

TECHNIQUES THAT INVOLVE SIGNIFICANT EQUIPMENT MODIFICATION

Barrier Treatments (see Shields and Barriers)

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CASE HISTORY 14: FOLDING CARTON PACKING STATIONS, AIR HAMMER
NOISE
(OSHA Noise Problem)

Problem Description

In the manufacture of folding cartons, the individual cartons are cut, and the cut sheets are stacked by the cutting press on a pallet. To deliver the multiple sheets from the press, the cartons are held together with a nick or uncut portion. When stacked, the individual cartons are separated by stripping with an air-driven chisel which breaks the nicks and frees an entire stack. When no additional operations are needed, these stacks are packed in cases for shipment.

Air hammers/chisels produce noise that has not yet been eliminated by equipment manufacturers. Currently available air hammer mufflers do not reduce the noise to an acceptable level. The air hammer operator therefore must wear ear protection. The problem in this case was to protect other workers (packers) from the air hammer noise. A typical production air hammer stripping and packing set-up is shown in Figure 6.14.1.

The production sequence for this operation is for the stripper to air hammer a stack of cartons (precounted by the cutting press) and place them on the conveyor at Point C. The packer, at the end of conveyor E, prepares the case, packs the stacks of cartons, seals, labels, and stacks the finished pack on a delivery skid. Two packers are required to handle the output from one stripper. The stripper is actually using the air hammer about 50% of his time, with the balance of the time used in stacking or preparing the load. Thus, he can get some relief from continuous use of his ear muffs by hanging them around his neck while not actually using the hammer. It is easier to promote the use of ear muffs when needed if the operator can get some relief when muffs are not needed.

Problem Analysis

As frequency analysis is not critical in this problem, no octave-band readings were made; all data were based on A and C scale readings from an acceptable Type 2 sound level meter.

Control Description

It was decided to protect the packers from the air hammer stripping noise by using a barrier wall. A convenient rule-of-thumb is that useful protection is afforded by the barrier wall beyond 30 degrees into the acoustical shadow. Note that in Figure 6.14.1, the packers behind a wall 10 ft long and 6 ft high are within this protected zone in both top view and side view of the operation.

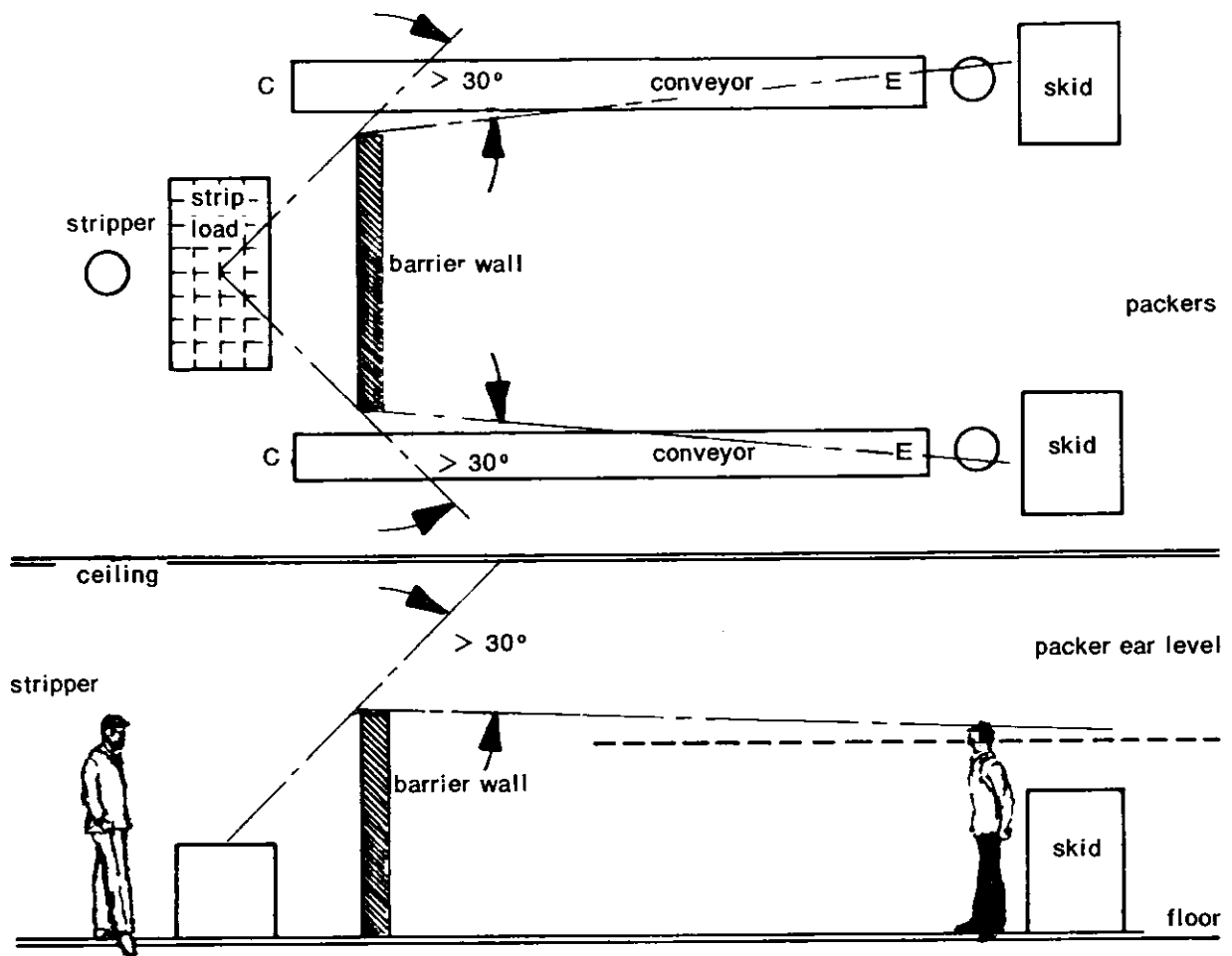


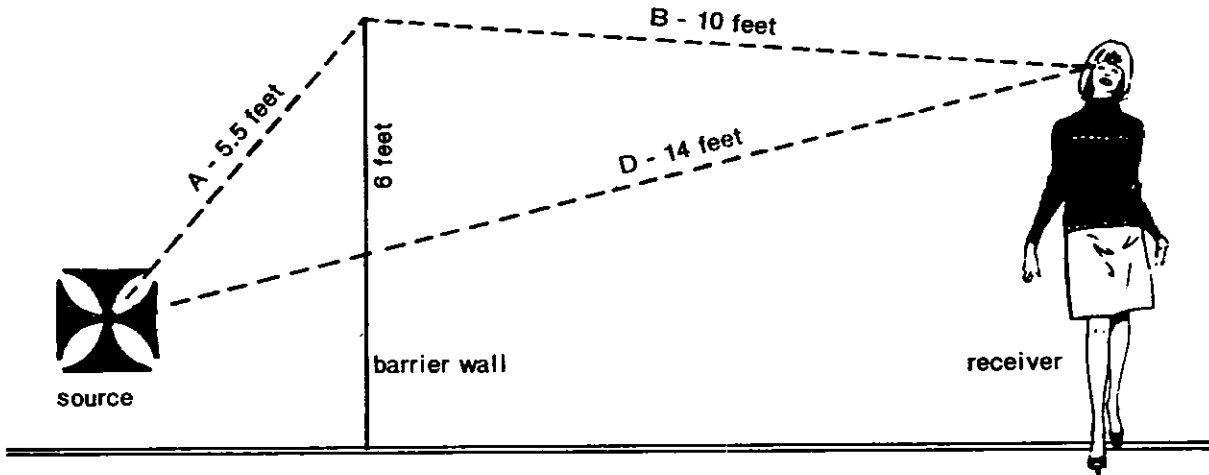
Figure 6.14.1. Air hammer stripper and packer line.

