

Table 4 Suggested Resistivities for Laying House Walls and Ceiling

Zone ^a	Walls	Ceiling
1 ^b	16	32
2	8	16
3	3	6
4	—	0 ^b

^a See Fig. 14 for location of zones.
^b To reduce heat gain.

densate drip from the ceiling. These advantages indicate the desirability of ceiling or roof insulation in all livestock shelters, particularly in densely populated buildings, such as broiler houses and confinement feeding houses for fattening swine.

Insulation of open sheds (most of one side open to the outside) is a consideration only in reducing the condensation on roofs in the winter and in reducing heat gain through roofs in the summer. Open sheds for cattle and sheep generally have about the same temperature inside as outside so that condensation is usually not a serious problem.

Equipment and Controls

Fans. Propeller type fans are generally used in farm livestock ventilation systems. They operate well in the dust of livestock shelters and cause a minimum obstruction along the walls. The dusty environment should also be considered when selecting an electric motor for the fan. Noise level is considered primarily from the standpoint of the operator as farm livestock apparently adjust to repetitious noises rather quickly. Fans are usually placed out of reach of farm animals and are fitted with guards to protect the operator and to protect the fan against such hazards as fork handles. Louvers on the outside of exhaust fans prevent back drafts and keep out flies when fans are not in operation. Hoods may be needed where fans would operate against prevailing winds. In all installations where fans exhaust to the outside, rated capacity should be provided when operating at a static pressure difference of $\frac{1}{8}$ in. or more.

Variations in ventilation rates may be obtained either with multi-speed units or multi-fan units. Generally the latter are lower in cost and are available with inherent overload protection. Exhaust fans for livestock shelters need to be located so that air will enter all intakes. Inherent looseness of barn doors

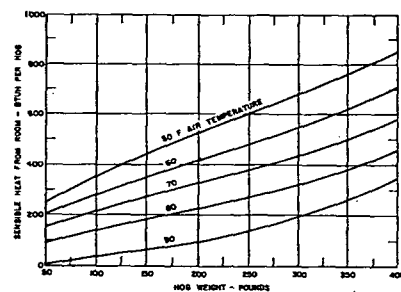


Fig. 9 Room Sensible Heat in a Hog House

Table 5 Suggested Resistivities for Milking Rooms and Milk Rooms

Zone ^a	Walls	Ceiling
1	5	16
2	4	13
3	2	8
4	2	2

^a See Fig. 14 for location of zones.

and windows usually establishes 40 feet for the lateral spacing of fans.

Where a pressure system is used fans should be small and well distributed with diffusers that will rapidly mix incoming and stable air. A duct system with a single fan would also be effective.

Inlets. In many exhaust systems there is sufficient crack leakage so that inlets are unnecessary, but where the windows and doors fit tightly, inlets should be provided. Several small well distributed inlets should be used rather than a few large inlets, in order to reduce drafts and provide a maximum opportunity for warming the incoming air before it strikes the animal. Slots at the plate line are effective.

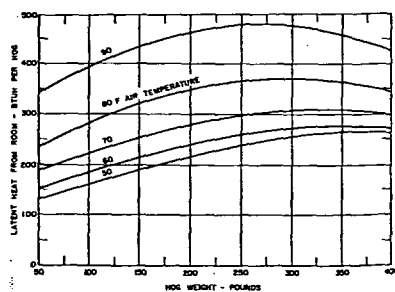
Controls. Thermostats are almost universally used for control of livestock ventilation systems. Thermostats should have enclosed contacts to avoid difficulties of dust and dirt. Actuating differentials of plus or minus 3 to 5 F deg are satisfactory. Line voltage contacts suitable for motor starting are normally used. Each fan motor and control system should be protected separately with time delay fuses or circuit breakers.

Where several fans or multi-speed fans are used, additional thermostats are used for each fan or speed. The thermostats are adjusted at a differential of 5 to 10 F deg between fans, for example: 1st—40 F, 2nd—50 F 3rd—60 F.

