Noise – Control Measures Fact Sheets



HOW IS NOISE MADE?

Sound can be produced by vibration or as a result of aerodynamic systems.

Vibration-induced noises are produced by:

- Mechanical shocks and friction between parts (e.g., hammering, pressing, running gears, bearings, cutting tools, chutes, hoppers, etc.)
- Out of balance moving parts (e.g., unbalanced rigid rotors)
- Vibration of large structures (e.g., ventilation ducts, guards on machines, equipment supporting structures, etc.)

The sound may be amplified by reflective surfaces that are around the devices.

Aerodynamic sources of noise are air or fluid flows through pipes and fans, or as the pressure drops in the air distribution system. Examples include:

- Steam released through exhaust valves
- Aircraft jets
- Turbulent flow of water through pipes
- Fans
- Combustion motors

What are the steps to take to control the noise in the workplace?

The steps that must be taken in order to effectively and efficiently control the noise in the workplace are:

- Identify the sound sources: vibrating sources and aerodynamic flow.
- Identify the path of the noise from the source to the worker.
- Determine the sound level of each source.
- Determine the relative contribution to the excessive noise of each source and rank the source accordingly. To obtain significant noise attenuation, the dominant source should be controlled first.
- Know the acceptable exposure limits identified in the health and safety legislation and quantify the necessary sound reduction.
- Identify solutions by taking into consideration the degree of sound attenuation, operation, and productivity restraints and cost.

How can we reduce the noise exposure?

The exposure to noise can be reduced by eliminating the source of noise (if

possible), substituting the source with a quieter one, applying engineering modifications, using administrative controls, and by using protective equipment.

The best way to reduce exposure to noise is to engineer it out at the design stage. In terms of equipment, always try to choose features that will reduce the noise level to a minimum acceptable level. In terms of new installations, select quiet equipment, have a procurement policy that opts for acquiring quiet equipment, and eliminate design flaws which would amplify the noise.

Engineering modifications, those changes that affect the source or the path of the sound, are the preferred methods of noise control in already established workplaces where noise protection was not factored in at the design stage. It is generally agreed that the solutions controlling the source are more cost effective than those controlling noise along the path. See the engineering solutions below for examples.

Administrative controls, (such as reducing the length of time the worker is required to work in a noisy area), and the use of personal protective equipment (PPE) are measures that control the noise at the worker. Depending on the type and level of noise; number of workers exposed, and the type of work, engineering controls might not always be considered as reasonable solutions. Where the exposure would not justify the implementation of more expensive solutions, a combination of administrative control (limitation of exposure length) and personal protection equipment may be considered. However, we must keep in mind that the administrative measures and the use of PPE may not be effective in protecting the workers (e.g., PPE may be used incorrectly or may not be used at all; administrative controls may not be followed, etc.). The use of PPE should be the last resort for controlling the exposure to noise. For information about hearing protectors, please refer to our Hearing Protectors OSH Answers fact sheet.

What engineering solutions can be used to reduce vibration-induced noise?

Some of the engineering solutions recommended for reducing vibration at the source are:

- Modification of the energy source such as reducing the speed of the fan, reducing the force of impact, etc.
- Damping or covering surfaces which vibrate due to mechanical forces (e.g., chutes and hoppers) with viscoelastic materials such as bitumastic, plastic, silicone, hard rubber and other elastomeric polymers. Single layer damping occurs when the surface is covered with a layer of material which is one to three times thicker than the surface itself. This solution is suitable for thin structures.

To prevent damage due to friction and impact with other materials, the damping material may be sandwiched between the wall of the equipment and a steel sheet or another material resistant to abrasion. This treatment is known as constraint layer treatment, and is adequate for chutes, hoppers, machine guards, conveyors, etc. Certain rules regarding the thickness of the damping material in relation to the thickness of the structure to be coated must be observed in order to obtain adequate noise reduction.

- Minimizing gaps in machine guards and/or covering them with acoustic absorbent material.
- Replacing chain and gear drives with belt drives.
- Replacing metal gears with plastic gears.
- Using gears with tooth patterns which provide a quiet run (e.g., chevron and other helical patterns).

- Replacing metal parts with plastic ones.
- Replacing motors with quieter ones.

What engineering solutions can be used to reduce aerodynamic -induced noise?

Noise control specialists recommend the implementation of the following engineering practices to reduce the noise associated with unstable air or water flow.