The barrier will need be no better acoustically than the attenuation afforded around the sides and top of the wall. Therefore, the wall was fabricated with a 2- x 4-in. frame faced on both sides by 1/4-in. plywood for a simple sturdy barrier wall.

If there had been any reason to reduce noise reflections from the noise source side, this side could have been faced with sound-absorbing acoustic materials.

The rule-of-thumb of aiming for the packer to be well within the 30-degree line from the acoustic shadow line was used in this case. Other means of estimating the attenuation of barrier walls are covered by Beranek* in *Noise and Vibration Control*, p. 178, and illustrated in Figure 6.14.2. The attenuation calculated for this barrier wall ranges from 10 to 15 dB, depending on the

*Beranek, L.L. 1971. *Noise and Vibration Control*. McGraw-Hill, New York, N.Y.



$N = \frac{2}{\lambda} (A + B - D)$		250 Hz	500 Hz	1000 Hz	2000 Hz
$N = \frac{2}{\lambda} (5.5 + 10 - 14)$	λ	4.8	2.4	1.2	0.6
$N = \frac{3}{\lambda}$	N	0.625	1.25	2.5	5
	dB	10	11	13	15

Source: Beranek, *Noise and Vibration Control*, page 178.

Figure 6.14.2. Barrier wall theory.

wavelength. This agreed with the measured attenuation of 7 to 12 dB and the noise reduction from the 92- to 97-dBA range to about the 85-dBA average measured at the packer's ear level.

The barrier costs were:

1/4-in. plywood, 2 sides, 5 sheets, 4x8; 160 ft ²	\$30.00
2x4 in. framing; 60 ft	10.00
In-plant labor	<u>60.00</u>
Approximate total	\$100.00

Comments

In this installation, there were, fortunately, no low ceilings, which would have established a serious sound reflection problem and defeated the barrier wall. Barrier walls will not give good results in a highly reverberant, low-ceilinged room. If there had been a low ceiling, useful noise reduction would still have been possible by adding sound-absorbing material at the reflecting portion on the ceiling (about 12 ft over the barrier wall and the noise source). The amount of attenuation gained is easily estimated by using the ratio of absorption of new material

to that of the existing ceiling. Ceiling reflection is a major pitfall of the use of barrier walls indoors. The design of the wall alone is based on freefield conditions.

CASE HISTORY 15: PRINTING AND CUTTING PRESS
(OSHA Noise Problem)

Problem Description

In the manufacture of folding cartons, one method is to print the cartons in a web, using multiple gravure color stations and feeding the printed web into a reciprocation cutting press.

The reciprocation cutting press, using a rule die, cuts the cartons and delivers cut cartons to a delivery belt. The rotary printing operation was not noisy, but the cutting press noise from the cutting head was in the range of 93 to 95 dBA at the normal operator position. The take-off operators were far enough from the noise source so that noise at their station was below 90 dBA.

Control Description

Figure 6.15.1 shows the operator location, control station, cutting head, and carton delivery. To reduce the noise of the cutter head at the operator position, a barrier wall was used. As access to the unit for job changes and maintenance was important, the barrier wall was specified to be lead-loaded vinyl sound stopper curtain material, available on a made-to-order basis and designed to be portable.

The curtain unit ordered was 7 ft high and 8 ft long, with a 10- x 20-in. viewing port, since the attenuation required for OSHA compliance was only about 5 dB minimum.

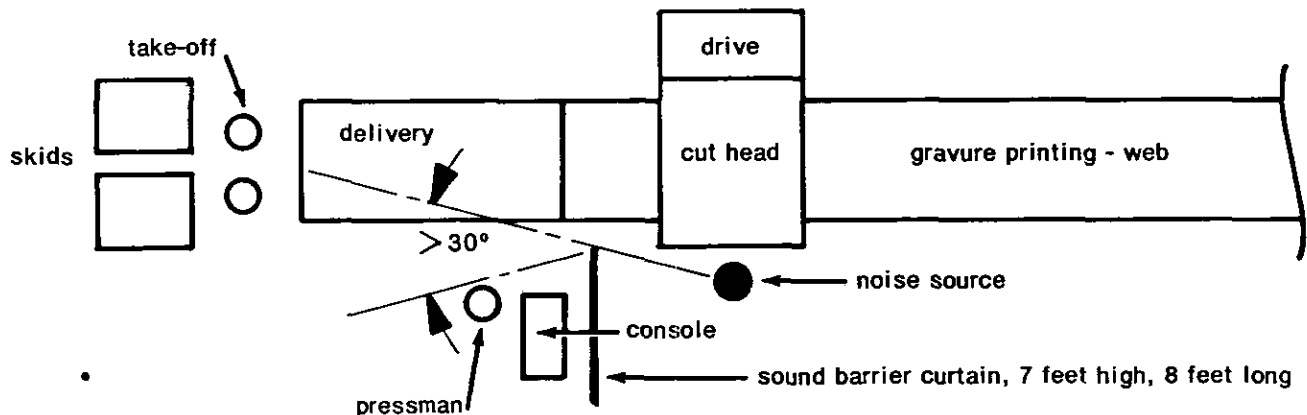


Figure 6.15.1. Top view of in-line gravure-cut press with sound barrier curtain.

Results

The noise at the operator control console was reduced from the 93- to 95-dBA range to an 86- to 87-dBA range. The operator performed inspection and adjustment at the cutter head for a few hours daily, as required, but was still within the time exposure limits.

Total cost, using a lead-loaded vinyl curtain at about \$4/ft², was about \$300, including hanging fasteners, viewing window in curtain, and pipe supports.

Comments

To get any attenuation from barrier walls, the receiver must be located with respect to the noise source so as to be beyond 30 degrees into the acoustical shadow line, as a rule-of-thumb. Note that in the top view, Figure 6.15.1, the pressman is just within this line. In Figure 6.15.2, showing over-the-wall vertical plane limitations of this same rule-of-thumb, the pressman is well within this limiting area. The curtain met the objective, since only a small attenuation of about 5 to 6 dB was required and the actual real attenuation was 7 to 8 dB. More attenuation would require a larger curtain.

A design pitfall in barrier walls is that if room conditions are too reverberant and the ceiling is too low, the barrier wall is bypassed. Low ceiling reflections can be overcome by adding an absorbent to the reflecting area of the ceiling over the barrier wall.

