Information about

Noise Control – Enclosures, barriers & screens

Guidance on design and use of enclosures, barriers & screens to control noise

March 2017

Background

Employers must ensure employee’s 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 2007 is an 8 hour average of 85dB (A) and a peak noise level of 140dB(C) at the employee's 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 risks associated with workplace noise.

Review process and noise sources

You should review workplace processes and noise sources before considering enclosures as a noise control measure. It is important to determine what is actually causing the noise and whether control measures such as those indicated below are practicable:

- eliminate noisy process/equipment. For example, purchase pre-cut or pre-fabricated materials
- substitute noisy plant, processes or methods of work with quieter alternatives such as laser cutting instead of grinding
- use engineering controls such as isolation mounts, damping of vibrating panels, quieter gears and cutters, fitting silencers.

The above measures may prove more cost effective and less restrictive than enclosures. However, if the above measures do not reduce noise exposure to below the noise exposure standard, a full or partial noise enclosure, control room or refuge, acoustic barrier or screen may be needed.

Full acoustic enclosures of plant

Full acoustic enclosure of plant can be an effective way to control employee exposure to high levels of noise. A well-designed and relatively airtight full enclosure lined with sound absorbing material can provide as much as 30dB to 40dB of noise reduction. Design guidelines for enclosures are suggested at the end of this information sheet.

Figure 1: Acoustic enclosures
Control rooms or employee refuges
Control rooms or employee refuges may be an effective risk control measure when:

- it is not reasonably practicable to enclose plant (e.g., where there are very large machines or a large number of machines)
- there are a small number of employees
- the process is or can be largely automated or operated remotely

Portable or demountable sound-insulating cabins are also available and are easy to assemble, dismantle or move. Typical reductions of 15 to 30dB may be achieved.

Partial enclosures
Partial enclosures can be used to reduce employee noise exposure where a full enclosure is not reasonably practicable. Partial enclosures do not typically achieve the same amount of noise reduction as full enclosures.

Partial enclosures should be constructed in a similar way to full enclosures. The number and size of any openings should be kept to a minimum and be directed away from employees where possible. Any product access chutes should also be extended and lined with sound-absorbing materials so as far as is reasonably practicable.

The amount of noise reduction achieved by partial enclosures depends on the particular geometry of the enclosure, the number and size of openings and the materials used to build it. Noise reduction of approximately 10dB may be achieved with the use of partial enclosures.

Acoustic barriers and screens
Barriers and screens may be appropriate where a full or partial enclosure is not reasonably practicable to implement or when a small reduction of approximately 5-7dB is needed to avoid exceeding the noise exposure standard.

Fixed, portable or demountable barriers or screens should be placed between the source of noise and employees. Barriers or screens should be as tall and wide as possible and be positioned close to the employee or the noise source.

Barriers and screens are less effective in highly reflective environments such as workplaces with concrete floors or walls. Reflective surfaces, such as walls and ceilings, should be lined with sound-absorbing material, such as foam, to minimise noise reflection. Gaps at floor level should also be minimised or sealed with flexible materials to increase the effectiveness of barriers and screens.
Enclosure design guidelines

It is possible to create your own enclosure to reduce employee noise exposure. To design an enclosure that will perform well and significantly reduce employee exposure to noise levels the following guidelines should be observed.

Wall materials

Suitable materials for constructing an acoustic enclosure include bricks, concrete, metal, plywood, MDF, plaster, glass and Perspex.

The level of noise reduction achieved depends on, for example, the type of wall material used, how well it is sealed, the frequency of the noise being controlled and the weight per unit surface area (eg kg/m²) of the wall material. Materials that are compact, dense and heavy are typically more effective at reducing noise. Noise reduction data for common materials is shown in Table 1 below.

<table>
<thead>
<tr>
<th>Enclosure material</th>
<th>Frequency Hertz</th>
<th>Transmission loss (db)</th>
<th>Noise reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>500</td>
<td>1000</td>
<td>2000</td>
</tr>
<tr>
<td>Plywood 6 mm</td>
<td>20</td>
<td>24</td>
<td>28</td>
</tr>
<tr>
<td>19 mm</td>
<td>27</td>
<td>28</td>
<td>25</td>
</tr>
<tr>
<td>CSR Hebel block 100mm</td>
<td>39</td>
<td>45</td>
<td>53</td>
</tr>
<tr>
<td>MDF 12 mm</td>
<td>20</td>
<td>24</td>
<td>30</td>
</tr>
<tr>
<td>Plaster board 13 mm</td>
<td>25</td>
<td>31</td>
<td>33</td>
</tr>
<tr>
<td>16 mm</td>
<td>28</td>
<td>32</td>
<td>31</td>
</tr>
<tr>
<td>Plaster stud wall – 16 mm plaster each side</td>
<td>33</td>
<td>43</td>
<td>50</td>
</tr>
<tr>
<td>Staggered wall – 16 mm plaster each side</td>
<td>42</td>
<td>52</td>
<td>57</td>
</tr>
<tr>
<td>Chipboard 19 mm</td>
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<td>26</td>
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<td>Glass 3 mm</td>
<td>23</td>
<td>25</td>
<td>26</td>
</tr>
<tr>
<td>6 mm</td>
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<td>28</td>
</tr>
<tr>
<td>100mm hollow concrete block</td>
<td>37</td>
<td>43</td>
<td>44</td>
</tr>
<tr>
<td>Perspex 6 mm</td>
<td>22</td>
<td>28</td>
<td>33</td>
</tr>
<tr>
<td>12 mm</td>
<td>26</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Sheet metal 1.3 mm</td>
<td>31</td>
<td>32</td>
<td>35</td>
</tr>
</tbody>
</table>

Table 1 – Noise reduction data for common materials

Tips on selecting wall materials:
Select suitable materials for the level of noise reduction required and the main frequencies present (ie. low, medium or high pitch noise sources).

