FAN DIFFUSER/MIXER

BLENDER CONE®

High Performance Diffusion Systems for New and Retrofit Applications

BENEFITS:
• Provides velocity uniformity
• Improves mixing effectiveness
• Reduces “System Effect”
The Blender Cone® fan diffuser/mixer provides the most energy efficient method to diffuse the fan discharge in blowthrough systems. The traditional method used to diffuse the high velocity jet from the discharge of a fan is to use a diffuser plate between the fan and the filter or coil bank. Unfortunately the use of these diffuser plates results in high energy use due to the system effect associated with their use. In addition, there is little actual test data that shows how well diffuser plates actually work.

Unlike diffuser plates, the Blender Cone fan diffuser mixer has been tested and has predictable performance. In addition, the integral diffuser cone provides static pressure regain from the fan jet and can reduce the system effect dramatically. The specially designed discharge vanes create turbulence that increases the natural diffusion angle of the jet from about 15° to about 90°. This results in more uniform velocity profiles at the downstream filter or coil which increases the efficiency of the downstream components. The energy savings provided by the Blender Cone fan diffuser/mixer typically pays for itself in one to two years.

### Blender Cone Selection and Specification Procedure

Selecting and specifying the correct Blender Cone fan diffuser/mixer for a specific fan consists of 3 easy steps. Following this procedure results in an efficient diffusion/mixing system for every blowthrough system.

**Step 1: Determine the fan outlet area.**

The size of the fan outlet determines which Blender Cone is used. No matter which fan is used, the Blender Cone is made to match the outlet of the fan. The fan outlet area is typically shown on the fan dimensional drawings. If the outlet area is not shown, it can be calculated using the following equation:

\[
\text{Area} = \frac{A \cdot B}{144}, \quad D_e = \frac{4 \cdot A \cdot B}{\pi}
\]

where
- \( \text{Area} \) = Fan outlet area (ft²)
- \( D_e \) = Diameter of fan outlet (inches)
- \( A \) = Width of fan outlet (inches)
- \( B \) = Height of fan outlet (inches)

Example:

A backward inclined airfoil fan has an outlet that is 30.125" wide and 24.875" high. What is the fan outlet area and diameter?

The outlet area is:

\[
\text{Area} = \frac{30.125 \cdot 24.875}{144} = 5.2
\]

\[
D_e = \frac{4 \cdot 30.125 \cdot 24.875}{\pi} = 30.89
\]

**Step 2: Determine the correct Blender Cone to use.**

Once the fan outlet area has been determined, check the following charts to determine the correct Blender Cone to use with the fan. If the fan outlet area is not shown, round to the nearest area that is shown. Table 1 shows the length for the Short Blender Cone option. The Short Blender Cone is primarily used with airfoil (AF) fans. It can also be used with Backward inclined (BI) and forward curved (FC) fans, however the long cone is a better choice with BI and FC fans due to pressure drop considerations. Table 2 shows the length for the Long Blender Cone.

### Table 1: Short Blender Cone fan diffuser/mixers.

<table>
<thead>
<tr>
<th>Fan Outlet Area (ft²)</th>
<th>Model</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.6</td>
<td>BCS-17</td>
<td>14.0&quot;</td>
</tr>
<tr>
<td>2.0</td>
<td>BCS-19</td>
<td>15.5&quot;</td>
</tr>
<tr>
<td>2.4</td>
<td>BCS-21</td>
<td>17.0&quot;</td>
</tr>
<tr>
<td>2.9</td>
<td>BCS-23</td>
<td>18.5&quot;</td>
</tr>
<tr>
<td>3.7</td>
<td>BCS-26</td>
<td>21.0&quot;</td>
</tr>
<tr>
<td>4.3</td>
<td>BCS-28</td>
<td>22.5&quot;</td>
</tr>
<tr>
<td>5.2</td>
<td>BCS-31</td>
<td>25.0&quot;</td>
</tr>
</tbody>
</table>