- Minimize fluid velocity and increase diameter of pipes.
- Minimize turbulence by using large, low speed fans with curved blades. The following table illustrates the correlation between the reduction of the speed of the fan and the noise attenuation.

Speed Reduction	Noise Reduction dB
10%	2
20%	5
30%	8
40%	11
50%	15

- Avoid elbows when installing a centrifugal fan.
- Increase distance between fans and devices that may reduce efficiency and increase noise (bends, dampers)

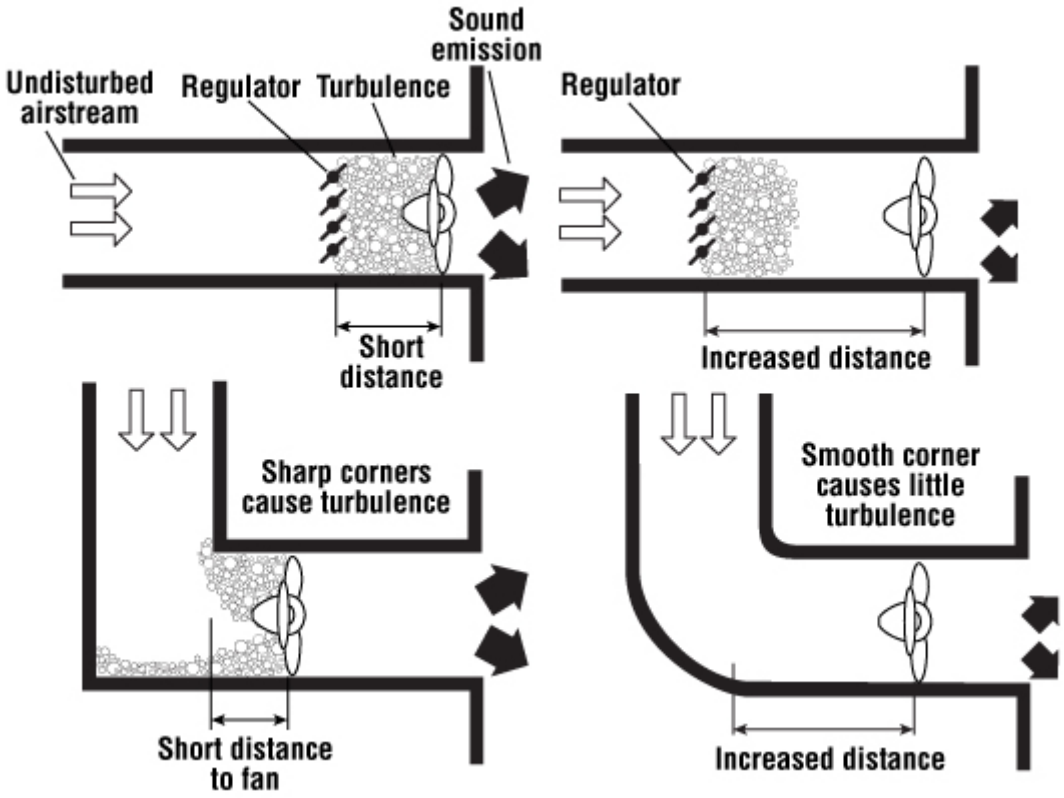


Figure 1: How to avoid turbulence (Figure from: World Health Organization, (no date). “Engineering Noise Control”)

- Choose quiet entraining nozzles (nozzles designed to draw and transport the air quietly) instead of simple nozzles

What are other engineering controls?

Enclosure and isolation

Noisy equipment can be enclosed in spaces or rooms that have special acoustic features – such as sound isolating, acoustic louvers, or sealed windows and doors. The degree of sound attenuation will depend on the noise reduction properties of the materials used to build the room.

In many cases only the individual machine is enclosed. The enclosure can be total or partial. Partial enclosures are preferred where worker access for operating or maintenance is required. The noise

attenuation offered by the partial enclosures is however lower than that of a total enclosure. An alternative to enclosure of the equipment is the enclosure of the workers. The workers may operate remotely the equipment from an isolated room.

Isolation is used to reduce the sound transmitted through vibrations. The equipment is isolated from radiating surfaces by materials such as springs, elastomeric materials, cork, and foam rubber. For example: heavy vibrating machinery can be supported by isolating springs and rubber inserts, or vibrating pipes can be supported by brackets that are padded by rubber isolators or by springs.

