

to determine the permissible limit. These intermittent sounds, which can be measured with a sound level meter, should not be confused with impulse sounds of very short duration resulting from impacts or explosions.

Control Measures

Paragraph (b) of sections 50-204.10 and 1910.95 refer to control measures to be taken:

"(b) When employees are subjected to sound exceeding those listed in the Table of Permissible Noise Exposures, feasible administrative or engineering controls shall be utilized . .
."

The Department of Labor considers "feasible" to mean the following, as stated in the Oxford English and Merriam-Webster Dictionaries: "Capable of being done, accomplished or carried out; capable of being dealt with successfully."

Engineering Noise Control Measures

Engineering controls are those which reduce the sound intensity either at the source of the noise or in the hearing zone of the workers.

The following are examples:

A. Maintenance

1. Replacement or adjustment of worn and loose or unbalanced parts of machines.
2. Lubrication of machine parts and use of cutting oils.
3. Properly shaped and sharpened cutting tools.

B. Substitution of Machines

1. Larger, slower machines for smaller, faster ones.
2. Step dies for single operation dies.
3. Presses for hammers.
4. Rotating shears for square shears.
5. Hydraulic for mechanical presses.
6. Belt drives for gears.

C. Substitution of Processes

1. Compression for impact riveting.
2. Welding for riveting.
3. Hot for cold working.
4. Pressing for rolling or forging.

D. Vibration Dampening

1. Increase mass.
2. Increase stiffness.
3. Use rubber or plastic bumpers or cushions.
4. Change size to change resonance frequency.

E. Reducing Sound Transmission Through Solids

1. Flexible mountings.
2. Flexible sections in pipe runs.
3. Flexible shaft couplings.
4. Fabric sections in ducts.
5. Resilient flooring.

F. Reducing Sound Produced by Fluid Flow

1. Intake and exhaust mufflers.
2. Fan blades designed to reduce turbulence.
3. Large, low speed fans for smaller, high speed fans.

G. Include Noise Level Specifications When Ordering New Equipment**H. Isolating Noise Sources**

1. Completely enclose individual machines.
2. Use baffles.
3. Confine high noise machines to insulated room.

I. Isolating Operator

Provide a relatively sound-proof booth for the operator or attendant of one or more machines.

Controlling noise at the source, as illustrated by A through H1, is the ideal means of preventing noise induced hearing loss. The results are relatively long lasting; the operator of the individual machine is protected, as well as those employees at a distance from it, and there is no need for wearing protective equipment or following prescribed schedules of exposure. The measures listed under H2, H3, and I will, if effective, limit the number of persons exposed to high noise levels, but are unlikely to protect operators and those close to the noise sources.

A number of the listed controls can be accomplished quite inexpensively by plant personnel. Others require considerable expense and highly specialized technical knowledge to ensure the expected results. It is therefore strongly recommended that plants avail themselves of the services of competent acoustical engineers in planning and carrying out their noise control programs.

The Department of Labor expects employers to explore the possibility and practicability of controlling noise by engineering and to take all feasible measures before resorting to use of administrative controls or of personal protective equipment.

Administrative Controls

If noise cannot be reduced to permissible intensities through engineering controls, administrative controls should be developed in order to limit duration of workers' exposure to noise levels above 90 dBA to the times shown in the Table of Permissible Noise Exposures.

The following are examples:

1. Arrange work schedules so that employees working the major portion of a day at or very close to the 90 dBA limit are not exposed to higher noise levels.
2. Ensure that employees who have reached the upper limit of duration for a high noise level, in accordance with Table I, work the remainder of the day in an environment with a noise level well below 90 dBA.
3. Where the man-hours required for a job exceed the permissible time for one man in one day for the existing sound level, divide the work among two, three, or as many men as are needed, either successively or together, to keep individual noise exposure within permissible time limits.
4. If less than full-time production of a noisy machine is needed, arrange to run it a portion of each day, rather than all day for part of the week.
5. Perform occasional high level noise producing operations at night or at other times when a minimum number of employees will be exposed.

Measures such as these can often be instituted at little cost or effort, simply by introducing noise exposure as a factor in production planning. While not as satisfactory as controlling noise at its sources, administrative control measures are more easily enforced, than is the requirement to wear personal protective equipment. For this reason it is preferred.

Personal Protective Equipment

When engineering and administrative controls fail to bring noise levels or duration of exposure to them below permissible levels, the use of personal protective equipment is required, as stated in the second sentence of paragraph (b), sections 50-204.10 and 1910.95:

"If such controls fail to reduce sound levels within the levels of the table, personal protective equipment shall be provided and used to reduce sound levels within the levels of the table."

The use of personal protective equipment is considered by the Department to be an interim measure while engineering and administrative controls are being perfected. There will be very few cases in which the use of this equipment will be acceptable as a permanent solution to noise problems.

