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# INDUSTRIAL MACHINERY NOISE IMPACT MODELING - VOL. I

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## EXECUTIVE SUMMARY

This study describes the development of a machinery noise computer model which may be used to assess the effect of occupational noise on the health and welfare of industrial workers. The purpose of the model is to provide EPA with the methodology to evaluate the personnel noise problem, to identify the equipment types responsible for the exposure and to assess the potential benefits of a given noise control action. Due to its flexibility in design and application, the model and supportive computer program can be used by other federal agencies, state governments, labor and industry as an aid in the development of noise abatement programs.

The model is developed based on the Level Weighted Population (LWP), and the fractional impact method used by EPA to assess occupational and environmental noise situations. To provide a comparison with the EPA evaluation, a parallel model based on the Occupational Safety and Health Act (OSHA) noise regulation administrated by DOL has also been developed.

The parametric design of the computer model allows the user to assess the noise exposure problem in several plants, an industry or a group of industries. Industry data are organized by Standard Industrial Codes (SIC) and the analysis can be performed by simply identifying a two-, three- or four-digit code depending on the detail required. Specific procedures for field data acquisition are provided. Additional data can be added to the existing data bank as it becomes available.

The end result of the evaluation is a rankordering of the machinery items which most contribute to the noise exposure problem in each industry. Furthermore, the effect of any noise control action on a specific equipment item can be quickly evaluated.

The accuracy of the results improves as the number of plants in the sample is increased. As an example of the use of the model two industries were surveyed; the Sawmill Industry and the Iron & Steel Foundry Industry. The sample size was nine plants for the sawmill industry and seven plants for the foundry industry. The accuracy of the results obtained using these limited sample sizes is discussed in the text.

Recommendations for the inclusion of an iteration procedure for the determination of minimum noise reduction requirements and the corresponding probable costs are also presented.

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# Section 1
# INTRODUCTION

## 1.1 Background

The effects of occupational noise on the health and welfare of industrial workers has been the subject of much debate in the past few years. Many industrial nations have recognized noise as one of the most serious and widespread health hazards in the workplace. Certainly, the most significant impact caused by long term exposure to high noise levels is the potential for hearing loss. It is estimated that 2.9 million workers in the U.S. today [1]* are exposed to a time weighted average sound level in excess of 90 dB and an additional 2.3 million are exposed to levels in excess of 85 dB.

However, the effects of industrial generated noise are not limited to hearing loss only. To the worker this hazard also means interference with speech communication (and thus possibly with job safety) and may be responsible for some physiological and work performance effects currently under study.

In response to this hazard, the Occupational Safety and Health Act of 1970, which is administered by the Department of Labor's Occupational Safety and Health Administration (OSHA), has imposed strict limits as to the maximum allowable noise exposure for employees. The OSHA noise standard is currently undergoing a review process that may result in still stricter limits.

In exercising its authority, the OSHA noise standard limits the total noise exposure of personnel during the workday (rather than any machine noise emission level) by the use of administrative or engineering methods or by personnel hearing protective

* Numbers in [ ] indicate references.

devices when the preceding two are found not feasible (see Chapter 2). Compliance is tested at the individual plant level with the plant owner being responsible for remedial action.

A second Act promulgated by Congress is the Noise Control Act of 1972 as amended by the Quiet Community Act of 1978. This Act gives the Environmental Protection Agency (EPA) the authority to promulgate regulations applicable to the manufacture of noisy products. Here the occupational noise problem is addressed through the reduction of equipment noise emissions by the equipment manufacturer rather than the equipment user. Though their approaches differ, the objectives of both OSHA and EPA noise legislation are similar: to reduce the hazard of noise to people.

To date, the thrust of the EPA noise regulations has been directed towards protecting the health and welfare of the general public from environmental noise sources. Major areas of interest have been transportation and construction machinery sources. Additionally, the EPA has developed the basis for voluntary noise emissions labeling programs and a mandatory labeling program for hearing protectors.

With respect to noise generated hearing loss, EPA has developed criteria relating hearing loss to noise exposure [2,3,4], identified levels requisite to protect health and welfare [5], and sponsored research on noise-induced hearing loss [6,7]. EPA has also studied national patterns in compensation for hearing loss [8], assessed the state of research and research needs for noise control of industrial machinery [9,10] and participated in the process of developing federal policies and revisions in the current OSHA regulation.

