VOLUME CONTROL DAMPERS
VOLUME CONTROL DAMPERS

SPK 30 - 100

VOLUME CONTROL DAMPERS

SPK 30 SERIES

FLANGE TYPE VOLUME CONTROL DAMPER

SPK 30 SERIES [SPK 30 - 100, SPK 30 - 110, SPK 30 - 120]

Air Performance

Pressure Drop

The tests for pressure prop of Volume Control Dampers were conducted as per ANSI / AMCA Standard 500-D, Figure 5.3 which simulate the actual site condition when installed in ventilation, supply and return air conditioning ductwork.

AMCA Test Figure 5.3

Pressure Drop at Face Area Velocity

<table>
<thead>
<tr>
<th>305 x 305</th>
<th>12 in. x 12 in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>120 x 120</td>
<td>24 in. x 24 in.</td>
</tr>
<tr>
<td>914 x 914</td>
<td>36 in. x 36 in.</td>
</tr>
<tr>
<td>305 x 1219</td>
<td>12 in. x 48 in.</td>
</tr>
<tr>
<td>1219 x 305</td>
<td>48 in. x 12 in.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Velocity (FPM)</th>
<th>Pressure Drop (in. W.G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1515</td>
<td>0.060</td>
</tr>
<tr>
<td>1652</td>
<td>0.048</td>
</tr>
<tr>
<td>1006</td>
<td>0.020</td>
</tr>
<tr>
<td>755</td>
<td>0.016</td>
</tr>
<tr>
<td>494</td>
<td>0.006</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Velocity (FPM)</th>
<th>Pressure Drop (in. W.G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>0.079</td>
</tr>
<tr>
<td>1752</td>
<td>0.060</td>
</tr>
<tr>
<td>1497</td>
<td>0.044</td>
</tr>
<tr>
<td>1011</td>
<td>0.023</td>
</tr>
<tr>
<td>948</td>
<td>0.006</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Velocity (FPM)</th>
<th>Pressure Drop (in. W.G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2494</td>
<td>0.110</td>
</tr>
<tr>
<td>1991</td>
<td>0.086</td>
</tr>
<tr>
<td>1649</td>
<td>0.055</td>
</tr>
<tr>
<td>1991</td>
<td>0.016</td>
</tr>
<tr>
<td>1493</td>
<td>0.004</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Velocity (FPM)</th>
<th>Pressure Drop (in. W.G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2494</td>
<td>1.899</td>
</tr>
<tr>
<td>1991</td>
<td>1.580</td>
</tr>
<tr>
<td>1649</td>
<td>1.129</td>
</tr>
<tr>
<td>1649</td>
<td>0.500</td>
</tr>
<tr>
<td>1493</td>
<td>0.312</td>
</tr>
</tbody>
</table>

Note:
Extrapolation below the minimum test static pressure drop shall be permitted as per AMCA (61-10), Section 13.2.1.1. The air performance shall not be extrapolated more than 50% of the static pressure range of test downward.

Catalog ID: SPK 30 - 100  September 30, 2013

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Description

The single and multi-leaf volume control dampers are designed for quiet, efficient and reliable air volume control in air conditioning and ventilation systems.

The SPK 30 dampers are ruggedly built dampers with a casing of robust assembly, formed from channel frame for flanged connection to ductwork. The blades are formed single skin and reinforced with longitudinal structurally designed triple vee shape.

Bollard's action can be opposed blades or parallel blades.

Standard Construction

Frame:
160mm x 30mm x 5.5mm (6 Ga.) galvanized steel formed channel frame for flange connection.

Blades:
250mm max. width, 1.5mm (6 Ga.) galvanized steel.

Finish:
Mill Galvanized

Linkage:
Side linkage concealed in frame for parallel and opposed blade operation.

Case Bearing:
Sintered bronze oilite (optional).

Control Shaft:
12mm diameter zinc plated mild steel.

Minimum and Maximum Single Section Size:
100 x 100mm minimum and 1000 x 1800mm maximum.

Please see “Air Performance” for the minimum and maximum sizes tested by AMCA.

Consult SAFID for multiple section assembly details.

SPK 30 - 110
General construction as type SPK 30 - 100 damper but with blades, shafts and blade to shaft fixing are from stainless steel Grade 304.

Optional: Blades from stainless steel Grade 316 or 316L.

SPK 30 - 120
General construction as type SPK 30 - 100 damper but with frame, blades, linkage, case bearing, axles and control shaft are from stainless steel Grade 304.

Optional: Frame and blades from stainless steel Grade 316 or 316L.

Catalog ID: SPK 30 - 100  September 30, 2013

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FLANGE TYPE VOLUME CONTROL DAMPER

SPK 30 SERIES [SPK 30 - 100, SPK 30 - 110, SPK 30 - 120]

Air Performance

Pressure Drop
AMCA Test Figure 5.3

Pressure Drop at Face Area Velocity
Damper Size 12 in. x 12 in. - Fully Open Blades

Pressure Drop at Face Area Velocity
Damper Size 24 in. x 24 in. - Fully Open Blades

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FLANGE TYPE VOLUME CONTROL DAMPER

SPK 30 SERIES [SPK 30 - 100, SPK 30 - 110, SPK 30 - 120]

Air Performance
Pressure Drop
AMCA Test Figure 5.3

Pressure Drop at Face Area Velocity
Damper Size 36 in. x 36 in. - Fully Open Blades

Catalog ID: SPK 30 - 100  September 30, 2013

AMCA Test Figure 5.3
Pressure Drop
Damper Size 12 in. x 48 in. - Fully Open Blades

Test Information
Tested for air performance in accordance with ANSI / AMCA Standard 500-D-07 (Pressure Drop), Figure 5.3

SAFID certifies that the Volume Control Damper shown herein is licensed to bear the AMCA Seal for Model SPK 30-100-OB-S-B-R. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with the requirements of the AMCA Certified Ratings Program. The AMCA Certified Ratings Seal applies to Air Performance Ratings.
**FLANGE TYPE VOLUME CONTROL DAMPER**

**SPK 30 SERIES [SPK 30 - 100, SPK 30 - 110, SPK 30 - 120]**

**Air Performance**

**Pressure Drop**
AMCA Test Figure 5.3

Pressure Drop at Face Area Velocity
Damper Size 48 in. x 12 in. - Fully Open Blades

![Pressure Drop Graph](image)

<table>
<thead>
<tr>
<th>Face Area Velocity (FPM x 100)</th>
<th>0.00</th>
<th>0.20</th>
<th>0.40</th>
<th>0.60</th>
<th>0.80</th>
<th>1.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure Drop (W.G.)</td>
<td>0.00</td>
<td>0.20</td>
<td>0.40</td>
<td>0.60</td>
<td>0.80</td>
<td>1.00</td>
</tr>
</tbody>
</table>

**Dimensions**

1. Casing  
2. Drive Shaft  
3. Side Linkage  
4. Blade  
5. Landing Angles  
6. Bearing

**Flange Type**

**Flange Type, Parallel/Opposed Blades**

<table>
<thead>
<tr>
<th>Standard Sizes</th>
<th>Width (mm)</th>
<th>Height (mm)</th>
<th>No. of Blades</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>100</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>150</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>200</td>
<td>2</td>
<td></td>
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<tr>
<td>250</td>
<td>250</td>
<td>3</td>
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<tr>
<td>300</td>
<td>300</td>
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<tr>
<td>350</td>
<td>350</td>
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<td></td>
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<tr>
<td>500</td>
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<tr>
<td>550</td>
<td>550</td>
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<tr>
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<td>650</td>
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<td>700</td>
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<td></td>
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<tr>
<td>800</td>
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<td>900</td>
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<tr>
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<td>950</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>1000</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

SAFID certifies that the Volume Control Damper shown herein is licensed to bear the AMCA Seal for Model SPK 30-100-OB-S-B-R. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with the requirements of the AMCA Certified Ratings Program.

The AMCA Certified Ratings Seal applies to Air Performance Ratings.