Some methods of control, such as providing an isolation booth for operators, or conducting noisy operations when few employees are in the plant, may require use of personal protective equipment by the operator when he must emerge from his booth to make adjustments, or by those few employees who carry on the noisy operation.

In addition, the regulations require both provision and use of personal protective equipment. How the latter is accomplished is up to the employer. The Department recommends, however, that an educational and promotional program precede initiation of required use of such equipment, and continue as long as necessary to achieve 100-percent acceptance by employees. In the absence of an observable high proportion of use, the Department would consider the lack of a training and promotional program as constituting a violation of the regulation.

Selection of Personal Protective Equipment

Cotton stuffed in the ears has little value and will not be accepted by the Department, because of the relatively small attenuation (reduction of noise level) and the care which must be taken in using it.

Fine glass wool can be used instead of cotton, because the attenuation which can be achieved is very good. It is an acceptable protective device.

Wax impregnated cotton, when properly inserted in the ear, provides protection equivalent to that provided by plugs or muffs. If supervisors can assure that this material is properly used and fresh material is provided daily, then this type of ear protection would be acceptable.

Properly fitted earplugs are essentially equal in attenuating ability to ear muffs; either is acceptable to the Department. Plugs are inexpensive but must be fitted to the individual. In addition, plugs, and any other type of protector inserted into the ear, must be issued by a trained person under the direction of a physician or by the physician himself. Frequent checks must be made to see that the plugs are being properly inserted.

Ear muffs, though relatively expensive, may be issued by any designated person in the plant, as the only fitting required is adjustment of the head band. This makes it very easy for the supervisor to check on proper use of the muffs. Long hair and spectacle or goggle temples will interfere with the seal made by the cushioned edges of the muffs and will correspondingly reduce the actual attenuation, as stated by the manufacturer.

Regardless of the type of ear protector decided upon, its attenuation, as stated by the manufacturer, must be sufficient to reduce the noise level in the worker's ear to the level and for the duration prescribed in Table I. The manufacturer's stated values are determined under ideal conditions, and, therefore, as a precaution, it is wise to assume that the attenuation actually attained in use in the shop will be at least 5 dB less than the stated value. Only those ear protectors which have been tested in accordance with ANSI standard Z24.22-1957, "Method for Measurement of the Real-Ear Attenuation of Ear Protectors at Threshold," are acceptable to the Department.

The Department strongly recommends that any employee who is exposed to high sound levels and requests ear protection be provided with it, even if the duration of exposure is within the limits prescribed by Table I.

Hearing Conservation Program

Sections 50-204.10 and 1910.95 conclude:

"In all cases where the sound levels exceed the values shown herein, a continuing, effective hearing conservation program shall be administered."

Therefore, where the sound level in a working area has not been reduced to 90 dBA or below by engineering means, and reliance must be placed on administrative controls to limit duration of exposure, or on ear protection to reduce the sound level actually reaching the ear, a hearing conservation program is required. The program will be applied to all those employees whose work brings them either steadily or infrequently into areas in which sound levels exceed 90 dBA.

Definitions

"Continuing" means that the program will be in effect and in use as long as noise levels above 90 dBA occur in the plant.

"Effective" means that exposed employees will not suffer continuing deterioration of hearing acuity because of their exposure, but that incipient loss of hearing will be detected and necessary steps taken to prevent further deterioration before serious hearing loss has occurred.

In a broad sense, "hearing conservation" covers the entire range of actions required by sections 50-204.10 and 1910.95. As used here, however, it refers to audiometry--periodic checks on the hearing ability of individual employees; and noise surveys--periodic checks of the noise level in the areas in which employees are working.

Audiometry

Audiometric tests will be made of all individuals working regularly or infrequently in areas in which the noise level is above 90 dBA. The purpose of these tests is to assure that administrative controls in use or ear protection devices provided are being adhered to or properly used and are effective in preventing loss of hearing from the noise levels encountered.

Audiometric tests may be made as frequently as specified by the plant's regular or consulting physician, but only under very special conditions shall they be made less than once a year.

The tests may be made in a doctor's office or elsewhere outside the plant, providing the test facilities, techniques, and records are equal to or exceed the minimum requirements described below.

1. Test Facilities and Procedures

The test booth or room shall meet criteria of ANSI standard S3.1-1960 (or latest), "Standard for Background Noise in Audiometric Rooms" for testing to a minimum level of 10 dB on the ISO 1964 audiometric scale.

The booth or room may be either prefabricated or locally built. Doors, gaskets, and other parts of the room or booth which may deteriorate, warp, or crack shall be carefully inspected periodically and necessary repairs or replacements made at once to ensure that successive audiometric tests of each individual are directly comparable and will give a true evaluation of the individual's hearing ability.

The operator of the audiometer should be positioned outside the room or booth but able to see the interior through a window. The person being tested must face away from the operator and the audiometer to ensure that all his responses are based on sound signals alone.

