Background

Employers must ensure employees' exposure to noise does not exceed the exposure standard by implementing the following hierarchy of control measures:

- eliminate the source of noise
- substitute noisy plant for quieter plant or processes or implement engineering controls
- use administrative controls
- provide hearing protection.

The noise exposure standard set out in the Occupational Health and Safety Regulations 2017 is an 8 hour average of 85dB (A) and a peak noise level of 140dB(C) at the employees ear position. Workplace noise that exceeds the noise exposure standard is considered dangerous to employees and must be controlled in accordance with the hierarchy of control.

Employers must apply each level of the hierarchy so far as is reasonably practicable before moving down to the next control measure. This means that an employer cannot go straight to hearing protection without first implementing higher level control measures so far as reasonably practicable.

Often a combination of control measures are required to effectively control risk associated with noise.

Axial fans are used in low pressure high volume applications while centrifugal fans are used in high pressure low volume applications. Fans can be installed inline (eg ducting at both ends) or as inlet or outlet fans on a wall, roof or acoustic enclosure.

Types of Fans

Fans and ventilation systems are used in workplaces for a variety of tasks including general ventilation, extraction of airborne contaminants and as blowers and dryers.

The two most common types of fans are axial fans and centrifugal fans as shown in figure 1 and 2. Axial fans have blades like a propeller and draw air straight through the blades. Centrifugal fans draw air into the center of the fan and exhaust it at a 90-degree angle. There are also mixed type fans that incorporate centrifugal and axial design features.
The noise generated by a fan is related to the turbulence of air around its blades and housing as well as mechanical vibration noise associated with fan parts (motor, bearings, belts etc) which can be transmitted through ductwork. Air turbulence can also occur as a result of abrupt changes within the ductwork and any associated fittings (dampers, obstacles, louvers etc). Poor maintenance can increase turbulence and mechanical vibration noise.

**Controlling fan and ventilation noise**

Lower noise levels can be achieved by reducing air turbulence and mechanical vibration. This can be achieved by:

- using quieter fans
- reducing fan speed
- improving the ductwork design and layout of the system
- using silencers and acoustically treated ductwork
- isolation mounts and connectors
- damping
- regular maintenance

**Quieter Fans**

There are various axial and centrifugal fan designs with different performance characteristics for different applications. Noise level data for fans should be readily available from suppliers or manufacturers. Suitable controls for fan noise include the following:

- use a quieter fan (eg backward curved blade or different profiles/shapes)
- modify the existing fan (blade, air inlet smoothing)
- replace radial/straight fan blades with backward-curved blades which produce a lower pressure.

Noise reduction of about 8-10dB can be achieved by replacing straight fan blades with backward-curved blades which typically produce a lower pressure and therefore emit lower noise levels.

**Fan speed**

Fan noise is affected by the speed and profile or shape of the blade. It is possible to achieve a large noise reduction from a small reduction in fan speed by changing control systems (eg variable speed drive) or pulley sizes and re-setting dampers. A reduction in fan speed reduces the volume of air which may need to be compensated for by using more blades. Table 1 below shows the correlation between reducing the fan speed and noise reduction.

<table>
<thead>
<tr>
<th>Fan speed reduction</th>
<th>Noise reduction</th>
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<tbody>
<tr>
<td>10%</td>
<td>2 dB</td>
</tr>
<tr>
<td>20%</td>
<td>5 dB</td>
</tr>
<tr>
<td>30%</td>
<td>8 dB</td>
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<tr>
<td>40%</td>
<td>11 dB</td>
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<tr>
<td>50%</td>
<td>15 dB</td>
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</table>

**Ductwork design and layout of system**

Noise associated with air turbulence can be reduced by having smooth transitions in the ductwork, avoiding sharp and sudden bends, using turning vanes in bends to smooth air flow, and not placing fans too close to sharp bends or objects (eg dampers, louvers, attenuators, vanes etc.). Placing a fan close to turbulent air increases the turbulence produced by the fan and therefore the level of noise.
Examples of good and bad ventilation design and layout are shown in Table 2 below.

### Table 2: Ductwork Design & Layout, courtesy Fantech Pty Ltd

**Acoustically lined ductwork or silencers**

Absorptive or dissipative silencers (cylindrical, rectangular or curved) lined with sound absorbing material (e.g., foam, glass wool or rock wool) are widely used in heating, ventilation, and air conditioning (HVAC) duct systems for dealing with a wide range of frequencies. Absorptive liners are often protected with perforated metal or cloth and can achieve noise reductions of about 10-20dB(A) (Figure 4).

Silencers can be in the form of lined ductwork, fabricated silencers (inline, outlet or inlet) acoustic louvers or unused absorbent lined cavities (e.g., in walls or roofs). As a general guide, the length of the absorbent duct or silencer liner should be at least three times the diameter of the duct.

**Figure 4: Examples of absorbent lined silences:**

Isolation mounts can be used to reduce vibrations from the fan/motor being transmitted through the supporting structures (walls, roof, ceilings etc.) and re-radiated as noise. Similarly, flexible connections should be used to connect the fan casing to the ductwork (Figure 5).
Information about Noise Control – Fan and ventilation noise

Damping

Noise reduction can be achieved by damping (sound deadening) vibrations in the ductwork and fan casing or by using a thicker fan casing. Damping involves coating or sticking a viscoelastic or bituminous type of material to thin, vibrating surfaces to reduce their tendency to amplify vibrations and radiate noise (Figure 6).

Maintenance

Maintaining ventilation systems is necessary to ensure that they are performing efficiently and therefore quieter. Inspection and maintenance should include the motor, shaft, bearings, belts and tightening of any loose parts or connections.

Further information

Contact the WorkSafe Victoria Advisory Service on 1800 136 089 or go to worksafe.vic.gov.au

WorkSafe Publications

Noise Control – A step by step approach
Noise Control – Circular saws
Noise Control – Compressed air noise
Noise Control – Enclosures, barriers and screens
Noise Control – Fan and ventilation noise
Noise Control – Grinders
Noise Control – Hearing protection
Noise Control – Impact, vibration and materials handling noise

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This guidance has been reviewed and updated for the sole purpose of amending year and regulation references relating to the Occupational Health and Safety Regulations, in line with amendments which came into effect on 18 June 2017.