### Table 2: Long Blender Cone fan diffuser/mixers.

<table>
<thead>
<tr>
<th>Fan Outlet Area (ft²)</th>
<th>Model</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.6</td>
<td>BCL-17</td>
<td>19.0&quot;</td>
</tr>
<tr>
<td>2.0</td>
<td>BCL-19</td>
<td>22.0&quot;</td>
</tr>
<tr>
<td>2.4</td>
<td>BCL-21</td>
<td>24.0&quot;</td>
</tr>
<tr>
<td>2.9</td>
<td>BCL-23</td>
<td>27.0&quot;</td>
</tr>
<tr>
<td>3.7</td>
<td>BCL-26</td>
<td>30.0&quot;</td>
</tr>
<tr>
<td>4.3</td>
<td>BCL-28</td>
<td>33.0&quot;</td>
</tr>
<tr>
<td>5.2</td>
<td>BCL-31</td>
<td>36.0&quot;</td>
</tr>
</tbody>
</table>
Step 3: Determine distance downstream of the Blender Cone fan diffuser/mixer.
The distance required downstream of the Blender Cone is a function of the shape and the area of the downstream plenum. Two items need to be calculated to determine the downstream distance. First, the ratio of the downstream plenum area to the fan outlet area needs to be calculated. Second, the aspect ratio of the plenum (the width of the plenum divided by the height of the plenum) is calculated. Once this is done, Chart 1 is used to determine how many fan outlet diameters are required between the discharge of the Blender Cone and the downstream coil or filter.

\[
\text{AreaRatio} = \frac{W_{\text{Plenum}} \cdot H_{\text{Plenum}}}{A \cdot B}
\]

where

- \(W_{\text{Plenum}}\) = Width of the plenum (inches)
- \(H_{\text{Plenum}}\) = Height of plenum (inches)
- \(A\) = Width of fan outlet (inches)
- \(B\) = Height of fan outlet (inches)

\[
\text{AspectRatio} = \frac{W_{\text{Plenum}}}{H_{\text{Plenum}}}
\]

Example:
The fan in the previous example is discharging into a plenum that is 72" wide by 60" high. What is the required distance between the discharge of the Blender Cone and the downstream filter bank?

\[
\text{AreaRatio} = \frac{72 \cdot 60}{30.125 \cdot 24.875} = 5.76 \approx 6
\]

\[
\text{AspectRatio} = \frac{72}{60} = 1.20
\]

Drawing a vertical line from the area ratio of 6 and interpolating between the lines for an aspect ratio of 1 and 1.5 yields a required distance of approximately 0.7 times the fan outlet equivalent diameter (0.7 x 30.89 = 21.6"). As a result, a distance of approximately 22" is required between the Blender Cone and the downstream filter bank.

Step 4: Determine the pressure loss of the Blender Cone.
The pressure loss of the Blender Cone depends upon the type of fan being used, the amount of expansion that the air stream must undergo and the length of the Blender Cone. Chart 2 should be used when using fan curves developed using an outlet duct. When using fan curves developed in a blowthrough arrangement, i.e. no outlet duct, the Blender Cone results in a reduction in the pressure loss. Chart 3 should be used to determine the pressure gained by using the Blender Cone. The only factor required to determine the pressure loss is the fan outlet velocity.
Step 5: Specify the Blender Cone fan diffuser/mixer.

The final step is to specify the Blender Cone fan diffuser/mixer. The specification shown below is an example performance specification for a fan diffuser.

**Specification**

Furnish Blender Cone fan diffusion system in sizes and quantities as shown on drawing.

**Construction**

Unit shall be 14 gauge, powder-coated steel, all welded construction. The unit shall be capable of withstanding initial air velocities of 4000 FPM. Unit shall be built with flanges to fit up to fan discharge. Blender Cone outlet shall be equipped with mounting plate for fit up to plenum walls.

**Performance**

Provide a Blender Cone unit to diffuse the discharge jet from the fan between the fan outlet and downstream filters and/or coils. This unit shall provide a uniform velocity profile across downstream filters and coils. The maximum velocity at the face of the downstream coil shall be no more than 1.3 times the average design velocity thorough the filters or coils. Any areas of reverse flow (negative velocity) shall be limited to less than 10 percent of the face area of the downstream filters or coil. The pressure drop of the diffuser shall include both system effect and dynamic pressure loss. The manufacturer of the diffuser device shall provide actual performance data from similar installations for velocity diffusion and pressure loss with product submittals.

**Manufacturer**

Units shall be manufactured by Blender Products, Inc., Denver, CO, or equal approved prior to bidding. Manufacturer of static mixing devices shall be able to furnish a list of over 500 proven installations of blending type of equipment in active service.