. Only the winter minimum ventilation rate should be used during periods when supplemental heat is being used. Fans used to pro-

vide higher rates of ventilation should be adjusted to turn on at a temperature at least 5° above the shut off temperature for the heating system. This will provide protection from unusually high building temperatures and prevent the fans from drawing excessive air into the building when the heating system is operating.

31. Building is not filled to design capacity with animals. This results in heater having to supply some of the heat which would normally have been given off by animals.

32. Minimum ventilation rates may be higher than needed (see PIH-60). This is a common problem with variable speed fans which do not always fit the desired ranges.

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