In Case History 16, a relatively permanent wood construction wall was used. This case required a different treatment because regular access was required to the cutter head between the console and the press. The freestanding, easily movable curtain wall provided both protection during operation and easy access to the press for set up.

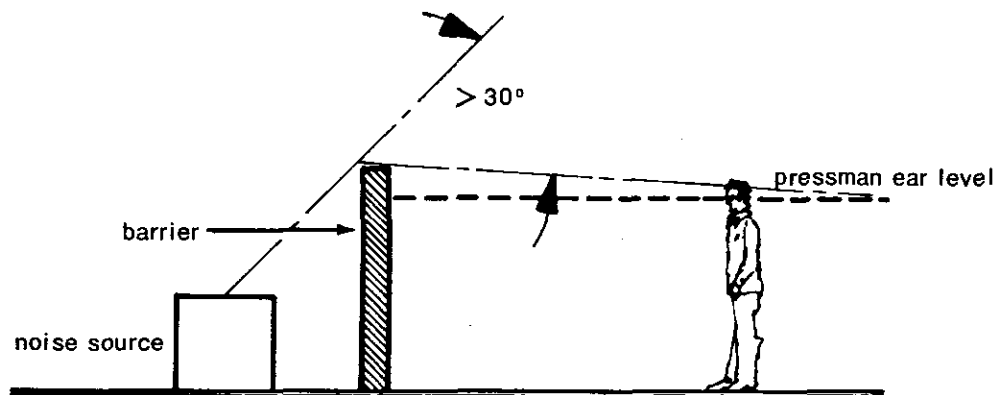


Figure 6.15.2. Side view of in-line gravure-cut press with sound barrier curtain.

CASE HISTORY 16: STRAIGHT-AND-CUT MACHINES (OSHA Noise Problem)

Problem Description

The straight-and-cut machine straightens heavy-gauge wire in an in-feed to a cutoff unit set to cut repeat lengths, resulting in sound levels of 92 dBA at the operator position. The client in this case sought to reduce the sound level to a maximum of 85 dBA at the operator position.

Problem Analysis

Figures 6.16.1 and 6.16.2 are close-in octave-band analyses of the diagnostic measurements made in front of the clutch mechanism. In Figure 6.16.1, curve A shows peak cutting levels, and curve B is the slow response of the same cutting sound pressure levels (wide separation indicates impact noise). Curve C is the idling, noncutting machine sound level. The differences indicate dominance of the total spectrum by the cutting noise. In Figure 6.16.2, curves D and E exceed curves A and B, indicating some directionality of the cutting noise.

Figures 6.16.3 and 6.16.4 are octave-band analyses made at the operator position. Most of the operator time is represented by Figure 6.16.3, with the cutting cycle sound level at 92 dBA (idling cycle at only 83 dBA), indicating that the dominant noise source of the clutch cutter mechanism is the same form as in the close-in diagnostic measurements. Comparison of the measured sound pressure levels with the 90-dBA criterion indicates the required attenuation is between 5 and 11 dB in the 1000- to 8000-Hz octave bands.

Control Description

On the basis of discussions with management, it was determined that noise control should take the form of a barrier wall that would block the sound path from the cutting assembly to the operator, rather than machine redesign.

Barrier materials for obtaining the required attenuation were 1/4-in. plywood, with 1/8- to 1/4-in. Plexiglas for viewing ports where necessary. The barrier wall was extended 26 in. past the extremities of the area encompassed by the cutter and was close to the cutter, about 6 to 8 in. away. The barrier was hung in place, supported by chains from overhead. In addition, an absorbent layer was hooked to the barrier on both sides. To prevent clogging of absorbent, the 1-in. polyurethane foam absorbent was supplied with Mylar facing. See Figure 6.16.5.

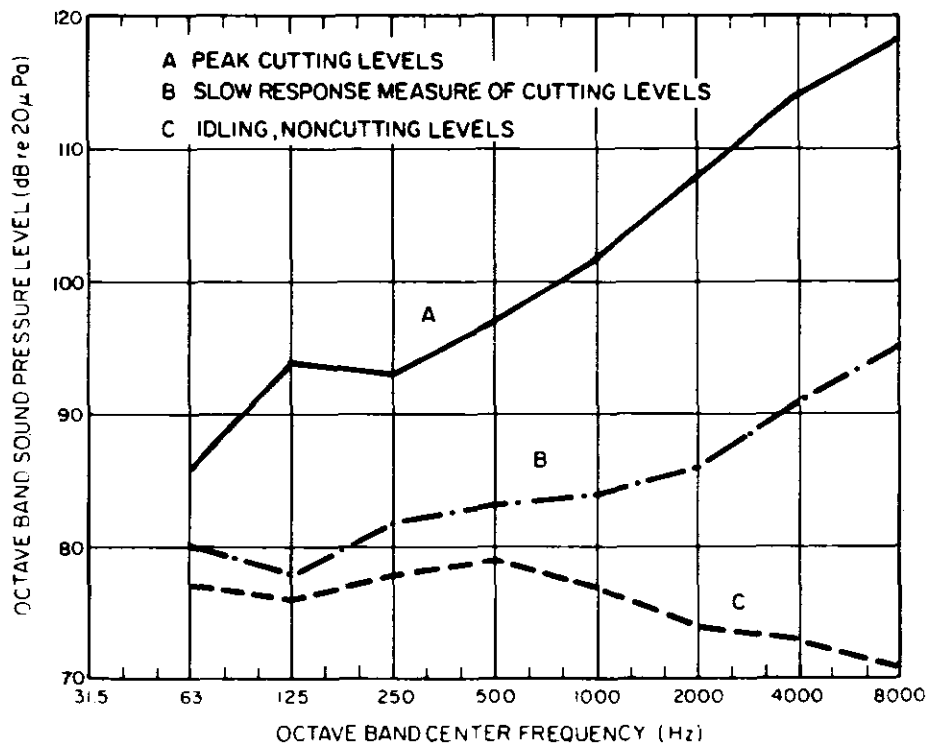


Figure 6.16.1. Straight-and-cut machine: close-in measurement near west side of clutch cutter mechanism (1.2 m above floor, 0.5 m from cutter).

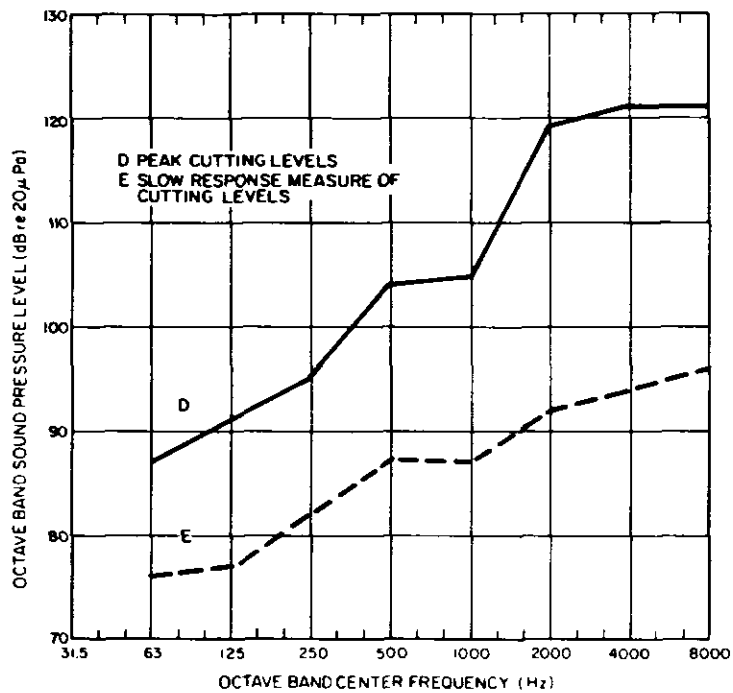


Figure 6.16.2. Straight-and-cut machine: close-in measurement near east side of clutch cutter mechanism (1.2 m above floor, 0.5 m from cutter).