Test Information

Tested for air performance in accordance with ANSI / AMCA Standard 500-D-07 (Pressure Drop), Figure 5.3.
MATERIALS CONSTRUCTION

SPK 30 SERIES [SPK 30 - 100, SPK 30 - 110, SPK 30 - 120]

Axle and Drive Shaft Fixing Details

Damper with Control Option Type A

Blade Seal (Optional)

Type S1

Type S2 (Stainless Steel Type 304)

Side Seal or Jamb Seal (Optional)

NOTE
1. Type S3 (Combination of S1 and S2)
2. Hand locking quadrant is shown above - Control Type Q

CATALOG ID: SPK 30 - 100  September 30, 2013

INSTALLATION DETAILS

SPK 30 SERIES [SPK 30 - 100, SPK 30 - 110, SPK 30 - 120]

Damper to Slide on Flange Connection

Damper to Angle Flange Connection

Flange Drilling Details

<table>
<thead>
<tr>
<th>Width (mm)</th>
<th>Height (mm)</th>
<th>No. of Holes W Dim.</th>
<th>No. of Holes H Dim.</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>100</td>
<td>1</td>
<td>2</td>
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<tr>
<td>150</td>
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<td>8</td>
<td>14</td>
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<tr>
<td>1000</td>
<td>1800</td>
<td>9</td>
<td>15</td>
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</table>

CATALOG ID: SPK 30 - 100  September 30, 2013
## Seals

<table>
<thead>
<tr>
<th>Construction Variants</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>No Seals</td>
</tr>
<tr>
<td>S1</td>
<td>Blade’s edge seals. Fitted to seal blades to blade’s joint. Blade seal is silicone rubber with temperature resistance up to 175 °C, to minimize air leakage.</td>
</tr>
<tr>
<td>S2</td>
<td>Side seals. Fitted to close gap between frame and blades (jamb seal) to minimize air leakage.</td>
</tr>
<tr>
<td>S3</td>
<td>Combination of S1 &amp; S2. Fitted to close gap between frame and blades and blade’s edge seals to seal blades to blade’s joints. Blade seals is silicone rubber with temperature resistance up to 175 °C for low air leakage characteristic.</td>
</tr>
</tbody>
</table>

## Linkage

<table>
<thead>
<tr>
<th>Construction Variants</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PB</td>
<td>Side linkage concealed in frame for parallel blade operation.</td>
</tr>
<tr>
<td>OB</td>
<td>Side linkage concealed in frame for opposed blade operation.</td>
</tr>
</tbody>
</table>

## Bearings

<table>
<thead>
<tr>
<th>Construction Variants</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>B1</td>
<td>Sintered bronze oilite.</td>
</tr>
<tr>
<td>B2</td>
<td>Stainless Steel.</td>
</tr>
</tbody>
</table>

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### Actuators

<table>
<thead>
<tr>
<th>Code</th>
<th>Type/Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>BF230-ME, BF24-M3 Spring-return</td>
</tr>
<tr>
<td>A15</td>
<td>BF230-5-ME, BF24-5-M3 Spring-return</td>
</tr>
<tr>
<td>A21</td>
<td>BF230 Spring-return</td>
</tr>
<tr>
<td>A22</td>
<td>BF24 Spring-return</td>
</tr>
<tr>
<td>A30</td>
<td>AF230 Spring-return</td>
</tr>
<tr>
<td>A33</td>
<td>AF230-5 Spring-return with limit switch</td>
</tr>
<tr>
<td>A35</td>
<td>AF230 US Spring-return</td>
</tr>
<tr>
<td>A36</td>
<td>AF230-5 US Spring-return with limit switch</td>
</tr>
<tr>
<td>A40</td>
<td>AF230 US Spring-return</td>
</tr>
<tr>
<td>A41</td>
<td>AF24-5 US Spring-return</td>
</tr>
<tr>
<td>A42</td>
<td>AF24 US Spring-return</td>
</tr>
<tr>
<td>A43</td>
<td>AF24-5 US Spring-return with limit switch</td>
</tr>
<tr>
<td>A44</td>
<td>AF24 US Spring-return</td>
</tr>
<tr>
<td>A45</td>
<td>AF24 SR Spring-return</td>
</tr>
<tr>
<td>A46</td>
<td>NF24 US Spring-return</td>
</tr>
<tr>
<td>A47</td>
<td>NF24-5 US Spring-return</td>
</tr>
<tr>
<td>A48</td>
<td>NF24-5 US Spring-return with limit switch</td>
</tr>
<tr>
<td>A49</td>
<td>NF24 US Spring-return</td>
</tr>
<tr>
<td>A50</td>
<td>NF24 SR US Modulating</td>
</tr>
<tr>
<td>A51</td>
<td>MF230A open/closed</td>
</tr>
<tr>
<td>A52</td>
<td>MF24A open/closed</td>
</tr>
<tr>
<td>A53</td>
<td>MF230A-SR Modulating</td>
</tr>
<tr>
<td>A54</td>
<td>NM230-5 open/closed</td>
</tr>
<tr>
<td>A55</td>
<td>NM24 open/closed</td>
</tr>
<tr>
<td>A56</td>
<td>NM24-5 SR Modulating</td>
</tr>
<tr>
<td>A57</td>
<td>GM240-5 open/closed</td>
</tr>
<tr>
<td>A58</td>
<td>GM24 SR Modulating</td>
</tr>
</tbody>
</table>

### Order Example

1. Type : SPK 30 - 100 - OB - S - B - R - 500 x 500 - Q
2. Type : SPK 30 - 100 - OB - S - B - R - 500 x 500 - A17

---

### Note:

- Contact SAFID for technical data sheet of actuators.
**Description**

The single and multi-leaf volume control dampers with extruded aluminum airfoil blades are designed for quite, efficient and reliable air volume control in air conditioning and ventilation systems.

The SPK 30 dampers are ruggedly built dampers with a casing of robust assembly, formed from a channel frame for flanged connection to ductworks.

The blades with airfoil construction provides a low pressure drop in the open position for smooth airflow and reduced air turbulence.

**Standard Construction**

**Frame:**
160mm x 30mm x 1.5mm (16 Ga.) galvanized steel formed channel for flange connection.

**Blades:**
100mm, 125mm and 150mm wide airfoil shaped blades extruded aluminum.

**Finish:**
Frame of mill galvanized.
Blades of mill aluminum.

**Linkage:**
Galvanized steel side linkage concealed in frame for parallel or opposed blade operation.
Hard PVC gear side linkage for opposed blade operation.

**Case Bearing:**
Brass bearing as standard.
Sintered bronze bush (optional).
Hard PVC gear integrated with 12mm x 12mm axle for opposed blade operation only.

**Control Shaft:**
12mm square or round zinc plated mild steel.

**Minimum and Maximum Single Section Size:**
100 x 100mm minimum and 1000 x 1000mm maximum.

Consult SAFID for multiple section assembly details.

**Pressure Drop at Face Area Velocity**

Damper Size 12 in. x 12 in. - Fully Open Blades

---

**AMCA Test Figure 5.3**

**Pressure Drop**

AMCA Test Figure 5.3

Catalog ID: SPK 30 - 300 December 19, 2013

SAFID certifies that the Volume Control Damper shown herein is licensed to bear the AMCA Seal for Model SPK 30-300-OB-S-B-R. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with all the requirements of the AMCA Certified Ratings Program.

The AMCA Certified Ratings Seal applies to Air Performance Ratings.

Tested for air performance in accordance with ANSI / AMCA Standard 500-D-07 (Pressure Drop), Figure 5.3.

Catalog ID: SPK 30 - 300 December 19, 2013

SAFID certifies that the Volume Control Damper shown herein is licensed to bear the AMCA Seal for Model SPK 30-300-OB-S-B-R. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with all the requirements of the AMCA Certified Ratings Program.

The AMCA Certified Ratings Seal applies to Air Performance Ratings.

Tested for air performance in accordance with ANSI / AMCA Standard 500-D-07 (Pressure Drop), Figure 5.3.
VOLUME CONTROL DAMPERS

FLANGE TYPE VOLUME CONTROL DAMPER
WITH EXTRUDED ALUMINUM AIRFOIL BLADES

SPK 30 SERIES [SPK 30 - 300, SPK 30 - 310]

Air Performance

Pressure Drop

AMCA Test Figure 5.3

Pressure Drop at Face Area Velocity

Damper Size 24 in. x 24 in. - Fully Open Blades

Catalog ID: SPK 30 - 300  December 19, 2013

Pressure Drop (in. W.G.)

Face Area Velocity (FPM X 100)

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Test Information

Tested for air performance in accordance with ANSI / AMCA Standard 500-D-07 (Pressure Drop), Figure 5.3.

FLANGE TYPE VOLUME CONTROL DAMPER
WITH EXTRUDED ALUMINUM AIRFOIL BLADES

SPK 30 SERIES [SPK 30 - 300, SPK 30 - 310]

Air Performance

Pressure Drop

AMCA Test Figure 5.3

Pressure Drop at Face Area Velocity

Damper Size 36 in. x 36 in. - Fully Open Blades

Catalog ID: SPK 30 - 300  December 19, 2013

Pressure Drop (in. W.G.)

Face Area Velocity (FPM X 100)

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Test Information

Tested for air performance in accordance with ANSI / AMCA Standard 500-D-07 (Pressure Drop), Figure 5.3.

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FLANGE TYPE VOLUME CONTROL DAMPER
WITH EXTRUDED ALUMINUM AIRFOIL BLADES

SPK 30 SERIES [SPK 30-300, SPK 30-310]

Air Performance

Pressure Drop

AMCA Test Figure 5.3

Pressure Drop at Face Area Velocity

Damper Size 12 in. x 48 in. - Fully Open Blades

Catalog ID: SPK 30 - 300  December 19, 2013

SAFID certifies that the Volume Control Damper shown herein is licensed to bear the AMCA Seal for Model SPK 30-300-OB-S-B-R. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with the requirements of the AMCA Certified Ratings Program. The AMCA Certified Ratings Seal applies to Air Performance Ratings.

