Warm Weather Ventilation

Jody Purswell, PhD, PE
Agricultural Engineer
USDA-ARS Poultry Research Unit
- Fan performance decreases as static pressure increases.

- Static pressure increases occur at:
  - The collision of opposing air streams
  - Obstructions
  - Friction at the walls
Understanding Fan Performance

BESS Laboratory tests are used to compare fans

CAUTION: Installed performance can vary dramatically from laboratory values.

Use BESS Lab values as a relative guide

NOT as an absolute value
Fan Output vs. Distance (60’)

- **Static Pressure (inH2O)**
- **Fan Flow Rate (cfm)**
- **Distance from Endwall (ft)**

Legend:
- **Rated**
- **Installed**
- **SP**
Fan Output vs Distance (50’)

Fan Flow Rate (cfm)

Static Pressure (inH2O)

Distance from Endwall (ft)

- Rated
- Installed
- SP
Operating Costs vs. Static Pressure

- 48 in: $340, $354, $367, $378
- 54 in: $325, $341, $354, $371

Static Pressure (in H2O):
- 0.10
- 0.15
- 0.20
- 0.25
Fan Placement

- Endwall fans run at a lower static pressure

- Lead fans (closest to evaporative pads) perform the worst in full tunnel
  - CFM decreases from 20000 to 17000 (15%)
  - CFM/Watt decreases

- Stage tunnel fans on starting with fans farthest from the inlet if possible.
26% Reduction in Airflow Capacity

60 x 560
Fan Placement

![Diagram showing fan placement and airflow](image)

**North**
- Flow: 19000 cfm

**East**
- Flow: 20000 cfm

**South**
- Flow: 18000 cfm

**Static Pressure (inH2O)**
- Level: 0.2

Legend:
- Evaporative Pad Inlet
- Exhaust Fan
- Air Deflector
- Velocity Measurement Point

[Diagram showing airflow and static pressure graphs]
Effects of Fan Installation on Velocity Distribution
Shutter Types

- Shutter type can affect fan output
- New shutters were tested on the same fans
- Static pressures: 0.05, 0.10, 0.20, 0.25
- Tunnel fan pressures are typically > 0.15

<table>
<thead>
<tr>
<th>SP inH2O</th>
<th>Aluminum cfm</th>
<th>Plastic cfm</th>
<th>Difference cfm</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.05</td>
<td>24140</td>
<td>21544</td>
<td>2596</td>
<td>10.8</td>
</tr>
<tr>
<td>0.10</td>
<td>21836</td>
<td>18926</td>
<td>2910</td>
<td>13.3</td>
</tr>
<tr>
<td>0.20</td>
<td>17226</td>
<td>13690</td>
<td>3536</td>
<td>20.5</td>
</tr>
<tr>
<td>0.25</td>
<td>14922</td>
<td>11072</td>
<td>3850</td>
<td>25.8</td>
</tr>
</tbody>
</table>
Maintaining Fan Performance

Fan maintenance is key!
- Fans must be serviced to maintain performance
- Fan maintenance also affects static pressure test

Dirty shutters = Loss of 10\% in fan output after one flock
- Increases with each successive flock
Flow Obstructions

Obstructions include:

- Box heaters
- Exposed studs
- Ceiling deflectors/baffles
- Brood curtains
- Feed hoppers

Obstructions create increases in static pressure and reduce fan performance and air exchange rate.

- CFM/watt goes DOWN!

Obstructions create dead spots within the house.
Effects of Obstructions on Velocity Distribution

60 x 560

4300 Birds

1500 Birds

50 x 475

4000 Birds

1000 Birds

40 x 400

1600 Birds

0 ft/min  200  400  600  800  1000
Ceiling deflectors reduce fan performance by 10%

Average CFM with deflectors:
- Down = 17,500
- Up = 19,625

Fan maintenance is ABSOLUTELY CRITICAL if deflectors are used

Additional losses from deflectors compounds fan/shutter maintenance problems
Acknowledgements

Dr. Jeremiah Davis
Agricultural & Biological Engineering, Mississippi State University

Dr. Brian Luck
Biological Systems Engineering, University of Wisconsin
Alternative Energy
System Efficiency
Insulation Value
House Tightness
Effect of Belt Wear
48 inch Fan

Airflow (cfm) vs. Static Pressure (in H2O)

- New Belt
- 1/16"
- 1/8"
- 3/16"
- 1/4"
## Fan Selection

<table>
<thead>
<tr>
<th>Static Pressure in H₂O</th>
<th>36 in cfm/Watt</th>
<th>48 in cfm/Watt</th>
<th>52 in cfm/Watt</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>20.4</td>
<td>21.9</td>
<td></td>
</tr>
<tr>
<td>0.05</td>
<td>18.3</td>
<td>19.7</td>
<td></td>
</tr>
<tr>
<td>0.10</td>
<td>16.2</td>
<td>17.6</td>
<td>17.6</td>
</tr>
<tr>
<td>0.15</td>
<td>14.1</td>
<td>15.4</td>
<td></td>
</tr>
<tr>
<td>0.20</td>
<td>11.4</td>
<td>12.6</td>
<td></td>
</tr>
<tr>
<td>0.25</td>
<td>8.6</td>
<td>9.8</td>
<td></td>
</tr>
</tbody>
</table>