## 1.2 Objective

The objective of this program is to develop an industrial impact model that may be used by EPA to evaluate industrial noise exposure problems, to identify the equipment types responsible for the exposure and to assess the potential benefits of various noise control actions. To accomplish this, models using the EPA occupational noise criterion have been developed. A parallel model using the OSHA noise regulation was also formulated to allow for comparisons between the two agencies. Due to its flexibility in design and application the model and supportive computer program can be used by other federal agencies, state governments, labor and industry as an aid in occupational noise evaluations and development of noise abatement programs.

## 1.3 Organization

This report is organized as follows: Section 2 discusses the criteria used, both EPA and OSHA, and their basic differences. Section 3 presents an overview of the mathematical models used to calculate personnel noise exposure and to assess the machinery noise problem. Section 4 discusses the data acquisition procedures necessary to collect the input information used in the models.

Section 5 contains the results of the analysis conducted for the two industries surveyed under this program; the Sawmill and Planer Mill Industry and the Foundry Industry. Section 6 is an assessment of the errors inherent in the size of the data samples acquired. Section 7 contains recommendations for future research. Finally, a number of Appendices are included to support the results and conclusions presented in the report.

# Section 2
# CRITERIA

The identification of machinery responsible for hearing loss and the assessment of the degree it contributes to the noise exposure problem cannot be made without a proper set of criteria as a basis of evaluation. The original intent of this program was to use the EPA-established method through the calculation of the fractional impact. It was later decided that a comparison between the EPA method and the existing/proposed OSHA noise standard would also be desirable. Therefore, both the EPA and OSHA criteria methods are discussed here. A comparison between the two methods is also provided.

## 2.1 EPA Noise Impact Assessment

The impact of a noise environment on people regularly experiencing that environment is the degree to which the noise interferes with various activities such as speech, sleep, etc. - and the degree to which it may impair health, for example, through the inducement of hearing loss. The impact of a particular noise environment is a function of both sound level and the size of the population experiencing a particular value of sound level. EPA has established a method that can be used to assess a particular noise exposure through the calculation of the fractional impact. In terms of hearing loss considerations (occupational noise exposure), EPA has adopted the 8-hour equivalent sound level, $L_{eq}(8)$ to describe the physical phenomena.

In the "Levels Document" [2], EPA identifies an $L_{eq}(8)$ of 75 dBA as the criterion to protect against hearing loss. Various graduations of impact are then defined for levels exceeding these limits.

It is desirable to derive a single number that represents quantitatively the integrated effect of "impact" of the noise on the total population experiencing different sound levels. This single number quantification is the Level-Weighted Population, (LWP).

Level-Weighted Population is a single-number representation of the significance of a noise environment to the exposed population. Several assumptions are made in this method of analysis:

1. Intensity of human response to an average sound level can be characterized by several functions; the appropriate function being dependent upon the response mode of interest (annoyance, speech interference, hearing loss).

2. The impact of high noise levels on a small number of people is equivalent to the impact of lower noise levels on a larger number of people in an overall evaluation. Thus the properties of intensity (level of sound) and extensity (number of people affected by the sound) can be combined mathematically.

3. On the basis of these two assumptions one can assign differing numerical degrees of impact to different segments of the population of concern, depending on average sound level.

The preceding concepts have been embodied into a descriptive term called the fractional impact method. In this method, the fractional impact is the product of a sound level weighting value and the number of people exposed to a specified sound level. Summing the fractional impacts over an entire population provides the Level-Weighted Population.

That is, LWP is defined as:

$$LWP = \int P(L_x).W(L_x).d(L_x)$$

where $P(L_x)$ is the population distribution function, $W(L_x)$ is the sound level weighting function characterizing the severity of the impact as a function of sound level described below, and $d(L_x)$ is the differential change in sound level. $L_x$ represents $L_{eq}(8)$ for hearing loss effects.

It is usually not necessary to use the integral form to compute LWP. Sufficient accuracy is usually obtained by taking average values of the weighting function between equal decibel increments, from 1 to 5 decibels in size, and replacing the integrals by summations of successive increments in average sound level.

Different weighting functions are provided for use in the analysis of environmental noise impact for hearing damage. In those specialized environments where people are directly exposed on a regular, continuing, long-term basis to 8-hour average sound levels [$L_{eq}(8)$] above 75 decibels, there is a potential for producing noise-induced loss of hearing and other severe health effects. The weighting function for loss of hearing/severe health effects, is expressed as:

$$W(L_{eq}(8))_h = 0.025\ (L_{eq}(8) - 75)^2.$$

The above method of evaluating impact was adapted to the problem of equipment noise and its effect on the working population, and is described more fully in Section 3.