The test shall consist of an air conduction octave band analysis, as described in ANSI standard S3.1, and shall include, at least, 500, 1,000, 2,000, and 4,000 Hz.

The audiometric tests shall be made by a person trained and skilled in audiometric testing.

2. Audiometers

The audiometer used to make these tests shall meet the specifications for limited range, pure tone audiometers in ANSI standard S3.6-1969, "Specifications for Audiometers."

The audiometer shall have a certificate of calibration before it is placed in use, and shall be recalibrated each year thereafter. This calibration shall check both frequency and intensity at each setting, rise time and overshoot, and electrical and mechanical integrity. A current certificate attesting to such calibration shall be readily available for inspection by the Department of Labor.

On the audiometer shall be a statement indicating whether it is calibrated to ASA 1951 values or to the current American National Standard, which is identical to the ISO 1964 standard.

The audiometer shall be subjected to a biological check, preferably once a week but at least once a month, or before each use of the instrument if it is used less than once a month. The check shall be made by testing a person with a known and stable audiometric curve. The monthly check should include movement and bending of cord, wire, and lead, knob turning, switch actuating, and button pushing to ensure that there are no sounds other than the test tones. A log of these checks shall be maintained and be available for inspection.

3. Records

In addition to the certificates and logs referred to in 2 above, a record of each audiogram made on each individual tested shall be available for inspection. Records of audiometric tests shall indicate whether readings are based on ASA 1951 or on American National Standard (ISO 1964). The complete records on each employee required to be tested shall be retained for 1 year following termination of employment or transfer to an area in which noise levels above 90 dBA do not exist.

The records will be examined for evidence of any deterioration of hearing acuity and of action taken to prevent further deterioration in those employees found to suffer some loss of acuity. Conclusions as to effectiveness of control measures taken will be based on examination of a significant number of audiograms and not upon the basis of one or two cases.

4. Audiometric Tests Outside of Plant

If audiometric tests are done outside the plant, the Department of Labor representative will also inspect the facilities and test records, as noted above, and the same standards will apply.

Plant management will make arrangements for such inspection with the person conducting the audiometric tests and may accompany the representative in his inspection and review of records.

Noise Surveys

A noise survey of each area in the plant in which sound levels exceed 90 dBA shall be made at least once each year to ensure that sound levels have not increased above those originally existing. The survey may also establish that noise levels in some areas have been reduced to levels below 90 dBA and thereby justify discontinuing application of requirements for administrative controls, ear protection, and audiometric tests of individuals in such areas.

A noise survey of an area is recommended whenever a change is made in either equipment or type of operations so that significant changes in noise level will be acted upon immediately.

Tests of noise levels will be made with a sound level meter on the A-scale, slow response. The use of octave band analyzers or impact meters for control or other purposes shall be in addition to, not in place of, tests made with the sound level meter.

The sound level meter used will be one meeting specifications in ANSI standard S1.4-1961, "General Purpose Sound Level Meters."

Records will be made of such surveys showing: the instrument used; date, time, and location of such tests; machinery or equipment generating the noise; and name of person making the test.

Test records shall be kept readily available for inspection for 1 year or until a subsequent survey is made, if done more frequently.

The noise survey will be made by an insurance carrier, a consultant, a representative of a State health or labor department, or by a qualified individual designated by the company.

Compliance Plan

Whenever a noise survey shows noise levels in excess of those listed in Table I, necessary steps to reduce the noise exposure to or below those levels shall be ascertained and a detailed plan, with completion dates for individual steps, shall be prepared.

Following the original survey which shows existence of overexposures, the steps in a typical compliance plan might include the following, not necessarily in this order and some usually going on simultaneously:

1. A detailed survey of sound levels and sound spectra to determine the sources of excessive sound levels.
2. Initiation of engineering studies to determine methods for reducing sound levels at their sources.
3. Planning and initiation of feasible administrative controls, such as modifying production schedules to divide noisy jobs among enough people to bring each below the permissible limit or spreading part-time noisy operations.
4. Initial audiograms for personnel excessively exposed.
5. Installation of a personal protective equipment program.
6. Followup audiograms at appropriate intervals to assess effectiveness of the personal protective equipment program and administrative controls.
7. Installation of engineering controls, or process changes to reduce noises at their source.
8. Repeated noise surveys to measure effectiveness of the engineering changes.

When the compliance plan involves long term engineering projects (for example, 1 or 2 years) it may be revised from time to time as conditions change. The orderly completion, on schedule, of the various phases of the compliance plan, together with other components of the hearing conservation program, will be considered compliance with the regulation.

Applicable ANSI standards are available from the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018

- S1.4-1961 -- Specification for General Purpose Sound Level Meters--\$2.75
- S1.6-1967 -- Preferred Frequencies and Band Numbers for Acoustical Measurements--\$2.75
- S3.1-1960 -- Criteria for Background Noise in Audiometer Rooms--\$2.75
- S3.6-1969 -- Specification for Audiometers--\$4.50

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