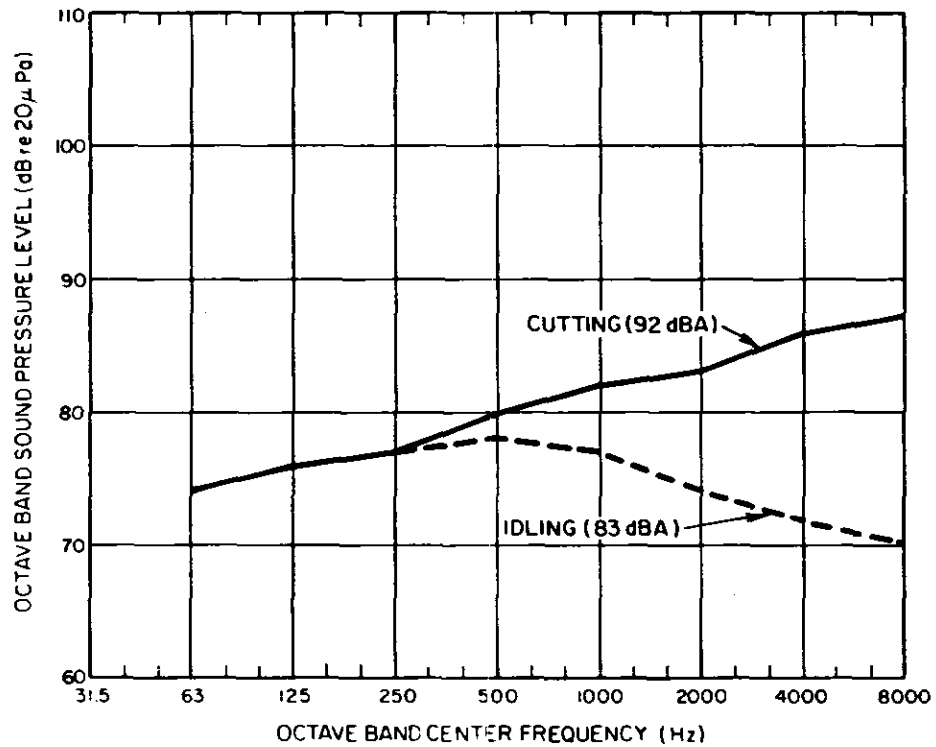


Figure 6.16.3. Straight-and-cut machine: operator's nearfield exposure.

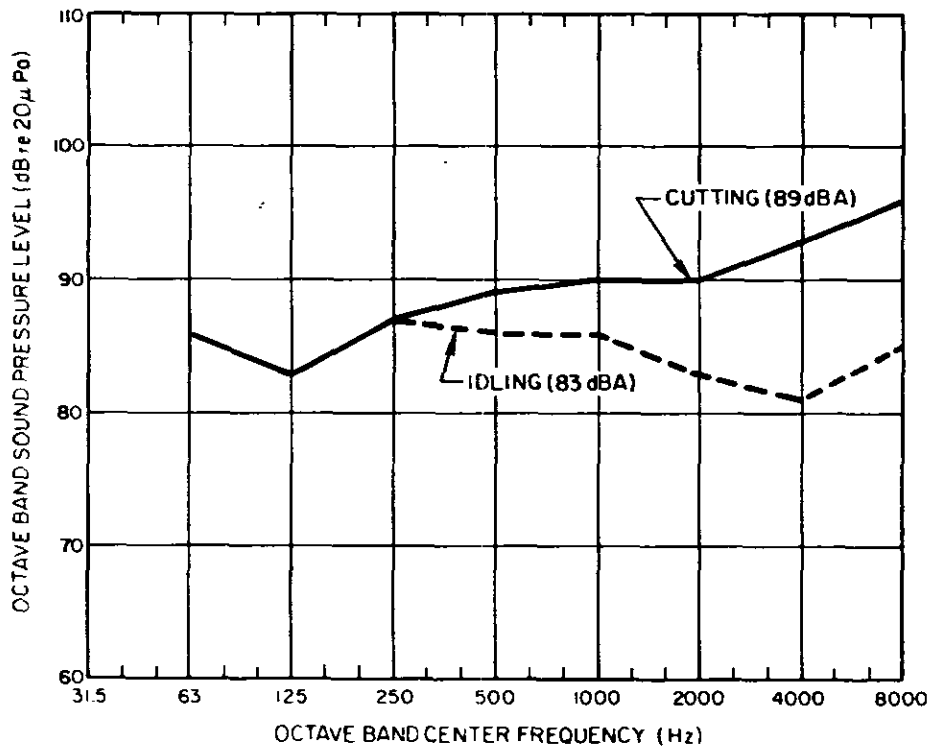


Figure 6.16.4. Straight-and-cut machine: operator's farfield exposure.