## 2.2 OSHA Noise Regulation

Early Federal legislation on occupational noise standards was contained in the Walsh Healey Public Contracts Act under Section

50-204.10. The recent Occupational Safety and Health Standards contained under Section 1910.95 of the Williams-Steiger Occupational Safety and Health Act of 1970 (OSHA) sets essentially the same noise exposure limits proposed by the Walsh Healey regulations, however, their applicability extends to all businesses.

In the next few pages, the occupational noise exposure regulations under Section 1910.95 of the 1970 OSHA are presented. It should be noted that at this time, a revised occupational noise exposure regulation has been proposed by DOL. The proposed modifications were published by OSHA in the Federal Register (37773) on October 24, 1974. The hearing conservation portion of the revised regulation was published in the Federal Register on 16 January, 1981, to be effective on 15 April, 1981. However, further DOL review has postponed the implementation date.

The occupational noise exposure regulations, essentially as they appear in Section 1910.95 of the Williams-Steiger Occupational Safety and Health Act of 1970, specify that protection against the effects of noise exposure shall be provided when the sound levels exceed those shown in Table 2-1 when measured on the "A-scale" of a standard sound level meter at slow response.

The relationship between sound level and time shown in Table 2-1 can be expressed in equation forms as:

$$T_j = 8/2^{(L_j-90)/5} \qquad (2\text{-}1)$$

where $L_j$ is the sound pressure level measured at the operator position $j$ and $T_j$ indicates the total time of exposure permitted at the level $L_j$. For the case when the Daily Noise Dose (DND) is composed of two or more periods of noise exposure to different levels, their combined effect should be considered as follows:

$$\text{Daily Noise Dose (DND)} = \frac{C_1}{T_1} + \frac{C_2}{T_2} + \cdots + \frac{C_N}{T_N} \qquad (2\text{-}2)$$

where $C_j$ indicates the actual time of exposure at level $L_j$.

**Table 2-1 Permissible Noise Exposure**

| Duration per day, hour | Sound Level Slow Response dBA |
|---|---|
| 8 | 90 |
| 6 | 92 |
| 4 | 95 |
| 3 | 97 |
| 2 | 100 |
| 1-1/2 | 102 |
| 1 | 105 |
| 1/2 | 110 |
| 1/4 or less | 115 |

When the addition of the fractional noise exposures, $\left(\frac{C_j}{T_j}\right)$, or the Daily Noise Dose exceeds unity, the personnel noise exposure is above the permissible level.

Essentially the above computation methods identify the following important factors:

1. Noise levels above 90 dBA are potential hearing hazards. 90 dBA is the maximum allowable exposure for the 8-hour work day and also represents the threshold of noise. That is, noise levels below 90 dBA are not considered to be contributing to exposure.

2. The exchange rate between level and time of exposure is 5 dBA. That is, for each halving of exposure time, the allowable noise level may be increased by 5 dBA (i.e., 95 dBA for 4 hrs.; 100 dBA for 2 hrs., etc.).

3. When multiple exposures to different noise levels exist during the work day, the Daily Noise Dose is computed by adding fractional exposures.

## 2.3 EPA and OSHA Criterion Comparisons

Unlike the OSHA noise regulation which, based on the personnel noise exposure, establishes strict limits that must not be exceeded, the EPA criterion is based on the calculation of a fractional impact which then is used to compute the LWP. Thus, while the OSHA regulation results in the establishment of a compliance/non-compliance situation on an individual worker basis, the EPA criterion assesses the degree of noise impact associated with a population group.

The differences between the two spawn from the basic principles underlining the development of each criterion. The OSHA noise regulations were established to limit the extent of occupational hearing loss. It is assumed that the 90 dBA-8 hour criterion will protect approximately 80% of the working population from the hearing loss hazard. The EPA noise impact assessment on the other hand was developed to protect the public health and welfare with an adequate margin of safety. The main differences between the two are:

1. OSHA establishes a threshold level of 90 dBA. Noise levels below that value do not contribute to exposure. EPA does not implicitly have a threshold level but instead specifies the $L_{eq}(8) = 75$ dBA as the 8 hrs. exposure level below which no impact exists.

2. The exchange between level and time is different between the two methods; 3 dBA for EPA and 5 dBA for OSHA.

3. Both methods provide for the accumulation of exposure over an 8-hour period.

4. While the OSHA method compares each individual exposure to a specific criterion the EPA noise exposure method ($L_{eq}(8)$) uses that data as a first step in the calculation of the fractional noise impact and subsequently in the computation of the LWP for a population group.