Test Information

Tested for air performance in accordance with ANSI/AMCA Standard 500-D-07 (Pressure Drop), Figure 5.3.
### MATERIALS CONSTRUCTION

#### SPK 30 SERIES [SPK 30 - 300, SPK 30 - 310]

<table>
<thead>
<tr>
<th>Blade Profile (Standard)</th>
<th>Blade Seal (Optional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axle &amp; Drive Shaft Fixing Details</td>
<td>Mounting Bracket for Actuator</td>
</tr>
</tbody>
</table>

#### Axle & Drive Shaft Fixing Details

- Damper to Slide on Flange Connection
- Damper to Angle Flange Connection

### INSTALLATION DETAILS

#### SPK 30 SERIES [SPK 30 - 300, SPK 30 - 310]

<table>
<thead>
<tr>
<th>Width (mm)</th>
<th>Height (mm)</th>
<th>No. of Holes W Dim.</th>
<th>No. of Holes H Dim.</th>
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</tr>
</tbody>
</table>

Catalog ID: SPK 30 - 300  September 30, 2013

Catalog ID: SPK 30 - 300  December 19, 2013

**Flange Drilling Details**

- No Blade Seal - Type S
- Type S1

Catalog ID: SPK 30 - 300  September 30, 2013

Catalog ID: SPK 30 - 300  December 19, 2013

100 mm and 150 mm Wide Blade
SPK 30 SERIES [SPK 30 - 300, SPK 30 - 310]

Seals

<table>
<thead>
<tr>
<th>Construction Variants</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>No Seals</td>
</tr>
<tr>
<td>S1</td>
<td>Blade's edge seals. Fitted to seal blades to blade's joint. Blade seal is a gasket tape 6mm wide.</td>
</tr>
</tbody>
</table>

Linkage

<table>
<thead>
<tr>
<th>Construction Variants</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PB</td>
<td>Side linkage concealed in frame for parallel blade operation.</td>
</tr>
<tr>
<td>OB</td>
<td>Side linkage concealed in frame for opposed blade operation.</td>
</tr>
</tbody>
</table>

Bearings

<table>
<thead>
<tr>
<th>Construction Variants</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Brass (Standard Supply)</td>
</tr>
<tr>
<td>B1</td>
<td>Sintered Bronze Oilite</td>
</tr>
<tr>
<td>B2</td>
<td>Stainless Steel</td>
</tr>
<tr>
<td>B3</td>
<td>Hard PVC gear integrated with 12mm x 12mm axle (for opposed blade operation only).</td>
</tr>
</tbody>
</table>

Actuators

<table>
<thead>
<tr>
<th>Code</th>
<th>Type/Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>BF230-S, BF24-S Spring-return</td>
</tr>
<tr>
<td>A12</td>
<td>NF230-S, NF24-S Spring-return</td>
</tr>
<tr>
<td>A15</td>
<td>BF230-S, BF24-S Spring-return</td>
</tr>
<tr>
<td>A18</td>
<td>SM230A open/closed</td>
</tr>
<tr>
<td>A21</td>
<td>NM230 open/closed</td>
</tr>
<tr>
<td>A22</td>
<td>NM24-SR Modulating</td>
</tr>
<tr>
<td>A23</td>
<td>GM240 open/closed</td>
</tr>
<tr>
<td>A24</td>
<td>GM24-SR Modulating</td>
</tr>
<tr>
<td>A25</td>
<td>GM24-SR Modulating</td>
</tr>
</tbody>
</table>

Variants - Code

- OB = Opposed Blade Operation
- PB = Parallel Blade Operation
- *S = No Seals (Standard Supply)
- S1 = Blade's Edge Seals
- A = Brass Case Bearing
- B1 = Sintered Bronze (oilite) Case Bearing
- B2 = Stainless Steel Case Bearing
- B3 = Hard PVC Gear

Order Example

Standard
Make: SAFID
1. Type : SPK 30 - 300 - OB - S - B - R - 900 x 900 - A
2. Type : SPK 30 - 300 - OB - S - B - R - 900 x 900 - Q
3. Type : SPK 30 - 300 - OB - S - B3 - R - 900 x 900 - A

Note:
Contact SAFID for technical data sheet of actuators.

Catalog ID: SPK 30 - 300 December 19, 2013
Description

SPK 30 - 300L low leakage volume control dampers are recommended for use in multiple Air Conditioning Units where one common air duct system on which one or two A/C Units needs to be isolated during standby mode while the other A/C Unit is on operational mode.

In building pressurization it can be used as an isolation damper to maintain the required pressure in the space.

In office buildings where some occupants are outside most of the time, this type of damper is recommended to shutdown the flow of air when the space is unoccupied on which can save energy consumption.

It is also being used as a fresh air intake damper for Air Conditioning Units where it needs a fresh air damper to be closed upon detection of heavy dust on the fresh air side.

The blades with airfoil construction provides a low pressure drop in the open position for smooth airflow and reduced air turbulence.

Standard Construction

- Frame: 160mm x 30mm x 1.5mm (16 Ga.) galvanized steel formed channel for flange connection.
- Blades: 100mm, 125mm and 150mm wide airfoil shaped blades extruded aluminum.
- Finish: 250mm max. width, 1.5mm (16 Ga.) galvanized steel.
- Linkage: Compression type stainless steel grade 304 to close gap between frame and blades.
- Control Shaft: 120mm diameter zinc plated mild steel.
- Tip Seal: Gasket tape 6mm wide.
- Side Seal (Jamb Seal): 12mm diameter zinc plated mild steel.
- Case Bearing: Brass bearing as standard. Sintered bronze sleeve (optional).
- Compression type stainless steel grade 304 to close gap between frame and blades.

Minimum and Maximum Single Section Size:

- 200 x 200mm minimum and 900 x 900mm maximum.

Consult SAFID for multiple section assembly details.

Catalog ID: SPK 30 - 300L  December 18, 2013

Air Leakage Performance

Air Leakage Data

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>36 in. x 36 in.</td>
<td>3.0</td>
<td>6.8</td>
<td>15.6</td>
<td>N/A</td>
</tr>
<tr>
<td>(914 mm x 914 mm)</td>
<td>Class 1</td>
<td>Class 2</td>
<td>Class 3</td>
<td>Class 3</td>
</tr>
</tbody>
</table>

The torque applied holding the damper blades at closed position is 133 in-lb.
VOLUME CONTROL DAMPERS

SPK 30 SERIES [SPK 30 - 300L, SPK 30 - 310L]

Air Performance

Pressure Drop

The tests for pressure prop of Volume Control Dampers were conducted as per ANSI / AMCA Standard 500-D, Figure 5.3 which simulate the actual site condition when installed in ventilation, supply and return air conditioning ductworks.

AMCA Test Figure 5.3

Pressure Drop at Face Area Velocity

<table>
<thead>
<tr>
<th>Damper Size</th>
<th>Velocity (FPM)</th>
<th>Pressure Drop at Face Area Velocity (in. W.G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 in. x 12 in.</td>
<td>1519</td>
<td>0.076</td>
</tr>
<tr>
<td>24 in. x 24 in.</td>
<td>1500</td>
<td>0.079</td>
</tr>
<tr>
<td>36 in. x 36 in.</td>
<td>1502</td>
<td>0.080</td>
</tr>
<tr>
<td>48 in. x 12 in.</td>
<td>1500</td>
<td>0.080</td>
</tr>
<tr>
<td>24 in. x 24 in.</td>
<td>6059</td>
<td>0.398</td>
</tr>
<tr>
<td>36 in. x 36 in.</td>
<td>6057</td>
<td>0.398</td>
</tr>
<tr>
<td>48 in. x 12 in.</td>
<td>6052</td>
<td>0.402</td>
</tr>
<tr>
<td>24 in. x 24 in.</td>
<td>3018</td>
<td>0.233</td>
</tr>
<tr>
<td>36 in. x 36 in.</td>
<td>3018</td>
<td>0.233</td>
</tr>
<tr>
<td>48 in. x 12 in.</td>
<td>3013</td>
<td>0.233</td>
</tr>
</tbody>
</table>

Catalog ID: SPK 30 - 300L  December 18, 2013

SAFID certifies that the Low Leakage Volume Control Damper shown herein is licensed to bear the AMCA Seal for Model SPK 30-300L. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with the requirements of the AMCA Certified Ratings Program. The AMCA Certified Ratings Seal applies to Air Leakage and Air Performance Ratings.

Test Information:
- Tested for air leakage in accordance with ANSI / AMCA Standard 500-D-07, Figure 5.4. Air leakage is based on operation between 32 ºF and 120 ºF.
- Tested for air performance in accordance with ANSI / AMCA Standard 500-D-07 (Pressure Drop), Figure 5.3.

