Variable swirl diffusers

Variable swirl diffuser OD-11

Application
Diffuser is designed for air conditioning of rooms with floor to ceiling highs of 3 to 10 m and high induction requirements. It is suitable for large temperature difference between supply and room air.

Description
Diffuser is made of housing which has a diffusing funnel mounted at the bottom. The direction of the discharged air is altered via the separately adjustable blades. The shape of the diffuser’s inner part allows “Coanda” effect.

Housing consists of sheet aluminium and blades of pickled sheet steel. Complete diffuser is powder painted in RAL 9010 or any colour upon customer’s request.

Individually adjustable blades OD-11
Use of the individually adjustable blades is recommended when the ventilation system is designed for the specific mode of operation and the blades can be adjusted during the diffuser installation.

Variable swirl diffuser OD-11V
Version OD-11V has centrally adjustable blades. Blades can be manually adjustable or by the means of electric motor installed on the outer side of the diffuser or by thermostat regulation. Diffuser is capable of altering discharge direction.

Variable swirl diffuser with the thermostat regulation OD-11V/TR
OD-11V/TR diffuser has a basic implementation of OD-11V upgraded thermostatically controlled. Automatic continuous regulation operates as a function of the temperature of air flowing through the diffuser. With additional configuration before installation to ensure optimum operation of the demands of comfort in the room.

Regulation with the OD-11V/.../RR handle
Regulation with this handle enables manual blade angle adjustment if the diffuser placement allows access to the handle. This type of regulation is suitable for buildings with a lower number of diffusers when the ventilation system is designed for both summer and winter operation.

1. handle
2. fixing screw
**OD-11V with the ADT-2 thermostat with analogue output**

**Description**
The ADT-2 differential thermostat with continuous analogue output is a controller that, based on the duct air temperature and room temperature signals, automatically adjusts the angle of OD-11V blades as required.

One ADT-2 can operate up to 10 OD-11V units.

**Operation**
The controller compares the selected temperature curve, which is set according to the OD-11V position, desired mode of operation, etc, with data received from temperature sensors located in the air supply duct and in the room. Taking into account the desired temperature difference, the controller generates a continuous analogue 0-10V DC output signal, which is then transmitted to the OD-11V electric motor drive. Comparing the temperature, the controller automatically recognises the heating or cooling mode and sets the OD-11V accordingly. In the case the duct air temperature is higher than the room temperature, the controller switches the OD-11V to the heating mode, i.e. to the vertical supply of warm air into the room. In the case the duct air temperature is lower than the room temperature, the controller automatically infers that the system is in the room cooling mode and accordingly generates a signal to set the OD-11V to the cooling mode.

**Advantage**
Applying ADT-2, the need for manual switching of a large number of OD-11V units to the proper operational mode is avoided, since the controller switches the units automatically. In this way, the efficiency of room air conditioning is enhanced as well.

**ADT-2 differential thermostat**

1. controller
2. room temperature sensor
3. duct temperature sensor
4. compact actuator (B3, B6, B9)

---

T1 – air temperature in the duct (°C)
T2 – air temperature in the room (°C)

T1<T2: cooling – the blade angle is towards 0°
T1>T2: heating – the blade angle is towards 90°
Variable diffuser with the thermostat regulation OD-11V/TR

Operation
At OD-11V/TR diffuser, centrally adjustable blades can be adjusted automatically with the thermostat regulation. Thermostat perceives temperature of the supply air and automatically adjusts the blades angle. No additional power supply and controls are required, so no additional wiring installation is needed. Blade angle according to the supply air temperature is shown in the chart below.

A hysteresis behavior of the thermostatic head in both cooling and heating mode is shown in the chart. After the temperature is stabilized, angle of the blades is adjusted to the medium value in about 15 minutes.

Size
OD-11V/TR diffuser can be made in sizes 200, 250, 315, 400, 500, 630 and 800 (sizes 125 and 160 are not available).