# Section 3
# NOISE EXPOSURE MODELS

This section presents an overview of two general models that will be used to quantify the noise exposure problem in industrial plants and discusses the data base requirements necessary to utilize them. One of the models is developed using EPA criterion and the other is developed using OSHA criterion. Comparison of results derived using each of the two models is left for another part of this report.

The need for a noise exposure model stems from the fact that personnel noise exposure is a complex quantity which requires the understanding of a number of variables, not all of which are associated with noise measurements. For example it is necessary not only to know the noise level of a given item of equipment at the operator position, but also the amount of time each day that a person in a given category spends using it and the relative amount it contributes to the background noise level of nearby personnel. In addition it is necessary to provide some means of allowing variations in noise level output for different items of equipment of the same type and variations in the amount of time personnel in the same category are assigned to particular items of equipment.

The objectives of the noise exposure models described here are as follows:

1. To quantify and rank order the impact of industrial noise environments on various personnel categories in a given industrial plant.

2. To quantify and rank order the importance of various equipment categories to the overexposure problem in a given industrial plant.

3. To include variability in noise levels for machines of the same type and variability in personnel work assignments for the same personnel category in order to deduce a "worst case" situation.

4. To extend the results derived from sampling several plants in a given industry to the entire industry and to establish confidence limits on these results.

5. To identify industries with the largest noise impact and to identify equipment sound sources which most warrant EPA regulatory or labeling actions.

A flow diagram for both the EPA and OSHA models is depicted on Figure 3-1. The data inputs required, components of the model and data outputs are presented in terms of this flow diagram.

## 3.1 Data Base Requirements

The data base requirements for each industrial plant considered are the same for each model and are as follows:

1. Equipment and background noise data.
2. Personnel work assignments[2]

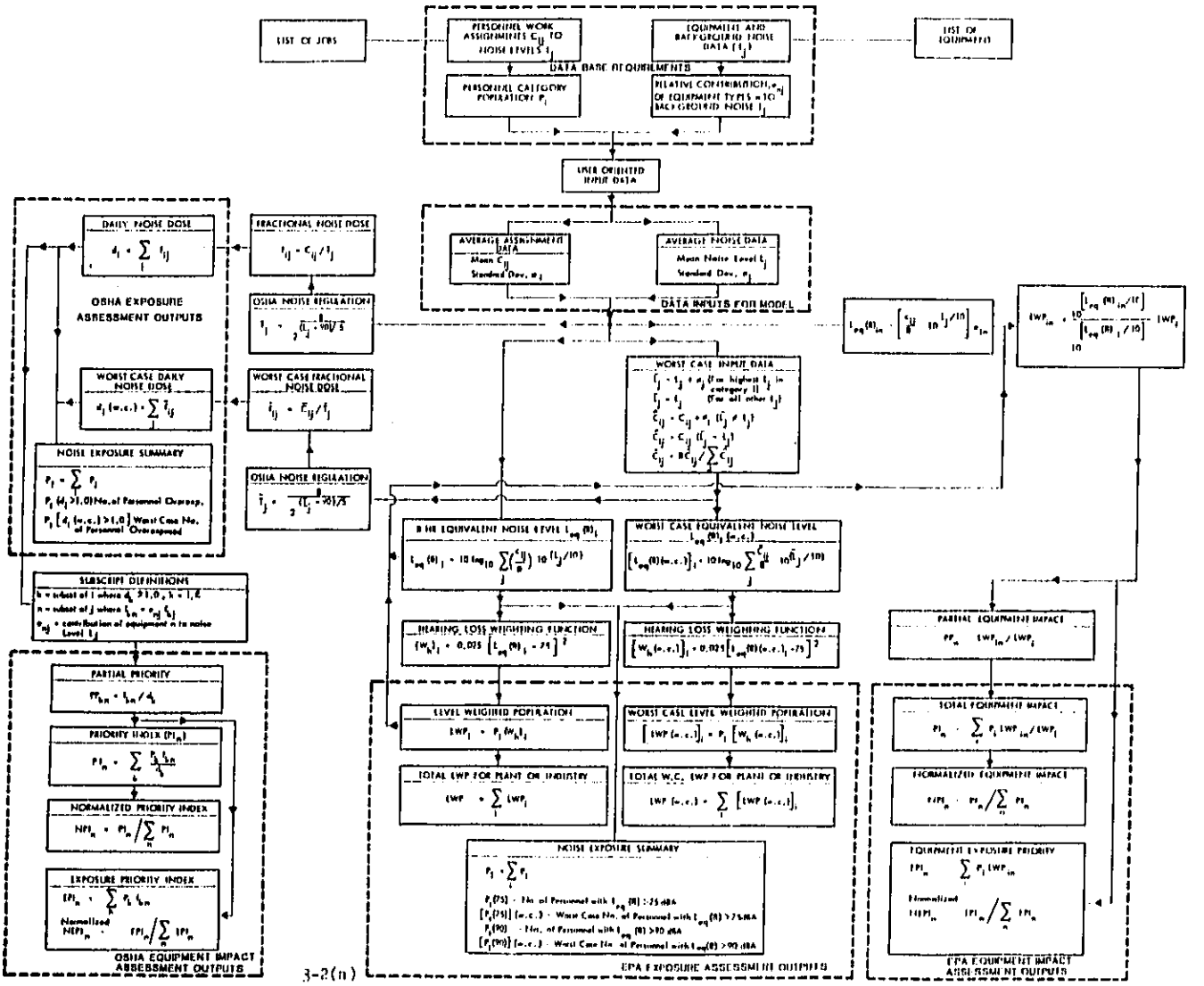
---

[2]There are two supportive requirements designed to more easily identify, measure and organize the basic data base. These are: a) List of Jobs and, b) List of Equipment.

The "list of jobs" is a list containing the job category identification code (2-digit SIC code + 3-digit job code) followed by a general 20 letter description of the job. One line is included for each job category identified.

The "list of equipment" contains a 4-digit equipment code unique to a given equipment type, followed by a description of the equipment and other details such as type, size, age, etc. The detailed requirements for this list and the list of jobs are discussed in Section 4 and in Appendix B of this report and will not be discussed further here.

FIGURE 3-1. FLOW DIAGRAM FO. NOISE EXPOSURE COMPUTER MODEL



The first requirement of the data base is the physical noise data. These data include noise level measurements at operator locations for each equipment item ("equipment noise data") and noise level measurements in selected areas removed from any specific equipment items ("background noise data"). The "background noise data" consist of noise levels which usually represent an area and are made up of contributions from one or more equipment types. The relative contributions of each category of equipment to the background level is assessed on a subjective basis by the person taking the measurements. The total relative contribution from all equipment categories must add up to unity. For example, if the contribution from a particular category of equipment is considered to be 10 dB down from the measured level, a relative contribution of 0.1 is recorded. Similarly, if the contribution of another category of equipment is considered to be 3 dB down from the measured level, then a relative contribution of 0.5 is recorded. Table 3-1 gives a more detailed breakdown.

The relative contribution data allow the background noise data to be used together with the equipment noise data for the assessment of the relative equipment impacts on overall personnel exposure.

In an attempt to keep the data acquisition as simple as possible, the maximum number of equipment types considered for any given location is limited to three. However, data for different locations having the same background I.D. code may include a different set of three equipment types. The total number of different equipment types allowed for any one background code is 20. If more are necessary a different background code should be used. Small errors in the subjective assessment of the relative contributions for each equipment category are acceptable as these data have a second order effect on the overall results.

Table 3-1 Relative Contributions of Equipment Categories to the Overall Noise Level Measured at a Given Location

| Number of dB by which the equipment contribution is considered to be below the measured level at the particular location (Subjective assessment) | Relative Contribution e to overall measured noise level, $L_j$ (Model input data) $e_{jn}$ |
|---|---|
| 10 | 0.1 |
| 9 | 0.1 |
| 8 | 0.2 |
| 7 | 0.2 |
| 6 | 0.2 |
| 5 | 0.3 |
| 4 | 0.4 |
| 3 | 0.5 |
| 2 | 0.6 |
| 1 | 0.8 |
| 0.5 | 0.9 |

Note: The total relative contribution at any one location from all contributing equipment types must add up to unity.

The size of the area associated with each background measurement will depend on the fluctuations of noise level in the area and the accuracy required. Note that if several items of equipment of the same type contribute to the noise level at a particular location, they should be lumped together and only their total relative contribution at that location should be recorded. Each background location is described in the model and identified with the equipment category which contributes most to the measured level. If the background level is 75 dBA or less, equipment contributors need not be identified. A contribution of 1.0 should be assigned to code 1000 which indicates a background less than 75 dBA. When detailed equipment categories are combined into generalized classifications, background levels are excluded unless no other equipment data exist.

The second requirement of the data base is the description and classification of personnel categories and the description of job assignments for each category. For a given category, each assignment corresponds to a particular percentage of the working day in a particular location where the noise levels have been defined, the total assignment to add up to 100%.