Only 100mm blade width and opposed blade action is AMCA certified.

FLANGE TYPE VCD WITH EXTRUDED ALUMINUM AIRFOIL BLADES

SPK 30 SERIES [SPK 30 - 300L, SPK 30 - 310L]

Air Performance

Pressure Drop

AMCA Test Figure 5.3

Pressure Drop at Face Area Velocity

Damper Size 12 in. x 12 in. - Fully Open Blades

Catalog ID: SPK 30 - 300L  December 18, 2013

SAFID certifies that the Low Leakage Volume Control Damper shown herein is licensed to bear the AMCA Seal for Model SPK 30-300L. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with the requirements of the AMCA Certified Ratings Program. The AMCA Certified Ratings Seal applies to Air Leakage and Air Performance Ratings.

Test Information:
- Tested for air leakage in accordance with ANSI / AMCA Standard 500-D-07, Figure 5.4. Air leakage is based on operation between 32 ºF and 120 ºF.
- Tested for air performance in accordance with ANSI / AMCA Standard 500-D-07 (Pressure Drop), Figure 5.3.

Only 100mm blade width and opposed blade action is AMCA certified.

FLANGE TYPE VCD WITH EXTRUDED ALUMINUM AIRFOIL BLADES
SAFID certifies that the Low Leakage Volume Control Damper shown herein is licensed to bear the AMCA Seal for Model SPK 30-300L. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with the requirements of the AMCA Certified Ratings Program. The AMCA Certified Ratings Seal applies to Air Leakage and Air Performance Ratings.

Test Information: Tested for air leakage in accordance with ANSI/AMCA Standard 500-D-07, Figure 5.4. Air leakage is based on operation between 32 ºF and 120 ºF. Tested for air performance in accordance with ANSI / AMCA Standard 500-D-07 (Pressure Drop), Figure 5.3.

Only 100mm blade width and opposed blade action is AMCA certified.
SAFID certifies that the Low Leakage Volume Control Damper shown herein is licensed to bear the AMCA Seal for Model SPK 30-300L.
The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with the requirements of the AMCA Certified Ratings Program. The AMCA Certified Ratings Seal applies to Air Leakage and Air Performance Ratings.

Test Information: Tested for air leakage in accordance with ANSI/AMCA Standard 500-D-07, Figure 5.4. Air leakage is based on operation between 32 ºF and 120 ºF. Tested for air performance in accordance with ANSI/AMCA Standard 500-D-07 (Pressure Drop), Figure 5.3.

Only 100mm blade width and opposed blade action is AMCA certified.

**SPK 30 SERIES [SPK 30 - 300L, SPK 30 - 310L]**

**Air Performance**

**Pressure Drop**

AMCA Test Figure 5.3

**Pressure Drop at Face Area Velocity**

Diameter Size 12 in. x 48 in. - Fully Open Blades

**SPK 30 SERIES [SPK 30 - 300L, SPK 30 - 310L]**

**Air Performance**

**Pressure Drop**

AMCA Test Figure 5.3

**Pressure Drop at Face Area Velocity**

Diameter Size 48 in. x 12 in. - Fully Open Blades
SPK 30 SERIES [SPK 30 - 300L, SPK 30 - 310L]

Flange Drilling Details

<table>
<thead>
<tr>
<th>Width (mm)</th>
<th>Height (mm)</th>
<th>No. of Holes W Dim.</th>
<th>No. of Holes H Dim.</th>
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<tr>
<td>900</td>
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Order Example

Standard
Make: SAFID
1. Type: SPK 30 - 300L - OB - B - R - 900 x 900 - A
2. Type: SPK 30 - 310L - PB - B - R - 900 x 900 - A

* - Stands for Standard Supply
**Class 1A and Class 1 Low Leakage Volume Control Damper**

**SPK 30 - 400**

**Description**

SPK 30 - 400 Class 1A and Class 1 low leakage volume control dampers are recommended for use in multiple Air Conditioning Units with one common air duct system on which one or two A/C Units needs to be isolated during standby mode while the other A/C Unit is on operational mode.

In building pressurization it can be used as an isolation damper to maintain the required pressure in the space.

In office buildings where some occupants are outside most of the time, this type of damper is recommended to shut down the flow of air when the space is unoccupied on which can save energy consumption.

It is also being used as a fresh air intake damper for Air Conditioning Units where it needs a fresh air damper to be closed upon detection of heavy dust on the fresh air side.

The blades with airfoil construction provides a low pressure drop in the open position for smooth airflow and reduced air turbulence.

**Standard Construction**

- **Frames:** 160mm x 300mm x 1.5mm (16 Ga.) galvanized steel formed channel for flange connection.
- **Blades:** 100mm, 125mm and 150mm wide airfoil shaped blades extruded aluminum.
- **Finish:** Mill galvanized.
- **External Linkage:** Galvanized steel side linkage concealed in frame for opposed blade operation.

**Case Bearing:**

Brass bearing as standard.

Sintered bronze oilite (optional).

**Control Shaft:**

12mm diameter zinc plated mild steel.

**Tip Seal:**

Bubble type seal.

For Air Leakage "Class 1A" and "Class 1".

**Side Seal:**

Compression type stainless steel grade 304 to close gap between frame and blades.

**Minimum and Maximum Single Section Size:**

100 x 100 mm minimum and 900 x 900 mm maximum.

**SPK 30 - 410**

General construction as type SPK 30 - 400 damper but with frame, linkages, case bearing, axles and control shaft are from stainless steel (Grade 304).

**Catalog ID:** SPK 30 - 400

**January 23, 2014**

**Air Leakage Performance**

<table>
<thead>
<tr>
<th>Pressure (W.G.)</th>
<th>Leakage (cfm/ft²)</th>
<th>Air Leakage Classification</th>
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<tr>
<td>1 in. W.G.</td>
<td>2.033</td>
<td>Class 1A</td>
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<tr>
<td>1.5 in. W.G.</td>
<td>3.549</td>
<td>Class 1</td>
</tr>
<tr>
<td>2 in. W.G.</td>
<td>5.498</td>
<td>Class 1</td>
</tr>
<tr>
<td>3 in. W.G.</td>
<td>6.646</td>
<td>Class 1</td>
</tr>
<tr>
<td>4 in. W.G.</td>
<td>9.796</td>
<td>Class 1</td>
</tr>
</tbody>
</table>

Data are based on a torque of 24.6 in.-lb/ft applied to close and seat the damper during the test.

**SPK 30 Series [SPK 30 - 400, SPK 30 - 410]**

**Conclusion**

SAFID certifies that the Class 1A & Class 1 Low Leakage Volume Control Damper shown herein is in accordance with the AMCA Certification Ratings Program, The AMCA Certified Ratings Program is based upon the performance of the damper in accordance with AMCA 511 and AMCA 500-D-07. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 87 and comply with the requirements of the AMCA Certification Ratings Program. SAFID certifies that the Class 1A & Class 1 Low Leakage Volume Control Damper shown herein is in accordance with AMCA 511 and AMCA 500-D-07. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 87 and comply with the requirements of the AMCA Certification Ratings Program. SAFID certifies that the Class 1A & Class 1 Low Leakage Volume Control Damper shown herein is in accordance with AMCA 511 and AMCA 500-D-07. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 87 and comply with the requirements of the AMCA Certification Ratings Program.

Catalog ID: SPK 30 - 400

**January 23, 2014**
FLANGE TYPE VCD WITH EXTRUDED ALUMINUM AIRFOIL BLADES

VOLUME CONTROL DAMPERS

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SPK 30 SERIES [SPK 30 - 400, SPK 30 - 410]

Air Performance

Pressure Drop

AMCA Test Figure 5.3

Pressure Drop at Face Area Velocity

Damper Size 12 in. x 12 in. - Fully Open Blades

AMCA certifies that the Class 1A & Class 1 Low Leakage Volume Control Damper shown herein is licensed to bear the AMCA Seal for Model SPK 30-400. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with the requirements of the AMCA Certified Ratings Program. The AMCA Certified Ratings Seal applies to Air Leakage and Air Performance Ratings.

Test Information: Tested for air leakage in accordance with ANSI / AMCA Standard 500-D-07, Figure 5.4. Air leakage is based on operation between 32 ºF and 120 ºF. Tested for air performance in accordance with ANSI / AMCA Standard 500-D-07, Figure 5.3. Only 150mm blade width is AMCA certified. Catalog ID: SPK 30 - 400  January 23, 2014

Pressure Drop at Face Area Velocity

Damper Size 24 in. x 24 in. - Fully Open Blades

AMCA certifies that the Class 1A & Class 1 Low Leakage Volume Control Damper shown herein is licensed to bear the AMCA Seal for Model SPK 30-410. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with the requirements of the AMCA Certified Ratings Program. The AMCA Certified Ratings Seal applies to Air Leakage and Air Performance Ratings.