Regulation of the initial and final blade angle
OD-11V/TR allows the regulation of the initial and final blade angle. During the selection of appropriate diffuser for certain room conditions with the Klima ADE software package, exact angles are calculated according to the installation height of the diffuser, supplied air quantity and the temperature difference between supplied and room temperature. Calculation is based on air flow speed of 0.2 m/s in the living area.

Initial blade angle is preadjusted with the special nut in the range between 30 and 50°. Automatic opening of the blades is initiated, when the temperature reaches limit value, shown in the chart according to the preadjusted angle and number of used spacers. When initial angle of 45° is preadjusted without additional spacers and final angle is 75°, blade opening temperature is between 22.5 and 23 °C (designation 1 in diagram).

Final blade angle is adjusted by adding spacers below thermostatic head. Default preassembled spacer allow complete opening of the blades until 75°. By each added spacer, final angle is reduced for 5°.

Adding of spacers also change the thermostatic head characteristics (average values according to the number of added spacers are shown in the chart).
Calculation example of initial and final blade angle for the OD-11V/TR diffuser with the Klima ADE 5.4 software package

### Input data:
- Air quantity
- Air temperature
- Room size
- Diffuser size

### Calculation

**Result of the calculation:**
- Minimum angle in the cooling mode = 45°
- Maximum angle in the heating mode = 60°

**Angle adjustment (designation 2 in diagram):**
- For 60° three spacers should be used.

**Angle adjustment (designation 3 in diagram):**
- Transitional period: automatic adjustment of blade angle to the supply air temperature.
Swirl diffusers, Variable swirl diffusers

**Variable swirl diffusers**

### Dimensions

<table>
<thead>
<tr>
<th>Size</th>
<th>( \Phi )</th>
<th>( \Phi D )</th>
<th>C</th>
<th>C1</th>
<th>( A_{e} ) (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>125</td>
<td>125</td>
<td>205</td>
<td>130</td>
<td>40</td>
<td>0.012</td>
</tr>
<tr>
<td>160</td>
<td>160</td>
<td>250</td>
<td>155</td>
<td>40</td>
<td>0.020</td>
</tr>
<tr>
<td>200</td>
<td>200</td>
<td>310</td>
<td>174</td>
<td>40</td>
<td>0.030</td>
</tr>
<tr>
<td>250</td>
<td>250</td>
<td>400</td>
<td>200</td>
<td>40</td>
<td>0.048</td>
</tr>
<tr>
<td>315</td>
<td>315</td>
<td>480</td>
<td>240</td>
<td>40</td>
<td>0.077</td>
</tr>
<tr>
<td>400</td>
<td>400</td>
<td>615</td>
<td>265</td>
<td>55</td>
<td>0.125</td>
</tr>
<tr>
<td>500</td>
<td>500</td>
<td>790</td>
<td>320</td>
<td>60</td>
<td>0.195</td>
</tr>
<tr>
<td>630</td>
<td>630</td>
<td>940</td>
<td>380</td>
<td>80</td>
<td>0.310</td>
</tr>
<tr>
<td>800</td>
<td>800</td>
<td>1142</td>
<td>555</td>
<td>75</td>
<td>0.503</td>
</tr>
</tbody>
</table>

\( A_{e} \) – effective discharge area (m²)