As a general rule, select materials that provide about 10dB higher noise reduction than actually required to compensate for any weaknesses in the acoustic enclosure.

Note: Significantly improved noise reduction (up to about 10dB) may be achieved by using two sheets of a given material rather than one sheet of the same material of equivalent thickness.

Wall types (single and double)

Double walls can provide noise reduction of 10 to 20dB higher than single-shell walls for the same weight per unit area. The sound insulation can also be improved by increasing the distance between the shells in the walls (up to 15cm), by filling the cavity with sound absorbing material and by avoiding rigid connection between the shells (eg staggered wall systems or using resilient furring channels) as shown below.

Figure 5: Examples of different double walls and use of flexible furring channels
**Size of enclosure**

Build the acoustic enclosure as large as possible as there may be a greater build-up of noise in close fitting enclosures. If there isn’t sufficient space for a large acoustic enclosure in the workplace, compensate for the extra noise build-up by using materials that provide higher noise reduction.

**Isolation**

- Avoid any rigid connection between plant and the acoustic enclosure to minimise mechanical vibration being transmitted and radiated as sound.
- Ensure that service ducts, pipes or electrical equipment do not come in contact with the acoustic enclosure or ensure that they are mechanically isolated by using flexible pipe sections, flexible sealants around services.
- Install vibration isolation mountings to the machine if floor vibration is an issue or isolate the acoustic enclosure (see Figure 6).

![Figure 6: Examples of isolation mounts and flexible attachments to minimise vibration transfer](image)

**Gaps**

Ensure any gaps or openings are minimised - a 10% gap or opening can reduce the effectiveness of an acoustic enclosure by about 9dB while a 5% gap or opening can reduce the effectiveness of an acoustic enclosure by about 19dB.

Where gaps or openings cannot be avoided (eg product access) and a high level of noise reduction is required, acoustically lined product chutes, tunnels, self-closing flaps or brushes can be used to minimise the amount of noise that may escape.

**Absorbent material**

Acoustic enclosures are most effective when their internal surfaces are lined with sound absorbent material. Suitable absorbent materials include mineral wool, glass wool and polyurethane foam. The absorption efficiency of a material depends on density, porosity and thickness. Absorption data for common materials is shown in Table 2 below.

<table>
<thead>
<tr>
<th>ABSORBENT MATERIAL</th>
<th>FREQUENCY (Hertz)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>250</td>
</tr>
<tr>
<td>Fibreglass</td>
<td></td>
</tr>
<tr>
<td>40mm</td>
<td>0.80</td>
</tr>
<tr>
<td>Mineral wool</td>
<td></td>
</tr>
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<td>25 mm</td>
<td>0.23</td>
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<tr>
<td>50 mm</td>
<td>0.57</td>
</tr>
<tr>
<td>100 mm</td>
<td>0.92</td>
</tr>
<tr>
<td>Foam</td>
<td></td>
</tr>
<tr>
<td>6 mm</td>
<td>0.07</td>
</tr>
<tr>
<td>12 mm</td>
<td>0.04</td>
</tr>
<tr>
<td>25 mm</td>
<td>0.12</td>
</tr>
<tr>
<td>50 mm</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Table 2: Noise absorption data for common materials (the larger the number the better the noise absorption)
Tips on using absorbent material:

- Line the inside of the acoustic enclosure with at least 50mm of a dense and appropriate sound absorbing material. At least 50% of the enclosure should be lined with absorbent material to prevent significant build-up of noise within the acoustic enclosure.

- Sound absorbing materials often need to have a protective facing such as perforated sheet metal, perforated foil wire mesh or thin plastic sheet, to prevent damage or dirt build-up. The percentage open area of the protective cover needs to be at least 25% for the absorbent material to be effective.

Figure 7: perforated sheets open areas

Windows, doors and access hatches

- Ensure that any windows, doors and access hatches are tightly sealed.

- Use double-glazing where higher noise reduction is required.

- Line walkways or tunnels with absorbent material to minimise noise escaping when doors are opened or where doors cannot be used.

- In control rooms, avoid a direct path to the noise source where possible alternatively, insulate or shield doorways and openings from the direct path of the noise (see Figure 9).

Product flow and worker access

- Where objects or product needs to pass through the acoustic enclosure, keep the openings to a minimum and ensure any chutes or tunnels are lined with sound absorbing material to minimise noise escaping.

- Relocate any controls outside the enclosure where practicable so that the enclosure is not frequently accessed.

Ventilation

- Any natural ventilation inlets, outlets or vents required to prevent overheating need to be lined with absorbent material.

- The length of the absorbent lining in a silencer or duct should be at least 3 times the maximum duct diameter (preferably up to 6 times) to achieve noise reductions of 15-30dB.

- Insert absorptive splitters (see Figure 8) inside ducts or silencers where higher noise reduction is required.

- Where mechanical ventilation is required, use a quiet fan or quiet air conditioning unit or fit a silencer (eg absorbent lined ducts/chutes/vents/mufflers) outside the fan.

Note When high volumes of air flow are required use large slowly rotating fans as they are generally quieter than small high-speed fans.

Figure 8: General silencer ducts and absorbent splitters
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Figure 9: Partial overhead cross section of lined enclosure walkways or vents which allow ventilation and shields direct path of noise.

Figure 10: Cutaway of a pump motor enclosure to illustrate the design principles for an acoustic enclosure – Ref ACC NZ

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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