Test Information: Tested for air leakage in accordance with ANSI / AMCA Standard 500-D-07, Figure 5.4. Air leakage is based on operation between 32 ºF and 120 ºF. Tested for air performance in accordance with ANSI / AMCA Standard 500-D-07, Figure 5.3. Only 150mm blade width is AMCA certified. Catalog ID: SPK 30 - 410  January 23, 2014

Catalog ID: SPK 30 - 400 January 23, 2014

Catalog ID: SPK 30 - 400 January 23, 2014

FLANGE TYPE VCD WITH EXTRUDED ALUMINUM AIRFOIL BLADES

VOLUME CONTROL DAMPERS

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SPK 30 SERIES [SPK 30 - 400, SPK 30 - 410]

Air Performance

Pressure Drop

AMCA Test Figure 5.3

Pressure Drop at Face Area Velocity

Damper Size 12 in. x 12 in. - Fully Open Blades

AMCA certifies that the Class 1A & Class 1 Low Leakage Volume Control Damper shown herein is licensed to bear the AMCA Seal for Model SPK 30-400. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with the requirements of the AMCA Certified Ratings Program. The AMCA Certified Ratings Seal applies to Air Leakage and Air Performance Ratings.

Test Information: Tested for air leakage in accordance with ANSI / AMCA Standard 500-D-07, Figure 5.4. Air leakage is based on operation between 32 ºF and 120 ºF. Tested for air performance in accordance with ANSI / AMCA Standard 500-D-07, Figure 5.3. Only 150mm blade width is AMCA certified. Catalog ID: SPK 30 - 400  January 23, 2014

Pressure Drop at Face Area Velocity

Damper Size 24 in. x 24 in. - Fully Open Blades

AMCA certifies that the Class 1A & Class 1 Low Leakage Volume Control Damper shown herein is licensed to bear the AMCA Seal for Model SPK 30-410. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with the requirements of the AMCA Certified Ratings Program. The AMCA Certified Ratings Seal applies to Air Leakage and Air Performance Ratings.

Test Information: Tested for air leakage in accordance with ANSI / AMCA Standard 500-D-07, Figure 5.4. Air leakage is based on operation between 32 ºF and 120 ºF. Tested for air performance in accordance with ANSI / AMCA Standard 500-D-07, Figure 5.3. Only 150mm blade width is AMCA certified. Catalog ID: SPK 30 - 410  January 23, 2014

Catalog ID: SPK 30 - 400 January 23, 2014

Catalog ID: SPK 30 - 400 January 23, 2014
### Air Performance

**Pressure Drop**

AMCA Test Figure 5.3

**Pressure Drop at Face Area Velocity**

Damper Size 36 in. x 36 in. - Fully Open Blades

![Graph showing pressure drop vs. face area velocity](image)

---

### Dimensions

<table>
<thead>
<tr>
<th>Flange Type</th>
<th>1 - Casing</th>
<th>2 - Actuator</th>
<th>3 - Side Linkage</th>
<th>4 - Blade</th>
<th>5 - Tip Seal</th>
<th>6 - Side Seal (Jamb Seal)</th>
<th>7 - Bearing</th>
<th>8 - Landing Angles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flange Type</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</table>

### Standard Sizes

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<thead>
<tr>
<th>Width (mm)</th>
<th>Height (mm)</th>
<th>No. of Blades</th>
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</tr>
</tbody>
</table>

Catalog ID: SPK 30 - 400  January 23, 2014
SPK 30 SERIES [SPK 30 - 400, SPK 30 - 410]

Seal

Side Seal or Jamb Seal

MATERIALS CONSTRUCTION

Axle & Drive Shift Fixing Details

Mounting Bracket for Actuator

Flange Drilling Details

<table>
<thead>
<tr>
<th>Width (mm)</th>
<th>Height (mm)</th>
<th>No. of Holes W Dim.</th>
<th>No. of Holes H Dim.</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
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Catalog ID: SPK 30 - 400  January 23, 2014

INSTALLATION DETAILS

Damper to Slide on Flange Connection

Damper to Angle Flange Connection

Flange Drilling Details

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<tr>
<th>Width (mm)</th>
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Catalog ID: SPK 30 - 400  January 23, 2014

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### SPK SERIES [SPK 30 - 400, SPK 30 - 410]

<table>
<thead>
<tr>
<th>Order Code</th>
<th>SPK 30 - 400 - OB - B - R - 900 x 900 - A</th>
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</thead>
</table>

#### Variants - Code
- SPK 30 - 400
- SPK 30 - 410

#### Blade Operation
- OP = Opposed Blade Operation

#### Variants - Bearings
- *B = Brass Case Bearing (Standard Supply)
- B1 = Sintered Bronze (oilite) Case Bearing

#### Actuator
- SM235A, SM24A or equivalent
- Open-close control

#### Duct Size

#### Control Shaft
- 12mm diameter zinc plated mild steel. (Removable for sleeve shaft).

#### Minimum Size
- 100 x 100mm, damper up to 300mm high are single blade construction.

#### Maximum Size
- 1200 x 1800mm, as single section. Multiple section assembly with unlimited size, where each section operates independently.

#### Temperature Limits
- -40 °C to +100 °C.

### Description

Single and multi-leaf volume control dampers are designed for quiet, efficient and reliable air volume control in ventilation systems.

The SPK 40 damper are ruggedly built dampers, with a case of robust structurally designed hat section to slide in ducting for duct connection. The blades are formed single skin reinforced, with longitudinal structurally designed vee.

Blade action is standard as parallel but can be supplied as opposed blade action at no additional charge.

Blade edge seals and jamb (side) seals can be fitted for low leakage requirements. Dampers can be manual with locking quadrant or motorized with a wide range of electrical actuators readily available.

### Standard Construction

#### Frame:
- 100mm x 40mm x 1.5mm (16 ga.) galvanized steel, structurally designed hat section.

#### Blades:
- 300mm max. width, 1.5mm (16 ga.) galvanized steel.

#### Finish:
- Mill Galvanized

#### Linkage:
- Face linkage parallel blade operation.

#### Case Bearing:
- Brass bearing as standard. Sintered bronze oilite (optional).

#### Axles:
- 12mm diameter zinc plated mild steel.

### Standard

**Make:** SAFID

1. **Type:** SPK 30 - 400 - OB - B - R - 900 x 900 - A
2. **Type:** SPK 30 - 400 - PB - B - R - 900 x 900 - A

---

**Catalog ID:** SPK 30 - 400  January 23, 2014
SLEEVE TYPE VOLUME CONTROL DAMPER

**SPK SERIES [SPK 40 - 100, SPK 40 - 110, SPK 40 - 120]**

<table>
<thead>
<tr>
<th>Dimensions</th>
</tr>
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<td>1 - Casing</td>
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<td><strong>Sleeve Type</strong></td>
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**Sleeve Type, Parallel Blades**

**Sleeve Type, Parallel Blades**

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<th>Standard Sizes</th>
<th>Width (mm)</th>
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**SPK 50 - 100**

**SPK 50 - 120**

**Description**

Single and multi-leaf volume control dampers are designed for quiet, efficient and reliable air volume control in ventilation systems.

The SPK 50 dampers are ruggedly built dampers, with a spigot case of robust assembly formed circular spigot connection to ductworks. The blades are formed single skin reinforced, with longitudinal structurally designed vee.

Blade action is standard as parallel but can be supplied as opposed blade action at no additional charge.

Blade edge seals and jamb (side) seals can be fitted for low leakage requirements. Dampers can be manual with locking quadrant or motorized with a wide range of electrical actuators readily available.

**Standard Construction**

**Frame:**
161mm x 1.5mm (16 ga.) galvanized steel, spigot type 380mm wide with circular spigot duct connection.

**Blades:**
250mm max. width, 1.5mm (16 ga.) galvanized steel.

**Finish:**
Mill Galvanized

**Linkage:**
Side linkage concealed in frame for parallel and opposed blade operation. Face linkage available (optional).

**Case Bearing:**
Brass bearing as standard. Sintered bronze oilite (optional).

**Axes:**
12mm diameter zinc plated mild steel.

**Control Shaft:**
12mm diameter zinc plated mild steel.

**Minimum Size:**
From 100 mm diameter damper up to 200 mm diameter high are single blade construction.

**Maximum Size:**
1000 mm diameter as single section. Multiple section assembly with unlimited size, where each section operates independently.

For details of multiple sections consult SAFID.

**Temperature Limits:**
-40°C to +100°C.

**SPK 50 - 110**

General construction as type SPK 50 - 100 damper but blades, shafts and blade to shaft fixing in stainless steel (Grade 304).

**SPK 50 - 120**

General construction as type SPK 50 - 100 damper but with frame, blades, shaft and blade to shaft fixing and linkage all from stainless steel (Grade 304).
Circular Spigot Type Volume Control Damper

### Dimensions

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<tr>
<th>Diameter (mm)</th>
<th>No. of Blades</th>
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</table>

### Description

Single and multi-leaf volume control dampers are designed for quiet, efficient and reliable air volume control in ventilation systems.