### Installation of diffuser on a plenum box

1. Plenum box
2. Inlet spigot
3. Dispersing plate
4. Volume control damper M
5. Traverse
7. Adapter

<table>
<thead>
<tr>
<th>Size</th>
<th>A</th>
<th>H1</th>
<th>( h_1 )</th>
<th>( \Phi d )</th>
<th>( \Phi D )</th>
<th>( \Phi A_1 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>125</td>
<td>230</td>
<td>185</td>
<td>112</td>
<td>98</td>
<td>128</td>
<td>205</td>
</tr>
<tr>
<td>160</td>
<td>280</td>
<td>210</td>
<td>125</td>
<td>123</td>
<td>163</td>
<td>250</td>
</tr>
<tr>
<td>200</td>
<td>325</td>
<td>240</td>
<td>137</td>
<td>158</td>
<td>204</td>
<td>310</td>
</tr>
<tr>
<td>250</td>
<td>390</td>
<td>290</td>
<td>167</td>
<td>198</td>
<td>254</td>
<td>400</td>
</tr>
<tr>
<td>315</td>
<td>590</td>
<td>325</td>
<td>177</td>
<td>248</td>
<td>319</td>
<td>480</td>
</tr>
<tr>
<td>400</td>
<td>590</td>
<td>390</td>
<td>210</td>
<td>313</td>
<td>404</td>
<td>615</td>
</tr>
<tr>
<td>500</td>
<td>590</td>
<td>390</td>
<td>210</td>
<td>313</td>
<td>504</td>
<td>790</td>
</tr>
<tr>
<td>630</td>
<td>655</td>
<td>530</td>
<td>280</td>
<td>448</td>
<td>634</td>
<td>940</td>
</tr>
<tr>
<td>800</td>
<td>1049</td>
<td>630</td>
<td>340</td>
<td>498</td>
<td>804</td>
<td>1142</td>
</tr>
</tbody>
</table>

### Round plenum box

1. Plenum box
2. Inlet spigot
3. Suspension bracket
4. Volume control damper M
5. Dispersing plate

<table>
<thead>
<tr>
<th>Size</th>
<th>( \Phi )</th>
<th>H</th>
<th>H1</th>
<th>( \Phi d )</th>
</tr>
</thead>
<tbody>
<tr>
<td>125</td>
<td>128</td>
<td>250</td>
<td>154</td>
<td>98</td>
</tr>
<tr>
<td>160</td>
<td>183</td>
<td>250</td>
<td>166</td>
<td>123</td>
</tr>
<tr>
<td>200</td>
<td>204</td>
<td>245</td>
<td>144</td>
<td>158</td>
</tr>
<tr>
<td>250</td>
<td>254</td>
<td>285</td>
<td>164</td>
<td>158</td>
</tr>
<tr>
<td>315</td>
<td>319</td>
<td>335</td>
<td>189</td>
<td>248</td>
</tr>
<tr>
<td>400</td>
<td>404</td>
<td>400</td>
<td>221</td>
<td>313</td>
</tr>
<tr>
<td>500</td>
<td>504</td>
<td>400</td>
<td>221</td>
<td>313</td>
</tr>
<tr>
<td>630</td>
<td>634</td>
<td>535</td>
<td>289</td>
<td>448</td>
</tr>
<tr>
<td>800</td>
<td>804</td>
<td>585</td>
<td>314</td>
<td>498</td>
</tr>
</tbody>
</table>
Corections
In the case of the diffuser installation in the ceiling, the velocity \( V_h \) at the level \( A/2 + H \) is to be multiplied with a factor of 1.4 (due to the Coanda effect).

The above applies to the cases of heating and cooling operation with blade opening angles less than 30°.

**Diagram for fast selection**

**Definition of symbols**

- \( Q \) (m³/h): Air flow
- \( x \) (m): Horizontal distance to the wall
- \( H \) (m): Room height
- \( H_1 \) (m): Distance from ceiling to occupied zone
- \( L \) (m): Throw distance \((L=H_1+x)\)
- \( V_l \) (m/s): Air velocity at the throw distance \( L \)
- \( \Delta t \) (K): Temperature difference between the supply and room air
- \( \Delta t_L \) (K): Difference between the core and room air temperature
- \( \Delta p_t \) (Pa): Pressure drop
- \( L_{wa} \) (dB(A)): Sound power level
- \( V_{H1} \) (m/s): Air velocity at the \( H_1 \) distance
- \( A, B \) (m): Distance between diffusers by length and by width

**Diagram Fast Selection**

Blade angle 45°

- 25 - 35 dB(A)
- 35 - 45 dB(A)

Examples for selection 1, 2 and 3: see the following pages.
### Blade opening angle during heating and cooling operation