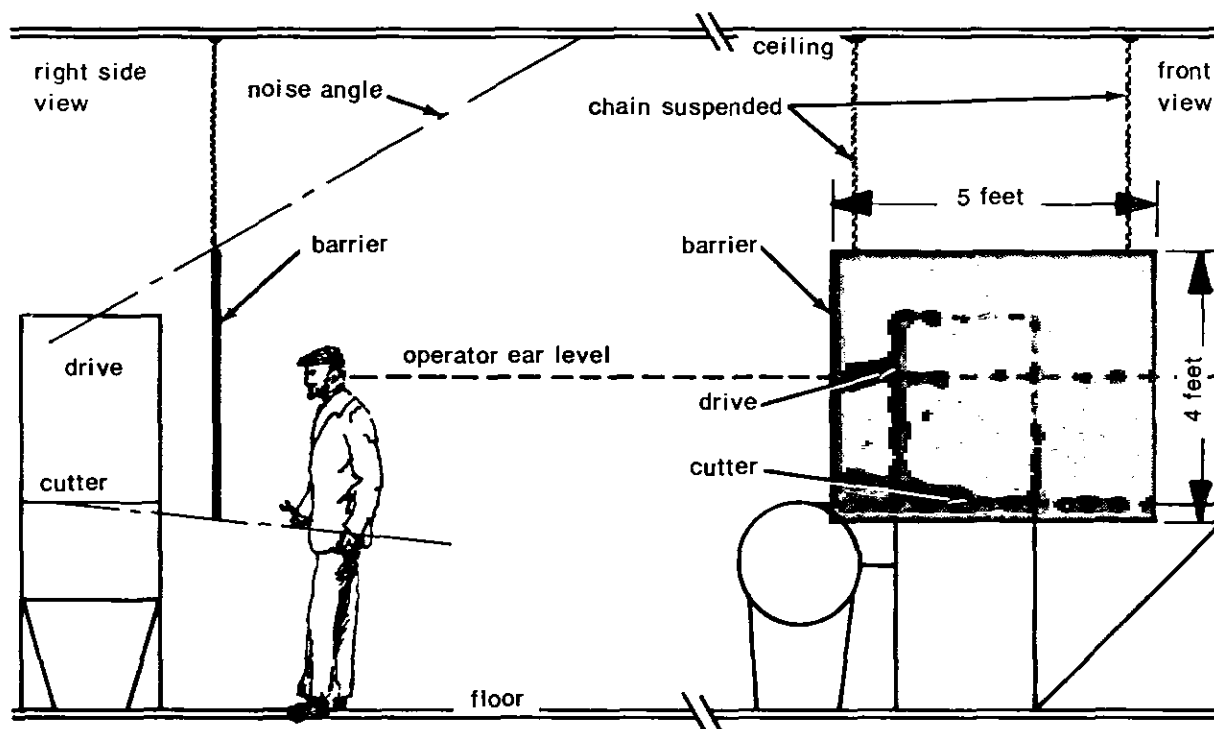


Figure 6.16.5. Barrier wall for straight-and-cut machine.

Normally, the noise absorbent for barriers is used only on the machine noise source side. In this case, however, noise absorbent was used on the operator side of the barrier as well, to reduce sound field build-up in the space between barriers. With the barrier close to the cutter, the operator would be within the safe sound shadow area – the area beyond a line at least 30 degrees from the edge of the acoustical shadow line.

As the barrier was built in-plant, no actual costs are available, but material costs are estimated at about \$100.

Results

The cutting cycle sound levels at the operator location were reduced from 92 dBA to 85 dBA, a 7-dB reduction in sound level. Idle cycle sound level was reduced from 83 dBA to 76 dBA.

Comments

Barriers are easy to remove by the operator for many reasons, real and imaginary, and use must be maintained by supervision.

Location of an effective portable barrier must be standardized so that the barrier is not bypassed. Barriers can be bypassed by noise reflections from a low ceiling. If this problem had existed in this case, a section of the ceiling above and about 4 ft on each side of the barrier could have been treated with absorbing material.

CASE HISTORY 17: IMPACT TRIMMING MACHINES
(OSHA Noise Problem)

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Problem Description

Eight George Knight air impact trimming machines, located close together in a large production area, performed the trimming function once every 5 to 6 sec. An operator sat directly in front of each machine, and the sound level at each operator's station varied between 80 and 99 dBA.

The trimming machines cut fabric-reinforced diaphragms to specified configurations. An air-actuated ram accelerates a cutting blade against a fixed anvil (the blade and anvil are constrained in a die set with metal stops so that the blade and anvil just make contact), creating a nipping action that trims the diaphragm at impact.

Since the eight workers were located in close proximity to each other, they received noise not only from their own machines (up to 97 dBA) but also from their neighbors' machines (up to 95 dBA). Equivalent daily exposures (time-averaged sound levels) for individual operators were found to be 91 to 92 dBA, marginally exceeding what is allowed under the OSHA regulation and indicating that only a small noise reduction was required.

Problem Analysis

No detailed measurements were performed because it was evident that the noise was being generated by the impacts of each of the trimming machines.

Examination of the situation revealed that the dominant portion of the noise exposure incurred by each operator was sound radiated directly to him from each machine. Since the amount of noise reduction required was small, it was clear that some redirecting of the machine-generated sound would be beneficial.

Control Description

The solution implemented consisted partly of partitions constructed around each work station, as shown in Figure 6.17.1. The partitions were about 8 ft high and were made of 3/4-in. plywood covered on both sides with 1-in.-thick glass fiber boards faced with open-weave burlap. In addition to the partitions, see-through safety shields were placed between the contact point of each machine and the operator.

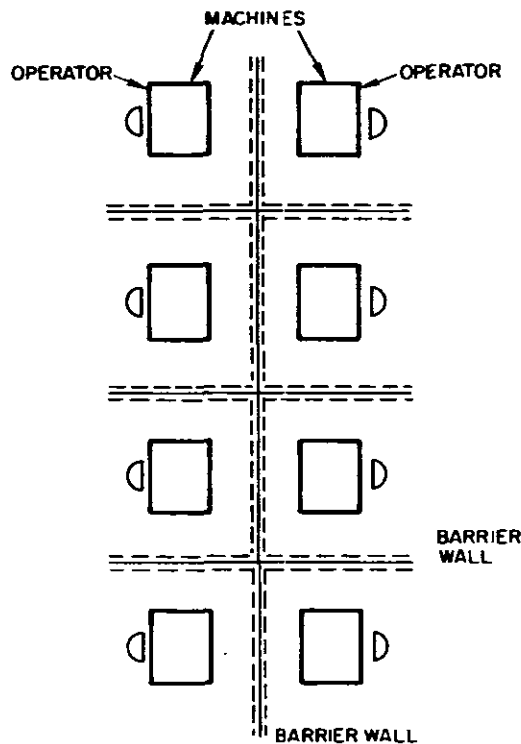


Figure 6.17.1. Knight trim department layout of acoustical barriers.

Results

Measurements made subsequent to the final installation showed that the average sound level at operator stations was reduced from 91/92 dBA to 85/86 dBA. Maximum sound levels are now no more than 94 dBA. Figure 6.17.2 shows a statistical analysis of the present noise exposure.

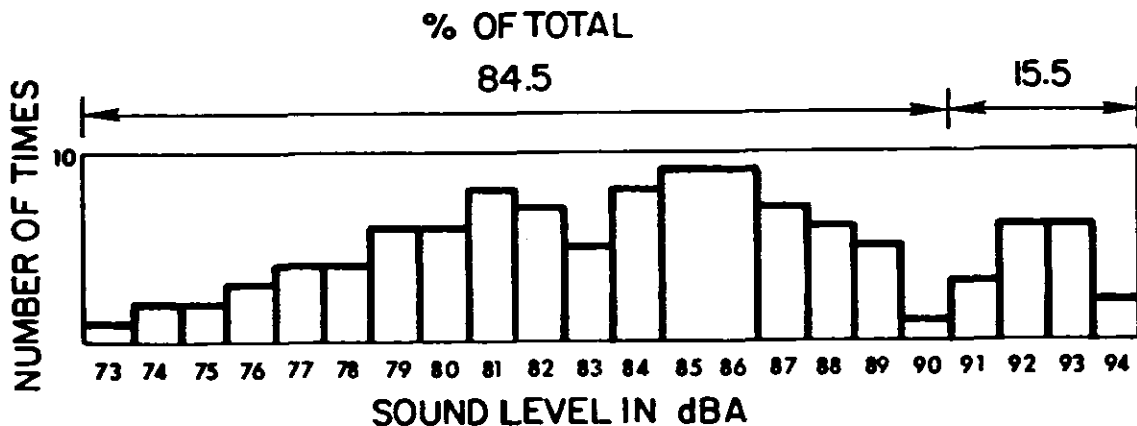


Figure 6.17.2. Result of statistical analysis of noise exposure at operator station (Knight trimming machine).