The SPK 60 Dampers are ruggedly built dampers, with a spigot case of robust assembly formed oval spigot connection to ductworks. The blades are formed single skin reinforced, with longitudinal structurally designed vee.

Blade action is standard as parallel but can be supplied as opposed blade action at no additional charge.

Blade edge seals and jamb (side) seals can be fitted for low leakage requirements. Dampers can be manual with locking quadrant or motorized with a wide range of electrical actuators readily available.

### Standard Construction

**Frame:**
180mm x 1.5mm (16 ga.) galvanized steel, spigot type 380mm wide with oval spigot duct connection.

**Blades:**
250mm max. width, 1.5mm (16 ga.) galvanized steel.

**Finish:**
Mill Galvanized

**Linkage:**
Side linkage concealed in frame for parallel and opposed blade operation. Face linkage available (optional).

**Case Bearing:**
Brass bearing as standard. Sintered bronze oilite (optional).

**Axles:**
12mm diameter zinc plated mild steel.

### Control Shaft

12mm diameter zinc plated mild steel.

### Minimum Size

200 x 100 mm, damper up to 20 mm high are single blade construction.

### Maximum Size

1000 x 950 mm, as single section. Multiple section assembly with unlimited size, where each section operates independently.

For details of multiple sections consult SAFID.

### Temperature Limits

-40˚C to +100˚C.

**SPK 60 - 110**

General construction as type SPK 60 - 100 damper but blades, shafts and blade to shaft fixing in stainless steel (Grade 304).

**SPK 60 - 120**

General construction as type SPK 60 - 100 damper but with frame, blades shafts and blade to shaft fixing and linkage all from stainless steel (Grade 304).
**OVAL SPIGOT TYPE VOLUME CONTROL DAMPER**

**SPK SERIES [SPK 60 - 100, SPK 60 - 110, SPK 60 - 120]**

**Dimensions**

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<tr>
<th>Casing</th>
<th>Drive Shaft</th>
<th>Side Linkage</th>
<th>Blade</th>
<th>Landing Angles</th>
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<td>SPK 60 - 100, 110, 120</td>
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**Oval Spigot Type, Parallel/Opposed Blades**

**Standard Sizes - Single Section**

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**Blade Seal**

- Type S1
- Type S2 (Stainless Steel Type 304)

**Side Seal (Jamb Seal)**

- Type S3 (Combination of S1 & S2)

Note:

- For Sleeve Type Only
- Damper with Mounting Bracket for Actuator

**Materials Construction**

- SPK SERIES [SPK 60 - 100, SPK 60 - 110, SPK 60 - 120]

**Removable Spindle**

**Mounting Bracket**

- Side Seal (Jamb Seal)

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**Flange Type SPK 30**

*Damper to Slide on Flange Connection*

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**Flange Type SPK 30**

*Damper to Angle Flange Connection*

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**Flange Drilling Details**

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**Technical Data**

**Pressure Loss**

\[ \Delta P = \frac{1}{2} \rho V^2 \]

- \( \Delta P \) in Pa = Total Pressure Drop.
- \( V \) in m/s = Face Velocity based on \( A \).
- \( A \) in m\(^2\) = Damper cross-sectional area.

\( \alpha \) = Blade angle, when \( \alpha = 0 \), blades are fully open.
Seals

<table>
<thead>
<tr>
<th>Construction Variants</th>
<th>Description</th>
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<tbody>
<tr>
<td>S</td>
<td>Standard supply construction. No side seals or blade seals.</td>
</tr>
<tr>
<td>S1</td>
<td>Blade edge seal to seal blade to blade joint for low leakage characteristic.</td>
</tr>
<tr>
<td>S2</td>
<td>Side seals. Fitted to close gap between frame and blades.</td>
</tr>
<tr>
<td>S3</td>
<td>Combination of side seals &amp; blade seals to close gap between frame and blades to seal blade to blade joint for ultra low leakage characteristic.</td>
</tr>
</tbody>
</table>

Linkage

<table>
<thead>
<tr>
<th>Construction Variants</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PB</td>
<td>Side linkage concealed in frame for parallel blade operation. Face linkage available (optional)</td>
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<tr>
<td>OB</td>
<td>External side linkage for opposed blade operation.</td>
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</table>

Bearings

<table>
<thead>
<tr>
<th>Construction Variants</th>
<th>Description</th>
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<tbody>
<tr>
<td>B</td>
<td>Brass (Standard Supply)</td>
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<tr>
<td>B1</td>
<td>Construction sintered bronze (oilite).</td>
</tr>
<tr>
<td>B2</td>
<td>Sintered bronze oilite.</td>
</tr>
</tbody>
</table>

Belimo Actuators

<table>
<thead>
<tr>
<th>Code</th>
<th>Type/Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>A01</td>
<td>BF230 Spring Return</td>
</tr>
<tr>
<td>A02</td>
<td>BF24 Spring Return</td>
</tr>
<tr>
<td>A03</td>
<td>AF230 Spring Return</td>
</tr>
<tr>
<td>A04</td>
<td>AF230-S Spring Return With Limit Switch</td>
</tr>
<tr>
<td>A05</td>
<td>AF230 US Spring Return</td>
</tr>
<tr>
<td>A06</td>
<td>AF240 US Spring Return</td>
</tr>
<tr>
<td>A07</td>
<td>AF230-S US Spring Return With Limit Switch</td>
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<tr>
<td>A08</td>
<td>AF230-S US Spring Return With Limit Switch</td>
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<td>AF24 US Spring Return</td>
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<tr>
<td>A10</td>
<td>AF24-S US Spring Return With Limit Switch</td>
</tr>
<tr>
<td>A11</td>
<td>AF24-SR Spring Return</td>
</tr>
<tr>
<td>A12</td>
<td>NF24 US Spring Return</td>
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<tr>
<td>A13</td>
<td>NF20 US Spring Return</td>
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<td>A14</td>
<td>NF24-S US Spring Return With Limit Switch</td>
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<tr>
<td>A15</td>
<td>NF24-S US Spring Return With Limit Switch</td>
</tr>
<tr>
<td>A16</td>
<td>NF24-SR US Modulating</td>
</tr>
<tr>
<td>A17</td>
<td>SM230A Open/Closed</td>
</tr>
<tr>
<td>A18</td>
<td>SM24A Open/Closed</td>
</tr>
<tr>
<td>A19</td>
<td>SM230A-SR Modulating</td>
</tr>
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<td>A20</td>
<td>NM230 Open/Closed</td>
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<tr>
<td>A21</td>
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<td>A23</td>
<td>GM240 Open/Closed</td>
</tr>
<tr>
<td>A24</td>
<td>GM24 Open/Closed</td>
</tr>
<tr>
<td>A25</td>
<td>GM24-SR Modulating</td>
</tr>
</tbody>
</table>

Specifications

Volume control dampers designed for volume flow and pressure control or to isolate sections of ducting in ventilation systems, shall be of the SPK series as specified. Damper casing shall be constructed of Ga. 16 galvanized steel. Blades shall be single skin reinforced constructed of Ga. 16 galvanized steel (optional with blade seals and/or side seals). Shafts to be 12mm mild plated steel with brass or sintered bronze bearings (optional). Blades to be connected by side or face linkage Parallel or opposed blade operation dampers, with manual or motorized operation. Limit switches and closed blade low leakage constructions are optional readily available.

Order Example

Standard
Make: SAFID
Type: SPK 40 - 100 PB - S - R / 500 x 500
Qty: 1
Description

Single and multi-leaf volume control dampers are designed for quiet, efficient and reliable air volume control in ventilation systems.

The SPK 30 - 200 dampers are ruggedly built dampers, with a casing of robust assembly formed from channel frame for flanged connections to ductwork. The blades are formed of double skin airfoil providing lower pressure drop in the open position for smooth airflow with reduced turbulence.

Blade seals and jamb (side) seals can be fitted for low leakage requirements. Dampers can be manual with locking quadrant or motorized with a wide range of electrical actuators readily available.

Standard Construction

Frame: 180mm x 30mm x 1.5mm (16 ga.) galvanized steel. Formed channel for flange connections.

Blades: Airfoil shaped galvanized steel double skin construction, 16 gauge equivalent thickness, 250mm max. width.

Finish: Mill Galvanized

Linkage: Side linkage concealed in frame for parallel and opposed blade operation.

Case Bearing: Brass bearing as standard. Sintered bronze oilite (optional).

Axes and Control Shaft: 12mm diameter zinc plated mild steel.

Minimum Size:
150 x 150mm, damper up to 250mm high are single blade construction.

Maximum Size:
1050 x 1800mm, as single section. Multiple section assembly with unlimited size, where each section operates independently.

For details of multiple sections consult SAFID.