#### Calculation

**Example 1 (cooling)**

- \( Q = 160 \text{ m}^3/\text{h} \)
- \( H = 3 \text{ m} \)
- \( H_1 = H - 1.8 = 3 - 1.8 = 1.2 \text{ m} \)
- \( v_{H1} = 0.2 \text{ m/s} \)
- \( \Delta T_z = -5 \text{ K} \)
- Recommended size: 125

\[
 v_{ef} = \frac{Q}{A_{ef} \times 3600} = \frac{160}{0.012 \times 3600} 
\]

\[
 v_{ef} = 3.6 \text{ m/s} 
\]

\[
 \frac{v_{H1}}{v_{ef}} = \frac{0.2}{3.6} = 0.056 
\]

Blade angle: 41°

**Example 1 (heating)**

- \( Q = 160 \text{ m}^3/\text{h} \)
- \( H = 3 \text{ m} \rightarrow H_1 = 1.2 \text{ m} \)
- \( v_{H1} = 0.2 \text{ m/s} \)
- \( \Delta T_z = 10 \text{ K} \)
- Recommended size: 125

\[
 v_{ef} = \frac{Q}{A_{ef} \times 3600} = \frac{160}{0.012 \times 3600} 
\]

\[
 v_{ef} = 2.7 \text{ m/s} 
\]

\[
 \frac{v_{H1}}{v_{ef}} = \frac{0.2}{2.7} = 0.074 
\]

Blade angle: 66°

---

<table>
<thead>
<tr>
<th>OD-11V 125</th>
<th></th>
<th>OD-11V 160</th>
</tr>
</thead>
<tbody>
<tr>
<td>COOLING</td>
<td>HEATING</td>
<td>COOLING</td>
</tr>
<tr>
<td>Blade angle</td>
<td></td>
<td>Blade angle</td>
</tr>
<tr>
<td>45°</td>
<td></td>
<td>50°</td>
</tr>
<tr>
<td>40°</td>
<td></td>
<td>50°</td>
</tr>
<tr>
<td>35°</td>
<td></td>
<td>50°</td>
</tr>
<tr>
<td>30°</td>
<td></td>
<td>50°</td>
</tr>
<tr>
<td>25°</td>
<td></td>
<td>50°</td>
</tr>
<tr>
<td>20°</td>
<td></td>
<td>50°</td>
</tr>
<tr>
<td>15°</td>
<td></td>
<td>50°</td>
</tr>
<tr>
<td>10°</td>
<td></td>
<td>50°</td>
</tr>
<tr>
<td>5°</td>
<td></td>
<td>50°</td>
</tr>
<tr>
<td>0°</td>
<td></td>
<td>50°</td>
</tr>
</tbody>
</table>

\( \Delta T_z \): -5 K, -10 K, -15 K, 0 K, +5 K, +10 K, +15 K

---

**Tables and Diagrams**

- OD-11V 125
- OD-11V 160

---

**PRODUCTS**

- Swirl diffusers, Variable swirl diffusers
- Variable swirl diffusers
Blade opening angle during heating and cooling operation

**Calculation**

Example 2 (cooling)

Q = 350 m³/h

H₁ = 1.4 m

vₘ = 0.15 m/s

ΔTᵢ = -10 K

Recommended size: 200

\[
\begin{align*}
\nu &= \frac{Q}{(\pi \times 3600)} = \frac{350}{(0.031 \times 3600)} \\
\nu &= 3.13 \text{ m/s} \\
\frac{v_{H1}}{\nu} &= \frac{0.15}{3.13} = 0.046 \\
\text{Blade angle: } 32°
\end{align*}
\]

(Blade angle 32° → Coanda effect)

H₁ = 1.4 × 1.4 = 1.96 m

H = H₁ + 1.8 = 1.96 + 1.8 = 3.67 m

or

H = 1.4 → \( \frac{v_{H1}}{\nu} = 0.15 \times 1.4 = 0.25 \text{ m/s} \)