Comments

In this case, acceptance by the workers of the noise controls presented the major problem. Large amounts of engineering and management time were used to discuss the project with workers in an attempt to convince them that the installation was for their own good. Workers were most upset at not being able to see neighboring machine operators. The workers also showed great resistance to wearing personal protective equipment throughout the project.

CASE HISTORY 18: TRANSFORMER
(Community Noise Problem)

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This case history discusses noise control treatments that were included in the design of a new electric station and evaluates their effectiveness.

Problem Description

A 345/115-kilowatt substation, designed for an 11-acre site located in a mixed commercial/residential area in New England, was to include two 300 MVA OA/FOA/FOA autotransformers and an oil-to-air heat exchanger for the underground 345-kilowatt line. Standard National Electrical Manufacturers' Association (NEMA) sound levels for transformers of this class are 84/86/87 dBA. The heat exchanger contains two 8-ft-diameter, 4-bladed, propeller-type fans, driven at 364 rpm by one 1-hp motor per fan. The fans are rated at 0.135 in. of water static pressure and 51,700 actual cfm air flow.

The nearest neighboring buildings, which are along the site property line, include an office building, a restaurant, and retail stores. Farther from the site, but within 1500 ft, are a motel, several high-rise apartment buildings, and other office buildings. In addition, a hospital and infirmary are within 3000 ft of the site.

The power company wanted to avoid (1) noise complaints from its new neighbors and (2) noise-related delays during the application hearings pending before various regulatory agencies. A study by Bolt Beranek and Newman Inc., submitted by the power company to the regulatory agencies in the form of a report, established appropriate sound level criteria, provided detailed noise control design, and estimated the community noise impact from station operation.

Various acoustic criteria were established for the station to meet the city and state sound level regulations. However, the power company's own criterion was the most stringent: A nuisance or probable-complaint condition must not be created by noise from the operating facility. From this criterion, an engineering design goal was chosen to limit the transformer tonal noise to within about 5 dB of the nighttime ambient residential sound levels measured in octave bands at nearby noise-sensitive locations.

Problem Analysis

There are several sources of transformer noise. Energized transformers produce a characteristic tonal sound, the frequency of which is proportional to the supply frequency. The cooling fans produce a broadband noise when in operation. Oil-circulating pumps, like the cooling fans, are a source of noise when used. When air-blast circuit breakers are used, they are a source of high-level, short-duration, infrequent noise.

Transformer tonal noise is comprised of harmonically related frequencies that are even multiples of line frequency. In the United States, the line frequency is 60 Hz, and transformers radiate tonal sounds at 120, 240, 360, 480...Hz. In almost all cases of transformer noise complaints, it is the tonal noise that causes problems.

Residual ambient sound pressure level measurements were made at nearby noise-sensitive areas during the day, evening, and nighttime periods. The late-night ambient sound levels were used to establish the transformer noise design goal.

Several alternative noise control treatments can be considered for transformers. These include:

- Specification of sound levels lower than those set by NEMA
- Barrier walls or partial enclosures
- Complete enclosures
- Purchase of additional real estate or noise easements as buffer zones
- Relocation to an area without noise-sensitive neighbors.

A complete enclosure can pose ventilation and maintenance problems and was not considered necessary. The purchase of additional real estate and relocation were not feasible. For this project, the first two noise control treatments listed above were selected.

Control Description

Both transformers were purchased from the manufacturer with sound levels specified to be 9 dB less than the NEMA standard. The lower-than-standard sound levels for this transformer were 75/77/78 dBA. This reduction is accomplished in the design of the transformer by providing a large core reducing the magnetostrictive forces, which, in turn, reduce the noise radiated by the tank wall.

A partial enclosure was also provided along three sides of the transformer. Noise-sensitive areas were positioned in three directions from the site. There were no noise-sensitive land uses in the remaining direction, and therefore an increase in noise level could be tolerated. The open side of the enclosure was, of course, aligned toward the direction that was not noise-sensitive.

The size and location of the partial enclosure relative to the transformer was designed to provide adequate insertion loss without restricting ventilation or maintenance. The enclosure walls were constructed from patented concrete blocks with sound absorption on the transformer side of the walls provided by slots leading into the interior cavities of the blocks. Sound absorption on the interior surfaces of the walls was necessary to minimize the build-up of sound within the enclosure. The masonry walls also served as fire protection between the two transformers.

Results

Measurements made after the station was operating show the sound level design goal was achieved. The transformer tonal noise is usually masked by ambient sounds and is therefore seldom audible at nearby sensitive areas.* Figure 6.18.1 shows the results of sound pressure level measurements before and after the transformers were energized. These measurements were obtained during the late nighttime hours, when the potential for station audibility was greatest. It should also be noted that no complaints have been received after three years of operation.

*The late-night ambient sound levels are occasionally lower than those used in the design goal and, hence, the transformer noise can occasionally be heard in the community. If it were appropriate to eliminate completely the possibility of a noise source from being heard, even more stringent design goals could be established (e.g., 5 to 10 dB lower than the expected sound level of the masking ambient). In this case, such extreme measures were inappropriate.

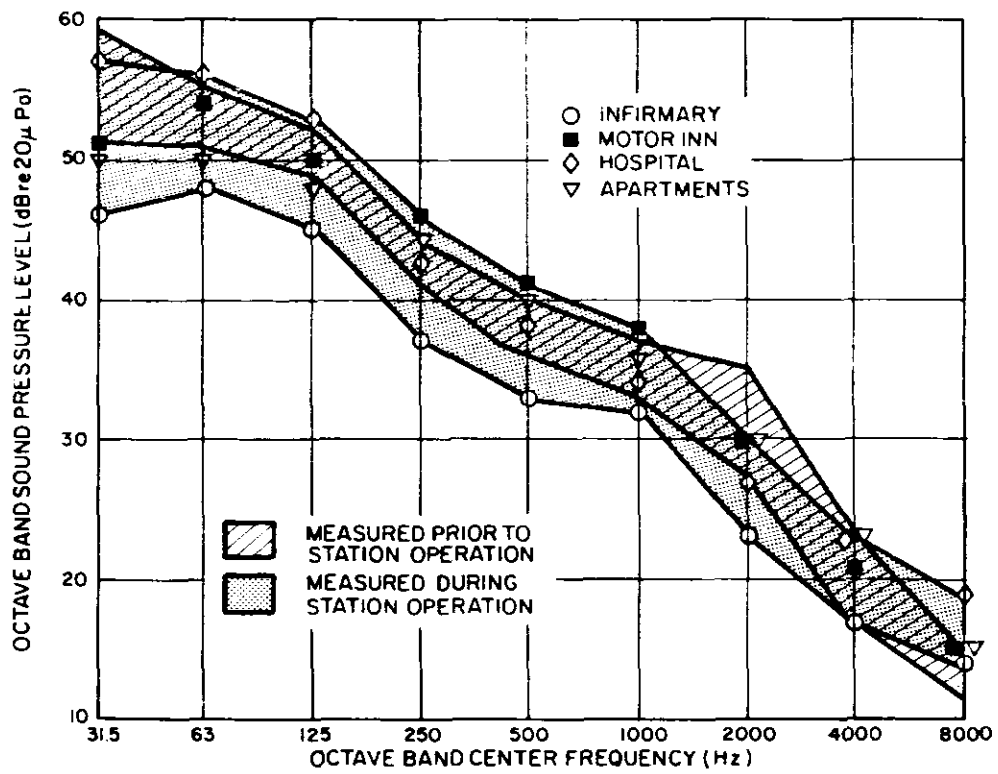


Figure 6.18.1. Late-night sound pressure levels measured at community locations.