Personnel category descriptions consist of names which are in common use in the industry under consideration. Ideally, each category should contain personnel with similar job assignments. In practice this is not always possible due to variability in job assignments on both a personnel and daily basis.

The variability in equipment type or location assignment for personnel in a given category appearing in the input data is taken into account in the computer model by dividing the category into separate subcategories. Within each subcategory a variation between data sets, in the time allocated to each job assignment, is allowed, but a variability in the type of job assignments is not allowed. The input job assignment data should represent an annual average and the accuracy of each set of data will depend on the ability to predict average personnel movements over the plant in the long term. Thus, each input data set contains the category description, a list of job assignments, the corresponding percentage of time allocated to each assignment and the number of people this applies to on an annual basis. There may be several data sets for a given personnel category in any one plant. Each data set may contain differing assignment times and differing assignments types.

In addition to the four types of data mentioned above the computer program requires user oriented input data which determines the type of analysis (OSHA or EPA) to be done and the depth of the analysis (one or several plants or extrapolation to an entire industry). For the extrapolation to the entire

industry data concerning the total population of the industry are required. These user oriented data input requirements are discussed more fully in Appendix B of this report.

## 3.2 Data Inputs for Noise Exposure Models

The selection from the data base of data which are to be used for an analysis is determined by the content of the user oriented data which is discussed in detail in Appendix B. Data may be selected for a given plant or all the above data for an entire industry may be selected.

Selected work assignment data sets which contain the same work assignments and belong to the same personnel category are combined together, and for each different work assignment a mean $C_{ij}$ and standard deviation $\sigma_i$ is calculated for the times spent on each assignment. For the calculation, the data sets are weighted by the number of personnel involved. If data sets for the same personnel category contain different work assignments then the category is split into sub categories by the computer program.

Selected equipment and background noise data are also grouped by I.D. code and for each different I.D. code a mean $L_j$ and standard deviation $\sigma_j$ is calculated for the measured noise levels.

A list of equipment codes to be grouped into general equipment classifications is included in the user oriented data input. All data for a general classification are combined to give a mean and standard deviation for the noise level corresponding to each classification. These data are then referred to as "generalized equipment data". No background noise data are included in the generalized equipment data. Details for selection of generalized classifications are discussed in

Appendix B, and examples are given in Section 5 for both the Sawmill and Foundry industries.

When an entire industry analysis is requested by the user oriented data the available data from plants within the industry are used together with the total industry population to obtain the required results. The accuracy of these resuls is determined by the number of plants included in the available data. Clearly the accuracy would be best if data from every plant in the industry were available and equally clearly this would be impractical. The alternative is to use the data from a random selection of plants within the industry to estimate the exposure problem for the entire industry, and to use the variability in the data to estimate a worst case situation.

The worst case estimate is derived from the standard deviation estimates $_i$ and $_j$ for the quantities $C_{ij}$ and $L_j$. The accuracy of the estimates for the mean exposure problem and the worst case exposure problem increases as the number of plants increases. This is discussed in detail in Section 6 of this report. The worst case estimates are not valid and should be ignored when a single plant is chosen for analysis and no extrapolation of results is required.

## 3.3 Development of the Noise Exposure Models

Two models are developed and results are compared later in this report. The first model uses the EPA criterion as a basis and the second uses the OSHA criterion as the basis.

### 3.3.1 EPA Model

The impact of a particular noise environment on an individual or personnel category is a function of both the sound level and the size of the population experiencing that sound level. EPA has

established a method which can be used to assess the noise impact of a given environment through the calculation of fractional impacts from each contributor to the overall environment. For occupational noise exposure EPA has adopted the eight-hour equivalent sound level $L_{eq}(8)$ to quantify the noise levels to which personnel are exposed. For a given personnel category, i, the equivalent 8-hour sound level may be calculated by summing the contributions of each job assignment as follows:

$$L_{eq}(8)_i = 10 \log_{10} \sum_{j=1}^{N} \frac{C_{ij}}{8} 10^{(L_j/10)} \qquad (3\text{-}1)$$

There are N job assignments, the $j^{th}$ job assignment corresponding to an average sound level of $L_j$ dBA and an exposure time of $C_{ij}$ hours.

In the "Levels Document" [1], EPA identifies an $L_{eq}(8)$ of 75 dBA as the criterion to protect against hearing loss and various gradations of impact for levels exceeding these limits. The impact of a value of $L_{eq}(8)_i$ on a particular population i may be quantified by a single number which takes into account the value of $L_{eq}(8)_i$ and the number of personnel exposed.

