Heat Stress Control In Summer*

Building orientation can significantly affect radiation heat gain. Orientation cannot be changed for existing buildings, but new buildings should be oriented with the long axis east-west. With approximately 2 feet of roof overhang, direct solar radiation is almost eliminated except on end walls.

Another basic construction component is adequate insulation. Insulation resists the flow of heat when installed to meet design recommendations for the locale, summer heat gain is greatly impaired. The heat gain from a typical attic is 2.6 BTU/hr-ft² with a ceiling "R" value of 10, but if the "R" value of the ceiling is 20, a typical recommendation in many areas, the heat gain is reduced to 1.3 BTU/hr-ft². With approximately 60 square feet of ceiling per sow and litter in a farrowing house, the heat gain is 78 to 156 BTU/hr per sow and litter, depending upon the level of insulation which means an additional ventilation requirement of 78 to 156 cfm per sow and litter.

Ways To Increase Comfort Level

Enclosed Buildings

1. Follow good construction practices and insulate adequately.

2. Orient buildings properly.

3. Obtain assistance in designing the ventilation system.
   a. provide ample fan capacity
   b. locate and size air inlets
   c. centrally locate controls for each fan
   d. install manometer to aid in controlling air inlet
   e. maintain static pressure between 0.06 and 0.1 inches of water

4. Wet walls and aisles during extremely stressful periods to increase evaporative cooling.

5. Wet heads of sows suffering from heat stress. Use drip cooling.

6. Increase air velocity over animals to promote convective and evaporative cooling.

The objective is to keep the inside temperature of a building within 1°F to 2°F of the outside temperature. The only way to maintain an inside temperature significantly lower than outside temperature is with mechanical air conditioning, which is expensive, or by evaporative cooling.
Buildings With Open Sidewalls

Buildings with open sidewalls should be designed to take advantage of natural ventilation. However, adequate natural ventilation is not always available or sufficient. Air velocity becomes more of a factor in summer cooling as the ambient temperature approaches the body temperature of hogs. A velocity of 300 feet per minute or approximately 3-1/2 miles per hour is preferred, but this does not always occur. Because the hogs in confinement are at high densities, mechanical ventilation can be helpful in dissipating body heat.

Ventilation - Fans

Fans may be suspended throughout a building to provide air movement directly on and near the hogs. Fans should not be spaced more than 20 fan diameters apart. Example: If 24-inch fans are used, their spacing should not exceed 40 feet.

Casablanca fans can provide summer air movement. They are low in initial cost, have low power requirements, and many are variable speed. These fans are mounted with the blades parallel to the floor and the spacing between these fans should not exceed 25 feet.

Natural Ventilation

Research shows an open ridge provides approximately 40 cfm per square foot. In a 36-foot wide building, there are four market hogs per foot of length. If each of these hogs requires 100 cfm to 150 cfm, then typical ridge ventilators are woefully inadequate.

Trees and other buildings can affect natural ventilation. Ideally, the distance between a building and trees should be 10 times the height of the trees. The distance between buildings should be 0.4 height of building times the square root of the building length. Example: Buildings 200 feet long with ridge heights of 16 feet should be spaced 90.5 feet apart:

\[
\text{Spacing} = 0.4 \times H \times \sqrt{\text{Length}}
\]

\[
= 0.4 \times (16) \times \sqrt{200}
\]

\[
= 0.4 \times (16) \times (14.1)
\]

\[
= 90.5 \text{ feet}
\]

Obviously the optimum spacing of buildings is often not practiced for many reasons. It should also be evident that because of this factor, hog density, building design, building width, and natural air movement that other means of providing hog comfort should be investigated.

The ratio of building width to sidewall opening should not be more than 3 to 1. Example: A house with a 6-foot sidewall curtain on each side should not be wider than 36 feet.
Sprinklers

Sprinklers are an effective method of cooling and are generally recommended for market hogs, boars and sows. Evaporative efficiency increases with air movement.

Table J2.1 shows the water requirements and nozzle sizes for a sprinkler system and Table J2.2 lists the pipe sizes for different flow rates.

Table J2.1: Nozzle Sizes For Sprinkler System

<table>
<thead>
<tr>
<th>Water Requirements</th>
<th>Nozzle Sizes</th>
<th>Operating 2 min/10 min</th>
<th>Operating 1 min/30 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigs per Pen (gal/hr)</td>
<td>gal/min</td>
<td>gal/hr</td>
<td>gal/min</td>
</tr>
<tr>
<td>10</td>
<td>0.2</td>
<td>0.017</td>
<td>1.0</td>
</tr>
<tr>
<td>20</td>
<td>0.4</td>
<td>0.033</td>
<td>2.0</td>
</tr>
<tr>
<td>30</td>
<td>0.6</td>
<td>0.050</td>
<td>3.0</td>
</tr>
</tbody>
</table>
Table J2.2: Water Line Sizes For Sprinkler Systems

<table>
<thead>
<tr>
<th>Pipe Size, ID</th>
<th>Class 160 PVC</th>
<th>Class 200 PVC</th>
<th>Schedule 40</th>
<th>Schedule 80</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4&quot;</td>
<td>7 gpm</td>
<td>6 gpm</td>
<td>4.5 gpm</td>
<td>3.5 gpm</td>
</tr>
<tr>
<td>1&quot;</td>
<td>13 gpm</td>
<td>13 gpm</td>
<td>9 gpm 7 gpm</td>
<td>15 gpm</td>
</tr>
<tr>
<td>1-1/4&quot;</td>
<td>25 gpm</td>
<td>23 gpm</td>
<td>18 gpm</td>
<td>15 gpm</td>
</tr>
<tr>
<td>1-1/2&quot;</td>
<td>35 gpm</td>
<td>32 gpm</td>
<td>28 gpm</td>
<td>23 gpm</td>
</tr>
<tr>
<td>2&quot;</td>
<td>55 gpm</td>
<td>55 gpm</td>
<td>50 gpm 45</td>
<td>65 gpm</td>
</tr>
<tr>
<td>2-1/2&quot;</td>
<td>85 gpm</td>
<td>80 gpm</td>
<td>70 gpm</td>
<td>65 gpm</td>
</tr>
</tbody>
</table>

* Maximum pressure drop of 2 psi per 100 ft. or velocity less than 5 feet per second.

Sprinklers are energized when the temperature reaches the thermostat setting, usually 80°F to 85°F, and the interval timer controls the frequency and period of sprinkler operation. The intermittent operation of sprinklers allows wetting of the skin and then during the off cycle the heat from the pig evaporates the moisture resulting in a loss of body heat from the pig. Figure J2.1 shows a schematic diagram of the controls for a sprinkler system.

Sediment and foreign material create problems with the low volume nozzles. A line strainer with a replaceable cartridge filter is an important part of the system.

![Figure J2.1. Control System For Sprinklers In Swine Buildings](image-url)