those responsible for plant design, plant equipment, and plant maintenance. Inadequate knowledge of these principles may lead to misguided attempts at noise control and, consequently, a lack of enthusiasm for further efforts. On the education and a general diffusion of knowledge of noise control will remove the difficulty. The first step in this educational process is probably an appreciation of the complexity of the subject. It cannot be mastered by learning a few simple rules. One must familiarize himself with new units, new materials, and new concepts.

The difficulties raised by any lack of understanding of the principles of noise control are rather insignificant compared to those raised by the simple question "Does noise control pay?" Noise control seems to have more sources of expense than income. Acoustical materials are rarely inexpensive, and there may be hidden expenses caused by a slowdown or interruption of production. The income from noise control is almost always an intangible, and conservation of the hearing of employees must be viewed as a long-term investment that will pay excellent interest in future years. Management must face these facts squarely before launching a program for the conservation of hearing. Otherwise the program has little chance of success.

The first step in such a program is an evaluation of the noise exposure. Methods for making the measurements involved are discussed in Volume III. The engineering criteria set forth in Section III.T of this chapter allow a classification of certain kinds of noise exposures and provide a goal for noise control.

Classification of noise exposures according to their severity makes it possible to assign priority to the most serious problems and defer those that are of minor importance. The goal for noise control provided by one of the engineering criteria makes it possible to avoid costly, unnecessary quieting. In addition the amount of noise reduction required to meet the criterion will influence the choice of the approach to the problem. For example, if only 5 db of noise reduction is necessary, sufficient quieting will probably be achieved after a few minor changes. However, if a reduction of 25 db is desired, a rather complete revision of the entire operation may be necessary.

If the complete solution of one of the more difficult noise problems is presently impractical, the engineering criteria can be used to evaluate the probable effect of smaller noise reductions. Any significant reduction in the noise exposure is, of course, worth while since it decreases the number of people who may suffer hearing impairment.

A. CONTROL OF NOISE AT THE SOURCE

1. Desirability

Compared to control of noise at its source, control along the transmission path or at the man is relatively simple to plan, but often difficult to carry out in practice. On the other hand, control at the source yields highly satisfactory results if it is well planned. The approach to the problem of noise control at the source should be made in a determined manner. Two important prerequisites are a strong will to do the job and an open mind.[23]

2. Is There a Quieter Way to Do the Job?

Control at the source may sometimes be accomplished by substitution of a quieter method of doing the job. Such substitutions have been listed by two authors,[23,24] and some notable examples follow: (*a*) welding instead of riveting, (*b*) compression riveting instead of pneumatic riveting, (*c*) mechanical forging instead of drop forging, (*d*) grinding instead of chipping, (*e*) electric tools instead of unquieted pneumatic tools, (*f*) conveyors instead of chutes, (*g*) mechanical stripping of work from punch press dies instead of air-blast stripping, (*h*) hot instead of cold working of metal, (*i*) belt drives instead of gears.

Other considerations may outweigh the importance of noise in selecting a tool or a method of doing a job. However, whenever this is not the case, those responsible for plant layout and equipment planning should be alert for quiet alternatives to noisy jobs.

An examination of the quieter methods suggested above discloses two general rules. A substitute method that eliminates the impact of metal on metal or reduces the rapid flow of air will often bring about considerable quieting. These two principles may bring to mind other substitutions that provide the solution to particular noise problems.

3. Examples of the Control of Noise at the Source

The control of noise at the source is usually difficult to plan because of the lack of general rules. For instance, identical machines may require different methods of noise control because of different production problems or different economic considerations. Although it is not possible to present a cookbook of noise control recipes, certain typical case histories can be reported. Those who have similar problems may be able to determine whether similar steps are applicable to their situations.

a. Circular Saws. A circular saw that is noisy during the sawing operation but quiet otherwise is operating as well as can be expected except that some quieting may be achieved occasionally by substitution of another kind of saw. A saw that is noisy whether it is sawing or not often can be quieted. Play in the arbor should be corrected by new bearings. If the saw does not run perfectly true, it may be necessary to remachine the saw collar. A kerf significantly wider than the rim of the saw blade indicates a rim that is vibrating excessively. Stiffening collars may be used in some situations to reduce rim vibration.

[23] C. R. Williams, Noise can be controlled, *Am. Ind. Hyg. Assoc. Quart.*, **15**, 32 (1954).

[24] G. Tyzzer, Reducing industrial noise: general principles, *Am. Ind. Hyg. Assoc. Quart.*, **14**, 264 (1953).