This number is referred to as Level Weighted Population ($LWP_i$) and allows differing numerical degrees of impact to be applied to different segments of the population. The formulation of LWP relies on the use of a weighting function $W_h$ to link the importance of sound level magnitude to the importance of population magnitude in assessing overall impact.

The weighting function $W_h$ is calculated from the eight hour equivalent sound level for a particular population or personnel category i using the following relation:

$$(W_h)_i = 0.025\ (L_{eq}(8)_i - 75)^2 \qquad (3\text{-}2)$$

If $L_{eq}(8)_i$ is less than 75 dBA then $(W_h)_i = 0$.

The level weighted population for this $i^{th}$ category is then defined as,

$$LWP_i = (W_h)_i . P_i, \qquad (3\text{-}3)$$

where $P_i$ is the population in personnel category i.

The Level Weighted Population for an entire industry is obtained by summing over all personnel categories i. Thus,

$$LWP = \sum_i LWP_i \qquad (3\text{-}4)$$

The use of the LWP descriptor for noise impact implies the following:

1. The impact of high noise levels on a small number of people is equivalent to the impact of lower noise levels on a larger number of people. This equivalence is expressed in the equation for the weighting function $W_h$ and the equation for LWP.

2. The properties of sound intensity and number of people affected by it may be mathematically combined into a single descriptor, LWP.

The quantity $LWP_i$ defined for each personnel category i may be used to rank order personnel categories in terms of noise exposure impact, and hence the impact of various personnel classifications on hearing loss within an industry.

Worst case exposure estimates are calculated from the mean and standard deviation values of the $C_{ij}$ and $L_j$ used in Equation 3-1. The worst case estimate for $L_{eq}(8)_i$ is given by

$$\left[L_{eq}(8)(w.c.)\right]_i = 10 \log_{10} \sum_{j=1}^{N} \frac{\bar{C}_{ij}}{8} 10^{(\bar{L}_j/10)} \qquad (3\text{-}5)$$

where $\bar{L}_j = L_j + \sigma_j$ (for highest $L_j$ assigned to category i)
$\bar{L}_j = L_j$ (for all other $L_j$)
$\hat{C}_{ij} = C_{ij} + \sigma_i \ (\bar{L}_j \neq L_j)$
$\hat{C}_{ij} = C_{ij} \ (\bar{L}_j = L_j)$
$\bar{C}_{ij} = 8\, C_{ij} / \sum_i \hat{C}_{ij}$

The worst case LWP values are calculated in a similar way as the mean values, except $L_{eq}(8)_i$ is replaced by $L_{eq}(8)_i(w.c.)$ in expression (3-2).

The accuracy of the estimates of the mean and worst case for the exposure is improved each time more data are added to the data base. Generally at least four plants are required in the sample for estimates of the worst case exposure to be reasonably accurate. If fewer plants are used there are usually not enough data to obtain accurate estimates of the standard deviations in the quantities used for the worst case estimates. In addition to industry-wide estimates, the model is suitable for analysis of individual plants. In this instance the worst case estimates should be ignored.

Note that each noise level is associated with a particular type of equipment or background which itself may be made up of contributions from several equipment types.

### 3.3.2 OSHA Model

OSHA regulations permit a maximum allowable noise level of 90 dBA for 8 hours, or a daily noise dose of unity. For exposure to N different noise environments the daily noise dose $d_i$ corresponding to personnel classification i is defined as follows:

$$d_i = \frac{C_{i1}}{T_1} \quad \frac{C_{i2}}{T_2} \quad \ldots + \frac{C_{iN}}{T_N} = \sum_{j=1}^{N} f_{ij} \qquad (3\text{-}6)$$

where $C_{ij}$ is the exposure time of personnel category i to noise level $L_j$.

$T_j$ is the total time of exposure permitted at level $L_j$ and is defined as,

$$T_j = \frac{8}{2^{(L_j-90)/5}} = \text{8 hours for } L_j = 90 \text{ dBA} \qquad (3\text{-}7)$$

When the daily noise dose exceeds unity the personnel noise exposure is above the permissible level.

The equivalent eight hour sound level $L_{eq(8)_i}$ experienced by personnel category i may be derived from the daily noise dose as follows:

$$L_{eq}(8)_i = 90 + 5 \log_2 d_i = 90 + 5 \left[3.322 \log_{10} d_i\right] \qquad (3\text{-}8)$$

The above computation methods identify the following important factors.