### Table: Blade angle

<table>
<thead>
<tr>
<th>Blade angle</th>
<th>OD-11V 200</th>
<th>OD-11V 250</th>
<th>OD-11V 300</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°</td>
<td>0°</td>
<td>0°</td>
<td>0°</td>
</tr>
<tr>
<td>10°</td>
<td>10°</td>
<td>10°</td>
<td>10°</td>
</tr>
<tr>
<td>15°</td>
<td>15°</td>
<td>15°</td>
<td>15°</td>
</tr>
<tr>
<td>20°</td>
<td>20°</td>
<td>20°</td>
<td>20°</td>
</tr>
<tr>
<td>25°</td>
<td>25°</td>
<td>25°</td>
<td>25°</td>
</tr>
<tr>
<td>30°</td>
<td>30°</td>
<td>30°</td>
<td>30°</td>
</tr>
<tr>
<td>35°</td>
<td>35°</td>
<td>35°</td>
<td>35°</td>
</tr>
<tr>
<td>40°</td>
<td>40°</td>
<td>40°</td>
<td>40°</td>
</tr>
<tr>
<td>45°</td>
<td>45°</td>
<td>45°</td>
<td>45°</td>
</tr>
<tr>
<td>50°</td>
<td>50°</td>
<td>50°</td>
<td>50°</td>
</tr>
<tr>
<td>55°</td>
<td>55°</td>
<td>55°</td>
<td>55°</td>
</tr>
<tr>
<td>60°</td>
<td>60°</td>
<td>60°</td>
<td>60°</td>
</tr>
<tr>
<td>65°</td>
<td>65°</td>
<td>65°</td>
<td>65°</td>
</tr>
<tr>
<td>70°</td>
<td>70°</td>
<td>70°</td>
<td>70°</td>
</tr>
<tr>
<td>75°</td>
<td>75°</td>
<td>75°</td>
<td>75°</td>
</tr>
<tr>
<td>80°</td>
<td>80°</td>
<td>80°</td>
<td>80°</td>
</tr>
<tr>
<td>85°</td>
<td>85°</td>
<td>85°</td>
<td>85°</td>
</tr>
<tr>
<td>90°</td>
<td>90°</td>
<td>90°</td>
<td>90°</td>
</tr>
</tbody>
</table>

### Diagrams

- OD-11V 200
- OD-11V 250
- OD-11V 315
- OD-11V 300

---

**IMP Klima**

Swirl diffusers, Variable swirl diffusers

Variable swirl diffusers
**Blade opening angle during heating and cooling operation**

**Example 3 (cooling)**

Q = 2700 m³/h  
υ₀ = 0.2 m/s  
Δtz = -10 K  
H = 9 m → H₁ = 9 - 1.8 = 7.2 m  
Recommended size: 630

\[ υ_{ef} = \frac{Q}{(A_{ef} \times 3600)} = \frac{2700}{(0.32 \times 3600)} \]

\[ υ_{ef} = 2.3 \text{ m/s} \]

\[ \frac{v_{H1}}{v_{ef}} = 0.2/2.3 = 0.08 \]

Blade angle: 44°
**Blade opening angle during heating and cooling operation**

**OD-11V 800**

![Diagram showing blade angles for heating and cooling operations with temperature changes.](image)

**Pressure drops and sound power level**

(for version with dispersing plate)

**OD-11V Size 125 - 800**

![Diagram showing pressure drops and sound power level for different flow rates.](image)

**Calculation**

- **Example 2 (cooling)**
  - \( Q = 350 \text{ m}^3/\text{h} \)
  - \( L_{WA} = 47 \text{ dB(A)} \)
  - \( \Delta p = 75 \text{ Pa} \)
  - Blade angle: 32°

- **Example 3 (cooling)**
  - \( Q = 2700 \text{ m}^3/\text{h} \)
  - \( L_{WA} = 37 \text{ dB(A)} \)
  - \( \Delta p = 16 \text{ Pa} \)
  - Blade angle: 44°