CASE HISTORY 19: TRANSFORMER
(Community Noise Problem)

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Problem Description

A transformer at the Puerto Rico Water Resources Authority, Santa Maria Substation, Ponce, Puerto Rico, is located just 22 ft from a neighboring home. The people living next to the substation complained about the noise radiated by the transformer.

Problem Analysis

A sound survey conducted by PRWRA confirmed that the sound levels resulting from the transformer operation exceeded the ambient noise levels in the area. From the data obtained, the degree of noise control required was ascertained. From Table 6.19.1, it is clear that a minimum of 9 dB of noise reduction is required in sound level. Low frequencies are involved in the problem, as seen from the large differences between A- and C-scale readings.

Table 6.19.1 Acoustic measurements, SPL

Measurement at Complaint Area	Overall Readings, dB	
	A-Scale	C-Scale
Lowest ambient level, sub-station not operating	48	58
Substation in operation, no barrier	57	66
Substation in operation, with barrier	48	58

Control Description

An 18-ft-high barrier was chosen as the control here. The barrier design incorporated IAC Noishield TM prefabricated panels. Such units are easy to install and provide flexibility in erection or relocation. The overall configuration of the barrier design is shown in Figure 6.19.1.

CASE HISTORY 20: SURFACE GRINDERS
(Office Noise Problem)

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Problem Description

Operation of three Brown & Sharpe surface grinders caused sound levels in the mid-70-dBA range in an 8-m by 8-m office area located about 7 m away. Grinding sounds reach the offices over the 4-m gap above the 2-m-high office partitioning. The grinder sounds were severe enough to interfere with the typical activities - telephone conversations, business meetings, etc. - that took place in the office.

Problem Analysis

The grinders were clearly the source of the noise problem, since the sound level dropped to between 63 dBA to 66 dBA when the grinders were shut down. Management considered the following remedial treatments:

- Extend the existing drywall to the true ceiling
- Extend the existing wall to the true ceiling by adding a lead-impregnated vinyl curtain
- Immediately move the office to a quieter location.

In this case, partly because management knew the office would eventually be moved to a new location, the second alternative was implemented. The curtain material was also selected to minimize problems of construction, where the treatment had to be routed through a support truss.

Results

Sound levels in the office areas were reduced 11 dB, to a maximum of 63 dBA. Office workers commented that the environment was much improved.

Comments

Even though the curtain material is relatively easy to handle, lead sheeting - an even more easily handled product - had to be employed at the truss area.

CASE HISTORY 21: PRINTER
(Worker Annoyance Problem)

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Problem Description

A small catalog and brochure mail-order company operated with a printing press, cutter, collator, envelope stuffer, and mail-room operation in a building basement. The eight employees were subjected to high levels of noise from the printing operation, particularly the cutter, on the order of 80 to 85 dBA for up to 90% of the time on each 8-hr shift. These workers complained about this noise exposure to the company owner. In addition, the printing machine operator was exposed to a daily noise dose of 92 dBA/8-hr equivalent, in excess of the limits allowed by Section 1910.95 of the Occupational Safety and Health Administration Regulations and Standards.

Problem Analysis

Bolt Beranek and Newman Inc. was asked to study the problem and make recommendations for alleviating the complaints. Observation indicated that the printing machine and cutter were the general sources of the noise problem. By a series of close-in measurements, the cutter, various gear trains, and the paper "snap" were noted as specific sources of noise. The distributed nature of the sources of the machine, arranged along one wall of the basement, made reduction of the noise at the source difficult. This approach was also clearly beyond the capabilities and resources of the staff of this small operation. No retrofit parts were available for the commercially produced printer and cutter.

Control Description

The first part of the proposed solution was to isolate the printer and cutter machinery from all workers in the basement, other than the direct operator, by construction of a floor-to-ceiling barrier. The barrier was open at the ends to allow access for paper rolls at the input and the product conveyor at the output. Acoustic curtains were suggested for the openings to provide the maximum relief of the workers away from the printer.

The inside of the acoustically solid barrier was to be lined with acoustic absorbent material, as was the far wall beyond the barrier, to reduce the reverberant build-up of sound within the newly constructed printer "corridor." An acoustical-absorbent-lined open-fronted booth, opposite the quietest part of the printer and cutter machinery, was proposed as a refuge for the printer operator, where he was encouraged to spend as much time as necessary monitoring the operation. A desk-shelf for conducting paperwork was proposed to encourage the use of this booth.

Results

The barrier was built of sheetrock on 2- x 4-in. stud, sealed to the floor and ceiling, and 4-in.-thick glass fiber batts were used as acoustic absorbent material. The noise outside the barrier was reduced to sound levels that allowed easy conversation among all workers, which led to a more relaxed and acceptable work situation. The noise exposure of the printer operator remained just in excess of the OSHA limits, since the owner chose not to build the booth immediately.

CASE HISTORY 22: METAL CUT-OFF SAW*
(OSHA Noise Problem)

Problem Description

A common problem in industry is that of protecting workers from noise produced by machines that the worker must guide or manipulate directly. An example is a cut-off saw used on metal shapes. Noise comes from two main vibrating sources: the saw blade itself and the workpiece. The saw itself is actuated downward and into the work by a lever attached to the hinged and counter-balanced (or spring-loaded) saw and motor.

The worker must visually monitor the cutting operation. In addition, the vibration and opposing force transmitted to him through the lever arm furnish useful cues on the progress of the cutting operation. The problem is to reduce the noise he receives, without undue interference with work flow, with visibility, and with the use of the lever arm.

Control Description

The solution was an enclosure covering the whole saw. Workpieces pass transversely through slots in the enclosure. Flaps of lead-loaded vinyl close off the opening and reduce to a small amount the unavoidable leakage area when a workpiece is present. The front, above saw bed height, is closed by two doors whose surface is mostly 1/4-in. clear plastic (polymethylmethacrylate). This plastic provides very good vision. The doors close with a gap the width of the control lever. Each door has a flap of lead-loaded vinyl about 3 in. wide to close the gap. The lever pushes aside the flaps only where it protrudes. Thus, the leakage toward the worker is greatly reduced.