SPK 30 - 210
General construction as type SPK 30 - 200 damper but blades, shafts and blade to shaft fixing in stainless steel (Grade 304).

SPK 30 - 220
General construction as type SPK 30 - 200 damper but with frame, blades shafts and blade to shaft fixing and linkage all from stainless steel (Grade 304).
Description

Single and multi-leaf volume control dampers are designed for quiet, efficient and reliable air volume control in ventilation systems.

The SPK 40 - 200 dampers are ruggedly built dampers, with a casing of robust assembly formed from channel frame for flanged connections to ductwork. The blades are formed of double skin airfoil providing lower pressure drop in the open position for smooth airflow with reduced turbulence.

Blade seals and jamb (side) seals can be fitted for low leakage requirements. Dampers can be manual with locking quadrant or motorized with a wide range of electrical actuators readily available.

Standard Construction

Frame:
180mm x 30mm x 1.5mm (16 ga.) galvanized steel.
Formed channel for flange connections.

Blades:
Airfoil shaped galvanized steel double skin construction,
16 gauge equivalent thickness, 250mm max. width.

Finish:
Mill Galvanized

Linkage:
Side linkage concealed in frame for parallel and opposed blade operation.

Case Bearing:
Brass bearing as standard.
Sintered bronze oilite (optional).

Axles and Control Shaft:
12mm diameter zinc plated mild steel.

Minimum Size:
150 x 150mm, damper up to 250mm high are single blade construction.

Maximum Size:
1050 x 1800mm, as single section.
Multiple section assembly with unlimited size, where each section operates independently.

For details of multiple sections consult SAFID.

SPK 40 - 210
General construction as type SPK 40 - 200 damper but blades, shafts and blade to shaft fixing in stainless steel (Grade 304).

SPK 40 - 220
General construction as type SPK 40 - 200 damper but with frame, blades shafts and blade to shaft fixing and linkage all from stainless steel (Grade 304).

Dimensions

<table>
<thead>
<tr>
<th>Width (mm)</th>
<th>Height (mm)</th>
<th>No. of Blades</th>
</tr>
</thead>
<tbody>
<tr>
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<td>150</td>
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<tr>
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<tr>
<td>1050</td>
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</table>
Description

Single and multi-leaf volume control dampers are designed for quiet, efficient and reliable air volume control in ventilation systems.

The SPK 50 - 200 dampers are ruggedly built dampers, with a casing of robust assembly formed top hat sleeve to slide in ductwork. The blades are formed of double skin airfoil providing lower pressure drop in the open position for smooth airflow with reduced turbulence.

Blade seals and jamb (side) seals can be fitted for low leakage requirements. Dampers can be manual with locking quadrant or motorized with a wide range of electrical actuators readily available.

Standard Construction

Frame (Spigot Type):
180mm x 1.5mm (16 ga.) galvanized steel, spigot type 380mm wide with circular spigot duct connection.

Blades:
Airfoil shaped galvanized steel double skin construction, 16 gauge equivalent thickness, 250mm max. width.

Finish:
Mill Galvanized

Linkage:
Side linkage concealed in frame for parallel and opposed blade operation.

Case Bearing:
Brass bearing as standard.
Sintered bronze oilite (optional).

Axles and Control Shaft:
12mm diameter zinc plated mild steel.

Minimum Size:
150mm diameter, damper up to 200 mm high are single blade construction.

Maximum Size:
1000 mm diameter, as single section. Multiple section assembly with unlimited size, where each section operates independently.

For details of multiple sections consult SAFID.

SPK 50 - 210
General construction as type SPK 50 - 200 damper but blades, shafts and blade to shaft fixing in stainless steel (Grade 304).

SPK 50 - 220
General construction as type SPK 50 - 200 damper but with frame, blades shafts and blade to shaft fixing and linkage all from stainless steel (Grade 304).

Parallel Blades (PB)  Opposed Blades (OB)

<table>
<thead>
<tr>
<th>Diameter (mm)</th>
<th>No. of Blades</th>
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<tbody>
<tr>
<td>150</td>
<td>1</td>
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</tr>
</tbody>
</table>
Description
Single and multi-leaf volume control dampers are designed for quiet, efficient and reliable air volume control in ventilation systems.

The SPK 60 - 200 dampers are ruggedly built dampers, with a casing of robust assembly formed top hat sleeve to slide in ductwork. The blades are formed of double skin airfoil providing lower pressure drop in the open position for smooth airflow with reduced turbulence.

Blade seals and jamb (side) seals can be fitted for low leakage requirements. Dampers can be manual with locking quadrant or motorized with a wide range of electrical actuators readily available.

Standard Construction
Frame (Spigot Type):
180mm x 1.5mm (16 ga.) galvanized steel, spigot type 380mm wide with ova spigot duct connection.
Blades:
Airfoil shaped galvanized steel double skin construction, 16 gauge equivalent thickness, 250mm max. width.
Finish:
Mill Galvanized
Linkage:
Side linkage concealed in frame for parallel and opposed blade operation.
Case Bearing:
Brass bearing as standard.
Sintered bronze oilite (optional).
Axles and Control Shaft:
12mm diameter zinc plated mild steel.

Minimum Size:
200 x 150 mm, damper up to 200 mm high are single blade construction.

Maximum Size:
1000 x 950 mm, as single section.
Multiple section assembly with unlimited size, where each section operates independently.
For details of multiple sections consult SAFID.

SPK 60 - 210
General construction as type SPK 60 - 200 damper but blades, shafts and blade to shaft fixing in stainless steel (Grade 304).

SPK 60 - 220
General construction as type SPK 60 - 200 damper but with frame, blades shafts and blade to shaft fixing and linkage all from stainless steel (Grade 304).

Parallel Blades (PB)  Opposed Blades (OB)

<table>
<thead>
<tr>
<th>Width (mm)</th>
<th>Height (mm)</th>
<th>No. of Blades</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>
**MATERIALS CONSTRUCTION**

- Removable Spindle
  - Sleeve type SPK 40

- Mounting Bracket
  - Damper with Mounting Bracket for Actuator

- Blade Seal
  - Type S1

- Side Seal (Jamb Seal)
  - Type S2 (Stainless Steel Type 304)

- Slide Seal

**INSTALLATION DETAILS**

- Flange Type SPK 30
  - Damper to Slide on Flange Connection

- Flange Type SPK 30
  - Damper to angle Flange Connection

**Flange Drilling Details**

<table>
<thead>
<tr>
<th>W in mm</th>
<th>H in mm</th>
<th>No. of Holes W Dim.</th>
<th>No. of Holes H Dim.</th>
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**Note:**
Type S3 (Combination of S1 & S2)
**Seals**

<table>
<thead>
<tr>
<th>Construction Variants</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>Standard supply construction. No side seals or blade seals.</td>
</tr>
<tr>
<td>S1</td>
<td>Blade edge seal to seal blade to blade joint for low leakage characteristic.</td>
</tr>
<tr>
<td>S2</td>
<td>Side seals. Fitted to close gap between frame and blades.</td>
</tr>
<tr>
<td>S3</td>
<td>Combination of side seals &amp; blade seals to close gap between frame and blades and blade seals to seal blade to blade joint for ultra low leakage characteristic.</td>
</tr>
</tbody>
</table>

**Linkage**

<table>
<thead>
<tr>
<th>Construction Variants</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PB</td>
<td>Side linkage concealed in frame for parallel blade operation. Face linkage available (optional)</td>
</tr>
<tr>
<td>OB</td>
<td>External side linkage for opposed blade operation.</td>
</tr>
</tbody>
</table>

**Bearings**

<table>
<thead>
<tr>
<th>Construction Variants</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Brass (Standard Supply)</td>
</tr>
<tr>
<td>B1</td>
<td>Construction sintered bronze oilite.</td>
</tr>
<tr>
<td>B2</td>
<td>Sintered bronze oilite.</td>
</tr>
</tbody>
</table>

**Belimo Actuators**

<table>
<thead>
<tr>
<th>Code</th>
<th>Type/Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>A01</td>
<td>BF230 Spring Return</td>
</tr>
<tr>
<td>A02</td>
<td>BF24 Spring Return</td>
</tr>
<tr>
<td>A03</td>
<td>AF230 Spring Return</td>
</tr>
<tr>
<td>A04</td>
<td>AF230-S Spring Return With Limit Switch</td>
</tr>
<tr>
<td>A05</td>
<td>AF230 US Spring Return</td>
</tr>
<tr>
<td>A06</td>
<td>AP120 US Spring Return</td>
</tr>
<tr>
<td>A07</td>
<td>AF230-S US Spring Return With Limit Switch</td>
</tr>
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<td>A08</td>
<td>AF120-S US Spring Return With Limit Switch</td>
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<td>A10</td>
<td>AF24-S US Spring Return With Limit Switch</td>
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<td>A11</td>
<td>AF24-SR Spring Return</td>
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<td>A12</td>
<td>NF24 US Spring Return</td>
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<td>NF120 US Spring Return</td>
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<td>NF24-S US Spring Return With Limit Switch</td>
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<td>NF120-S US Spring Return With Limit Switch</td>
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<td>A16</td>
<td>NF24-US Modulating</td>
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<tr>
<td>A17</td>
<td>SM230A Open/Closed</td>
</tr>
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<td>A18</td>
<td>SM24A Open/Closed</td>
</tr>
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<td>A19</td>
<td>SM230A-SR Modulating</td>
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<td>NM230 Open/Closed</td>
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<td>GM24 Open/Closed</td>
</tr>
<tr>
<td>A25</td>
<td>GM24-SR Modulating</td>
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</tbody>
</table>

Note:
For Belimo Actuators details, models and voltages see pages 230 - 249 or contact SAFID.
### Specifications

Airfoil blades volume control dampers designed for volume flow and pressure control or to isolate sections of ducting in ventilation systems, shall be of the SPK 200 series as specified.