Acoustic barriers

Acoustic barriers are panels made of sound absorbing material which are placed between the source of noise and the worker. Panels must be designed appropriately (e.g., panels placed in highly reflective rooms are not always effective in

attenuating the noise that reaches the worker).

Installation of silencers in the ducts and at pneumatic exhausts

Silencers are devices that allow the fluid to pass but restrict the passing of the sound by reflecting or dissipating the sound. Sound dissipation occurs in silencers containing absorbing materials. In reflective silencers, the sound propagation is reduced due to the existence of expansion cambers (as in the car mufflers) or openings.

What other general measures can I take to control the noise?

Perform regular maintenance. Focus on identifying and replacing worn or loose parts, lubricating moving parts, and ensuring that rotating equipment does not go off balance.

Substitute noisy processes with quieter ones. For example, replace:

- Pneumatic ejectors with mechanical ones
- Rolling or forging with pressing
- Impact riveting with welding
- Circular saw blades with damped blades

Reduce sound reverberation in the room. Reverberation happens when the sound produced in an enclosure hits a hard reflective surface. The sound reflects back in the room and ads to the original source. The strength of the reverberation decreases with the distance from the source to the reverberating surface. In some cases, the reverberated sound may dominate the original sound. In such cases, padding the reflective surfaces with sound absorbing materials will reduce the sound level.

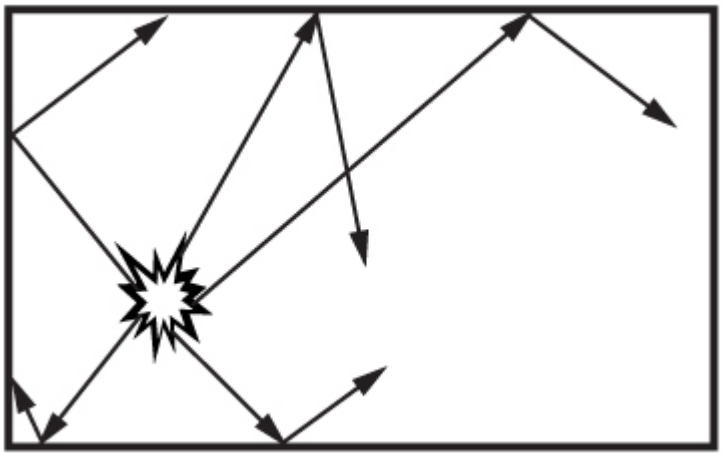


Figure 2: Sound reverberation in a room

Reverberation can be reduced by arranging the equipment in the room in such a way that the equipment is not too close to too many reflective structures. The sound level of a noise source placed near hard reflective surfaces increases with 3 dB for each surface. For example, if a motor is placed directly on the floor, close to one of the walls of the room (the motor is close to two surfaces) (Figure 3, Position 2), the sound level will increase by 6 dB; if the same motor is placed in the corner of the room (close to three surfaces: two walls and the floor) (Figure 6, Position 3), the sound level will increase by 9 dB.

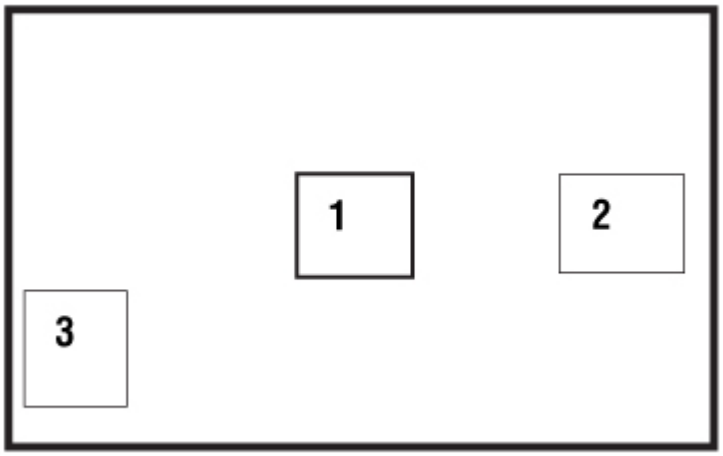


Figure 3: Sound reflection and placement of equipment in the room

Another way to reduce the sound radiation is to reduce the radiating surface (e.g. covering a transmission gear with a mesh enclosure instead of a solid box).

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