Results

Figure 6.22.1 shows the sound pressure levels at the worker position before and after the enclosure was installed. The decrease in sound level is 13 dB. The standard panels used in the enclosure are very much better than indicated by the reduction measure, illustrating again the importance of leaks in determining the performance of enclosures.

Comments

Several features of the design could be improved. The ears of the workers are very close to the leak at the door flaps. It should

*Handley, J.M. 1973. Noise - the third pollution. IAC Bulletin 6.0011.0.

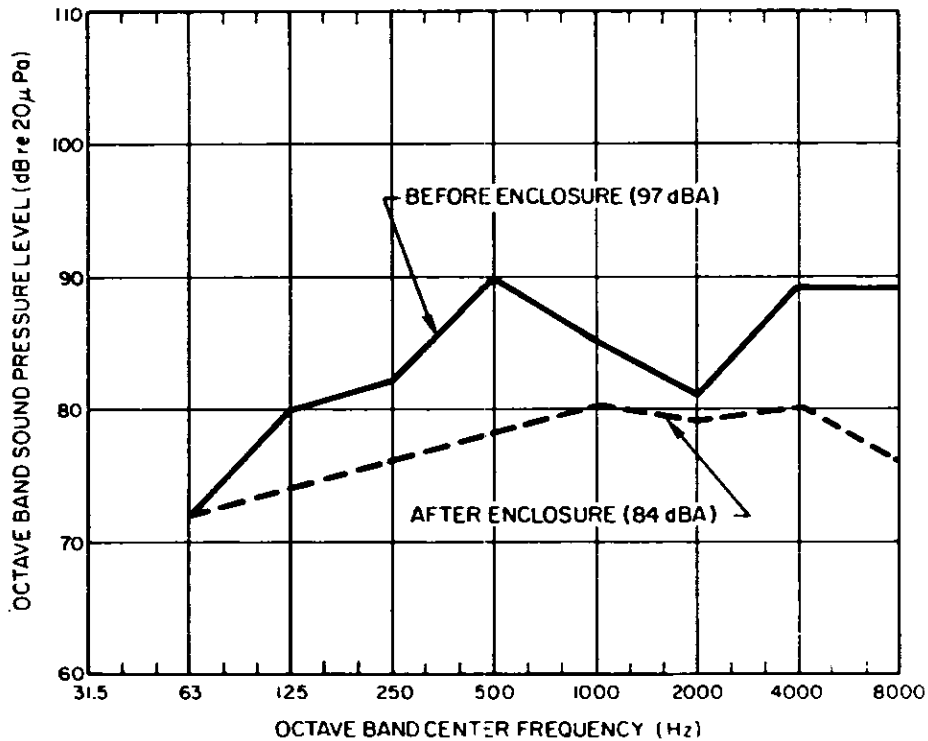


Figure 6.22.1. Metal cut-off saw: operator position sound pressure levels before and after enclosure of saw.

be relatively simple to offset the saw feed lever to the right (for the right-handed worker). This change has several advantages: (1) it places his right hand in a more comfortable position, (2) with the door gap and flaps moved to the right, his vision is greatly improved, and (3) the noise leak is moved farther from his ears. A nonacoustical improvement would be to have the doors slide open, rather than open out, which can be a safety hazard.

CASE HISTORY 23: WOOD-PLANER*
(OSHA Noise Problem)

Problem Description

Wood planers in the forest products industry produce sound levels of 102 to 108 dBA at the operator (feeder) work stations. Sound levels are 103 dBA at the grading station and trimmer and 95 dBA elsewhere in the planing mill.

Control Description

In the area cited in the article, enclosures were installed on 30 large planers. Out of the general program, the following specific guidelines for viable enclosures were developed by experience:

(1) Walls and roof should be from 8 to 10 ft high, using staggered studs, thus keeping the inside wall independent from the outside wall with separate sills and headers. Wall structure should be isolated from floor with felt or mastic. Space between walls should be filled with rock groove or equivalent plywood. Additional acoustical board was used on upper two-thirds of walls and ceilings for noise absorption. Removable wall or roof sections should be installed as needed for major machine repairs.

(2) Floors are usually adequate as constructed for a normal planer installation, but if the planer is elevated on piers, the enclosure walls should be extended to the main floor or acoustical floor similar to the walls constructed between piers.

(3) Doors should be refrigeration-type, with beveled or stepped edges. They should open out, so that suction from blowers keeps them closed. Doors or jambs should be sealed with weatherstripping. Heavy duty hinges should be used. Alternatively, standard acoustical doors may be purchased.

(4) Windows should be as small as practical, using double-glazed shatterproof or screened glass with an air space between.

(5) Infeed and outfeed openings should be as small as possible. A tunnel-type opening provides room for vertical multiple layers of old conveyor belt or lead-filled vinyl to block the noise path. Belt should be slit at intervals to accommodate various board widths, keeping the unused portion of the tunnel width blocked. The outfeed tunnel should be at least as long as the longest boards fed through the planer, so that noise caused

*From Pease, D.A. March 1972. Forest Industries.

by the vibrating board is confined inside. Funnel-shaped metal facing should be installed inside to guide the stock into the tunnel opening.

(6) Opening for ducts and pipes should be just enough overside to permit packing the annular space with insulation.

(7) Make-up air openings, to compensate for air exhausted by the blower system of the planer, must be constructed as a silencer to control noise leakage. The chimney should be several feet high, with baffles arranged inside so that incoming air must follow a zigzag path; baffles should be lined with acoustic material. Another method is a smooth-wall chimney with a "weather cap" baffle lined with acoustic material at the top.

Results

The article states that sound levels were reduced to less than 90 dBA, to comply with OSHA regulations.

Comments

When large amounts of noise reduction are needed, acoustical leaks can be critical; openings or enclosures should be kept to the minimum.

The absorbent used should be covered by a plastic film to avoid fouling by the dust. In addition, because lumber is not always fed in straight, the absorbent should be protected by a heavy, galvanized, open-mesh screen.

The feed tunnels should be long enough to hold the whole board, or else there should be positive hold-down to prevent board vibration.

CASE HISTORY 24: PUNCH PRESS
(OSHA Noise Problem)

Problem Description

Two Minster model P2-2000, 200-ton straightside presses were running over 250 strokes/min when stamping out laminations for a particular motor model. The press is located in a metal-construction building. Dies are changed often.

Sound level at the operator station was 104 dBA, and the general plant sound level was 92 dBA.

Control Description

Panels forming a total enclosure were constructed with:

- 1 layer absorbent polyurethane acoustical foam
- 1 layer 1/64-in. sheet lead
- 1 layer 3-in. fiberglass TIW blanket
- 1 layer fiberglass cloth to withstand industrial solvents.

The enclosure used was circular, 176 in. in diameter, 16 ft high, with top of domed construction. Access doors allow for maintenance, and there is a stock feed opening. Finished parts leave the enclosure by means of two under-floor part guides. Supply lines were rerouted under floor, using flexible conduits. A 3500-cfm heat exhaust system with a silencer was added to each dome.

The operator is outside the enclosure except to change dies, change feed reels, or make adjustments.

Results

Total enclosures reduced sound level for operator to 83 dBA and general plant sound level (with other equipment) to 87 dBA.