Damper casing will be constructed of Ga. 16 galvanized steel. Blades shall be double skin (airfoil section blades of Ga. 22 galvanized steel (optional) with blade seals and/or side seals).

Shafts to be 12mm mild plated steel with brass or sintered bronze bearings. Blades to be connected by face or external linkage.

Parallel or opposed blade operation dampers; with manual or motorized operation. Limit switches and closed blade low leakage constructions are optional readily available.

### Order Example

Standard

Make: SAFID
Type: SPK 30 - 200 - PB - S - B - R / 500 x 500
Qty: 1

---

**Order Code**

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<th>Frame Type</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>SPK30 = Flange (Standard Supply)</td>
<td>SPK40 = Sleeve</td>
<td>SPK50 = Circular Spigot</td>
<td>SPK60 = Oval Spigot</td>
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</table>

<table>
<thead>
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<th>Type</th>
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<tbody>
<tr>
<td>*200 (Standard Supply)</td>
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<table>
<thead>
<tr>
<th>Variants - Blade Operation</th>
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</thead>
<tbody>
<tr>
<td>*PB = Slide Linkage Parallel (Standard Supply)</td>
<td>OB = Opposed Blade</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variants - Seals</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>*S = None (Standard Supply)</td>
<td>S1 = Blade Seals Only (175˚C)</td>
<td>S2 = Side Seal (Jamb)</td>
<td>S3 = Side Seal &amp; Blade Seals (175˚C)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variants - Bearings</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>*B = Brass (Standard Supply)</td>
<td>B1 = Sintered Bronze oilite (optional)</td>
<td>B2 = Stainless Steel</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* - Stands for Standard Supply

---

### Actuator

(See Page 71)

#### Duct Size

Square or Rectangular

Dimensions ‘W’ x ‘H’ mm

Circular ‘D’ mm
dia.

Flat oval ‘W’ x ‘H’ mm

All damper spigots are manufactured down on duct size to fit inside ductwork connections.

#### External Controls

*R = Right Hand (Standard Supply)

L = Left Hand

---

**Order Reference Details**

### Order Example

Standard

Make: SAFID
Type: SPK 30 - 200 - PB - S - B - R / 500 x 500
Qty: 1
**Description**

Casing and blades made from galvanized steel sheet.

Adjustable damper blade mounted on brass bushes with manually operated quadrant and position indicator. The damper is used for regulating air flow or as shut-off damper when complete sealing against air flow is not required.

Dampers can be manual with locking quadrant or motorized with a wide range of electrical actuators readily available.

**Standard Construction**

**Body:**
- Galvanized steel sheet.
- Gauge 20: from Dia. 80mm to 500mm.
- Gauge 18: above 500 Dia.

**Blade:**
- Plain galvanized steel sheet.
- Gauge 18: from Dia. 80mm to 500mm.
- Gauge 16: above 500 Dia.
- Galvanized steel perforated blade (optional).

**Finish:**
- Mill Galvanized

**Case Bearing:**
- Brass bearing as standard.
- Sintered bronze oilite (optional).

**Control Shaft:**
- 12mm diameter zinc plated mild steel.

**Minimum and Maximum Size:**
- 80mm Dia. damper up to 610 Dia. are single blade construction.

Note: Sizes above 610 Dia. are multiblade type.

---

**SP 510**

General construction as type SP 500 damper but blades, shafts and blade to shaft fixing in stainless steel (Grade 304).

**SP 520**

General construction as type SP 500 damper but with frame, blades shafts and blade to shaft fixing all from stainless steel (Grade 304).

---

**SP SERIES**

**SP 500, 510, 520**

Mounting Bracket

Damper with Mounting Bracket and Motor

---

**Dimensions**

1 - Casing 2 - Blade 3 - Drive Shaft

---

**Section Details**

- **Standard Sizes**

<table>
<thead>
<tr>
<th>Dia (mm)</th>
<th>Dia (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>205</td>
</tr>
<tr>
<td>100</td>
<td>215</td>
</tr>
<tr>
<td>125</td>
<td>250</td>
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<td>140</td>
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<td>150</td>
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<td>160</td>
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<td>180</td>
<td>550</td>
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<tr>
<td>200</td>
<td>600</td>
</tr>
<tr>
<td>224</td>
<td>610</td>
</tr>
<tr>
<td>250</td>
<td>620</td>
</tr>
<tr>
<td>280</td>
<td>650</td>
</tr>
</tbody>
</table>

The end joints are also available with factory applied self sealing gaskets.
Description

Casing and blades made from galvanized steel sheet.

Adjustable damper blade mounted on brass bushes and blades with rubber seal, when complete sealing of air flow is required.

Dampers can be manual with locking quadrant and position indicator or motorized with a wide range of electrical actuators readily available.

Standard Construction

Body:
Galvanized steel sheet.
Gauge 20 : from Dia. 80mm to 500mm.
Gauge 18 : above 500 Dia.

Blade:
Gauge 14 (2mm thick): 2 layers gauge 20 plain galvanized steel bolted together equivalent to gauge 14 with full circumference.

Finish:
Mill Galvanized

Case Bearing:
Brass bearing as standard.
Sintered bronze oilite (optional).

Control Shaft:
12mm diameter zinc plated mild steel.

Minimum and Maximum Size:
80mm Dia. damper up to 610 Dia. are single blade construction.

Note: Sizes above 610 Dia. are multiblade type.

SP 610
General construction as type SP 600 damper but blades, shafts and blade to shaft fixing in stainless steel (Grade 304).

SP 620
General construction as type SP 600 damper but with frame, blades shafts and blade to shaft fixing all from stainless steel (Grade 304).

Dimensions

1 - Casing  2 - Blade  3 - Drive Shaft

Standard Construction

Mounting Bracket

SP 600, 610, 620

Damper with Mounting Bracket and Motor

Section Details

Standard Sizes

The end joints are also available with factory applied self sealing gaskets.
Description
Casing and blades made from heavy galvanized steel sheet.

Adjustable damper blade mounted on brass bushes with manually operated quadrant damper. The movement of the blade permits regulation from fully open to almost complete shut off.

Option:
Damper with Airtight Blade: Stopper end for airtight blade, code AT.

Dampers can be manual with locking quadrant and position indicator or motorized with a wide range of electrical actuators readily available.

Standard Construction
Body:
Galvanized steel sheet.

Blades:
Plain galvanized steel sheet gauge 10 (3.5mm thk).

Finish:
Mill Galvanized

Case Bearing:
Brass bearing as standard. Sintered bronze oilite (optional).

Control Shaft:
12mm diameter zinc plated mild steel.

Minimum and Maximum Size:
80mm Dia. damper up to 610 Dia. are single blade construction.

Note: Sizes above 610 Dia. are multi blade type.

SP 700
General construction as type SP 700 damper but blades, shafts and blade to shaft fixing in stainless steel (Grade 304).

SP 710
General construction as type SP 700 damper but blades, shafts and blade to shaft fixing in stainless steel (Grade 304).

SP 720
General construction as type SP 700 damper but with frame, blades shafts and blade to shaft fixing all from stainless steel (Grade 304).

SP SERIES
[SP 700, SP 710, SP 720]

Dimensions

<table>
<thead>
<tr>
<th>1 - Casing</th>
<th>2 - Blade</th>
<th>3 - Drive Shaft</th>
<th>4 - Stopper Ends for Airtight Blade</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP 700, 710, 720</td>
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Mounting Bracket
Damper with Mounting Bracket and Motor

Section Details

Standard Sizes

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<tr>
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<td>280</td>
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</tbody>
</table>

The end joints are also available with factory applied self sealing gaskets.
VOLUME CONTROL DAMPERS

Installation Details

For Motorized Dampers:
Wide range of electrical actuators are readily available, see pages 226 - 245 or contact SAFID.

Pressure Loss

Order Reference Details

Order Example
Product Code: SP 500
Type
SP 500
SP 600
SP 700
Diameter

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