A Revolutionary Method of Saving Energy for Commercial And Industrial Fan Systems

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ACEEE Summer Study on Energy Efficiency in Industry
The Peculiar Nature of Fans

- What does a fan deliver?
- What does fan consume?
- Efficiency Capability ≠ Efficiency Captured in Operation
Historic Metrics

- Based on the *efficiency capability* of the product
Many Options

General Purpose Fan - Backward Inclined / Flat Blade

Static Pressure (in wg)

Volume Flow Rate (CFM)

Most efficient fan at the prescribed operating condition

Size 18 @ 2510 RPM 8.4 BHP 61.4% TE
Size 20 @ 2047 RPM 7.8 BHP 60.6% TE
Size 22 @ 1661 RPM 6.2 BHP 71% TE
Size 24 @ 1364 RPM 5.6 BHP 75.1% TE
Size 27 @ 1110 RPM 5.3 BHP 76.7% TE (Highest Eff)
Size 30 @ 953 RPM 5.5 BHP 72.7% TE (Peak Ps)
Size 33 @ 865 RPM 5.8 BHP 67.4% TE (Peak Ps)
Revolutionary Metric

- Based on the efficiency capability of the product as specified

\[
FEI = \frac{\text{Fan System Efficiency}}{\text{Baseline Fan System Efficiency}}
\]

\[
FEI = \frac{\text{Baseline Fan Electrical Input Power}}{\text{Electrical Input Power}}
\]
\[ FEI = \frac{FEP_{std}}{FEP\;rating} \]

<table>
<thead>
<tr>
<th>Fan Regulatory or Voluntary Program Body</th>
<th>Possible FEI Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. Department of Energy</td>
<td>FEI ≥ 1.0 at Design Point</td>
</tr>
<tr>
<td>ASHRAE 90.1 or International Energy Conservation Code</td>
<td>FEI ≥ 1.0 at Design Point</td>
</tr>
<tr>
<td>ASHRAE 189.1</td>
<td>FEI ≥ 1.1 at Design Point</td>
</tr>
<tr>
<td>Utility Incentive Programs</td>
<td>FEI ≥ 1.1 at Design Point</td>
</tr>
</tbody>
</table>
Proper Metric for Fan Sizing

<table>
<thead>
<tr>
<th>Fan Size</th>
<th>Fan Class</th>
<th>Fan Speed (RPM)</th>
<th>Fan Shaft Power (bhp)</th>
<th>Elect. Input Power (kW)</th>
<th>Motor Size (hp)</th>
<th>Outlet Area (sf)</th>
<th>Outlet Vel (ft/min)</th>
<th>TE (%)</th>
<th>FEIr</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>III</td>
<td>3047</td>
<td>15.3</td>
<td>12.8</td>
<td>20</td>
<td>1.92</td>
<td>5,208</td>
<td>49%</td>
<td>0.83</td>
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<tr>
<td>20</td>
<td>II</td>
<td>2448</td>
<td>13.0</td>
<td>10.9</td>
<td>15</td>
<td>2.30</td>
<td>4,348</td>
<td>58%</td>
<td>0.98</td>
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<tr>
<td>22</td>
<td>II</td>
<td>1940</td>
<td>11.2</td>
<td>9.42</td>
<td>15</td>
<td>2.85</td>
<td>3,509</td>
<td>67%</td>
<td>1.13</td>
</tr>
<tr>
<td>24</td>
<td>II</td>
<td>1621</td>
<td>10.1</td>
<td>8.49</td>
<td>15</td>
<td>3.45</td>
<td>2,899</td>
<td>75%</td>
<td>1.25</td>
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<tr>
<td>27</td>
<td>I</td>
<td>1378</td>
<td>9.81</td>
<td>8.27</td>
<td>15</td>
<td>4.19</td>
<td>2,387</td>
<td>77%</td>
<td>1.28</td>
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<tr>
<td>30</td>
<td>I</td>
<td>1185</td>
<td>9.89</td>
<td>8.33</td>
<td>15</td>
<td>5.17</td>
<td>1,934</td>
<td>76%</td>
<td>1.27</td>
</tr>
<tr>
<td>33</td>
<td>I</td>
<td>1058</td>
<td>10.5</td>
<td>8.82</td>
<td>15</td>
<td>6.26</td>
<td>1,597</td>
<td>72%</td>
<td>1.20</td>
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</table>

Performance shown is for Installation type B: Free inlet, Ducted outlet. Power rating (BHP) does not include transmission losses. Performance ratings do not include the effects of appurtenances (accessories). FEIr values are calculated in accordance with AMCA 208 and are based on 4 pole TEFC motors of the size shown.
Questions
Additional Material for Questions

- Figure 1 from DRAFT AMCA 208
Additional Material for Questions

- Section B.2.2 from DRAFT AMCA 208