

GUIDELINES FOR BUILDING ENCLOSURES

In designing enclosures, several factors must be taken into consideration if the enclosure is to prove satisfactory from both an acoustical and a production point of view. Specific guidelines for enclosure design are as follows¹:

1. *Enclosure Dimensions:* There are no critical guidelines for the size or dimensions of an enclosure. The best rule to follow is bigger is better. It is critical that sufficient clearance be provided between the noise source and enclosure panels to permit the equipment to perform all intended movement without contacting the enclosure and to allow for efficient ventilation, lighting, maintenance, etc.
2. *Enclosure Panels:* The insertion loss (IL) or attenuation provided by an enclosure is dependent upon the materials used in the construction of the panels and how tightly the enclosure is sealed. Most panels commonly used for enclosures are rated for their sound transmission loss (TL) capabilities and published in acoustical textbooks or journals. To provide assistance with the selection of the appropriate TL materials for the enclosure panels, the following rules of thumb are offered:
 - A. For an enclosure with no internal absorption:
$$TL_{\text{reqd}} = IL_{\text{desired}} + 20 \text{ dBA},$$
 - B. For an enclosure containing approximately 50 percent coverage of the internal surface area with sound absorption:
$$TL_{\text{reqd}} = IL_{\text{desired}} + 15 \text{ dBA},$$
 - C. For an enclosure with 100 percent coverage of the internal surface area with sound absorption material:
$$TL_{\text{reqd}} = IL_{\text{desired}} + 10 \text{ dBA},$$

In these expressions TL_{reqd} is the transmission loss required of the enclosure, and IL_{desired} is the insertion loss desired to meet the abatement goal.

3. *Seals:* For maximum TL all enclosure wall joints must be tight-fitting. Openings around pipe penetrations, electrical wiring, etc., should be sealed with a flexible and non-hardening mastic such as silicon caulk. One of the most important people around during the construction or installation of an enclosure is the individual with a caulking gun.
4. *Internal Absorption:* To absorb and dissipate acoustical energy the internal surface area of the enclosure should be lined with acoustical absorbing materials. The manufacturer's published absorption data provide the basis for matching the material thickness and the absorption coefficients at each frequency to the source frequencies with the highest sound pressure levels (SPLs). The product vendor or manufacturer can also assist with selection of the most effective material.
5. *Protection of Absorption Material:* To prevent the absorptive material from getting contaminated, a splash barrier should be applied over the absorptive lining. This should be of a very light material, such as one-mil plastic film. The absorptive layer can be retained if necessary with expanded metal, perforated sheet metal, hardware cloth or wire mesh. However, the retaining material should have at least 25 percent open area.
6. *Enclosure Isolation:* It is important that the enclosure structure be separated or isolated from the equipment to ensure that mechanical vibrations are not

¹These guidelines were written by Dennis P. Driscoll, P.E., Principal Consultant, Associates in Acoustics, Inc.; and are published in *The Noise Manual*, 5th Edition (year 2000), available from the American Industrial Hygiene Association Press.

transmitted to the enclosure panels, which can re-radiate noise. When parts of the machine do come in contact with the enclosure, it is important to include vibration isolation at the point of contact to minimize any potential transmission path. If the floor vibrates due to motion or movement of the machine, then vibration isolation should be used under the machine.

7. *Product Flow:* As with most production equipment, there will be a need to move product into and out of the enclosure. The use of acoustically lined channels or tunnels can permit product flow and provide acoustical absorption. To minimize the leakage of noise, it is recommended that the length of all passageways be three times longer than the inside width of the largest dimension of the tunnel or channel opening.
8. *Worker Access:* Doors and windows may be installed to provide physical and visual access to the equipment. It is recommended that ideas regarding the location and size of all doors and windows be solicited from machine operators, which not only makes the design more practical, but also improves the likelihood employees will accept the enclosure system. It is important that all windows have nearly the same transmission loss properties as the enclosure walls. All access doors must tightly seal around all edges. To prevent operation of the equipment with the doors open, it is recommended that an interlocking system be included that permits operation only when the doors are fully closed. To facilitate access some industries support enclosures on hydraulic lifts that can quickly move the enclosure out of the way.
9. *Ventilation of Enclosure:* In many enclosure applications, there will be excessive heat build-up. To pass cooling air through the enclosure, a quiet blower with sufficient air movement capability should be installed on the outlet or discharge duct. Finally, the intake and discharge ducts should be lined with absorptive material.
10. *Fire Prevention:* Keep in mind that although most sound-absorbing materials are listed as fire resistant, fires can and have occurred when sparks and/or excessive internal heat ignites dust, oil mist, etc., that accumulates on the surfaces of the material. In addition, potentially harmful gas may be released by the burning material, depending on its chemical composition. Therefore, if fire is a potential problem for your equipment and enclosure application, it is recommended that an internal fire prevention or suppression system be installed, as is often dictated by local fire codes.