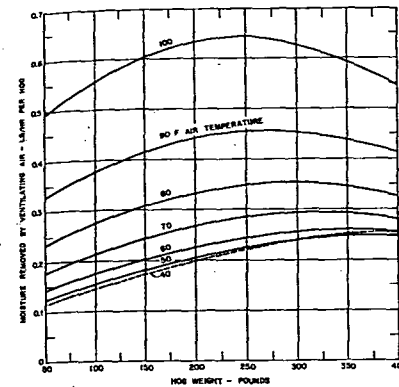
Humidity controls have been used successfully in dairy barns, but should not be used if the sensing element will be affected by dust. Where humidity control may result in excessively low temperatures, a low temperature cut-off thermostat should be provided. For well-insulated structures a carefully designed humidistat-thermostat system may give better control at low outdoor temperatures.

Control of summer ventilation, requiring additional air volume, can be added to the winter system by the use of additional thermostats and fans.

Except for locating thermostat elements away from the

Fig. 10 Room Latent Heat in a Hog House²⁵

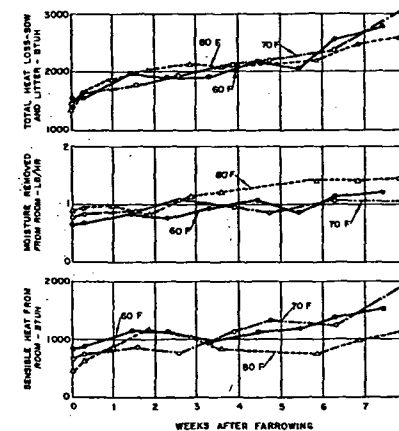
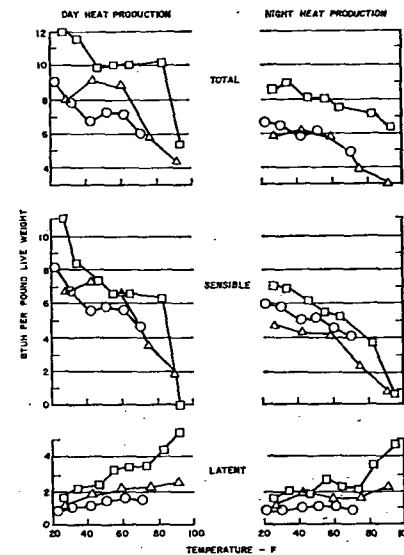
Air Conditioning for Animals



^a Evaporation from floors is included.

Fig. 11 Moisture to be Removed by Ventilation Air in a Hog House²⁴

reach of livestock (generally near the ceiling) the principles of locating industrial thermostats apply. In barns with uniform distribution of livestock, any point that is at least 2 ft in from the walls will be satisfactory, provided it is not in a draft of intake air. Thermostats may be placed in the exhaust air stream if the fan operates continuously. An 8 F deg differential between ceiling and floor air temperatures is not uncommon in livestock shelters.

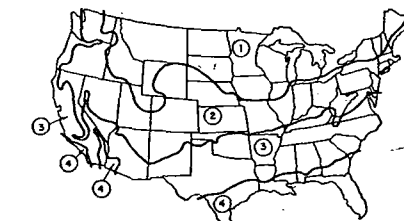
Fig. 12 Total Heat Loss from Sows and Litters, and Relation of Sensible and Latent Heat Removed from Room by Ventilation Air²⁴Fig. 13 Heat and Moisture Loads for Caged Laying Hens at Various Air Temperatures²

Air Filters

If a farm livestock shelter ventilation design requires the recirculation of air over cooling or heating coils some method of filtering will be needed. Filters are discussed in detail in Chapter 48 of the 1961 Guide And Data Book.

The physiological effect of dust upon farm livestock is not fully known. However, there are many situations in which it is desirable to filter the air to protect the equipment used for air conditioning.

The air in livestock shelters usually contains a wide variety

Fig. 14 Temperature Zones for Selection of Insulation from Tables 4 and 5²⁵