1. Noise levels above 90 dBA are potential hearing hazards. 90 dBA is the maximum allowable exposure for the 8-hour work day and also represents the threshold of noise. That is, noise levels below 90 dBA are not considered.

2. The exchange rate between level and time of exposure is 5 dBA. That is, for each halving of exposure time, the allowable noise level may be increased by 5 dBA (i.e., 95 dBA for 4 hrs.; 100 dBA for 2 hrs., etc.).

3. When multiple exposures to different noise levels exist during the work day, the Daily Noise Dose is computed by adding fractional exposures.

4. The degree of overexposure is indicated by the magnitude of the daily noise dose and in contrast to the EPA model, no consideration is given to the number of people involved in each category i. Thus a category with one person exposed to a high noise level (e.g. 110 dBA) is seen as being more important than a category with 100 people exposed to a lower noise level (e.g. 105 dBA).

The results for the noise exposure impact of an entire industry are quantified by adding together the total number of people with a daily noise dose in excess of one.

The worst case daily noise dose $d_i(w.c.)$ is calculated by replacing the quantities $C_{ij}$ and $L_j$ with the quantities $\bar{C}_{ij}$ and $\bar{L}_j$, (which are the same as those used in Eq.(3-5)) in Eqs.(3-6) and (3-7). The worst case eight hour equivalent sound level $\left[L_{eq}(8)(w.c.)\right]_i$ is calculated from $d_i(w.c.)$ using Eq.(3-8).

## 3.4 Development of Models for Assessing the Relative Impact of Equipment Types on Personnel Noise Exposure

As for the previous section two models are developed; one based on EPA criteria and the second based on OSHA criteria.

### 3.4.1 EPA Model

In Section 3.3.1 we showed how personnel categories could be rank ordered in terms of their noise exposure impact. The purpose of this section is to derive expressions to allow a similar rank ordering of equipment types.

We begin with Equation (3-1) which shows how the equivalent eight hour noise level may be calculated for a given personnel category i exposed to several different noise environments j. The contribution of noise environment j to the value of $L_{eq}(8)_i$ is defined as $L_{eq}(8)_{ij}$ and is given as:

$$L_{eq}(8)_{ij} = 10 \log_{10} \left[ \left( \frac{C_{ij}}{8} \right) 10^{L_j/10} \right] \qquad (3\text{-}9)$$

The noise environment $L_j$ may be associated directly with a single equipment type or may correspond to a background noise level characterized by several different equipment types. Thus the contribution of equipment type n to the value of $L_{eq}(8)_i$ is given by

$$L_{eq}(8)_{in} = 10 \log_{10} \left[ \left( \frac{C_{ij}}{8} 10^{L_j/10} \right) e_{jn} \right] \qquad (3\text{-}10)$$

where $e_{jn}$ is the contribution of equipment type n to the noise environment $L_j$ (see Table 3-1). $e_{jn}$ has a value of 1 for equipment noise data and a value between 0 and 1 for background noise data.

The contribution of equipment type n to the overall LWP for personnel category i may be written as,

$$LWP_{in} = \frac{10^{[L_{eq}(8)_{in}/10]}}{10^{[L_{eq}(8)_i/10]}} LWP_i \qquad (3\text{-}11)$$

The relative impact of equipment type n on the total noise impact experienced by personnel category i may be expressed as a partial priority as follows:

$$(PP)_{in} = LWP_{in}/LWP_i \qquad (3\text{-}12)$$

The relative impact of one equipment class n on the exposure problem for all personnel categories in a given industry is then defined as:

$$PI_n = \sum_i \frac{P_i LWP_{in}}{LWP_i} = \sum_i P_i \frac{10^{[L_{eq}(8)_{in}/10]}}{10^{[L_{eq}(8)_i/10]}} \qquad (3\text{-}13)$$

where $PI_n$ is the equipment impact for equipment type n.

The equipment impact may be normalized to unity as follows:

$$NPI_n = PI_n / \sum_n PI_n \qquad (3\text{-}14)$$

The $PI_n$ result allows the rank ordering of equipment types in terms of their impact on the exposure problem. The exposure problem is defined as the existence of personnel exposed to an $L_{eq}(8)$ in excess of 75 dBA. The degree of overexposure or the amount by which $L_{eq}(8)$ exceeds 75 dBA is not taken into account.

The rank ordering of equipment types in terms of the impact on overall exposure is also desirable and may be expressed in terms of a new index which we will refer to as the Equipment Exposure Impact which is defined as follows:

$$EPI = \sum_{I} LWP \qquad (3\text{-}15)$$

and which may be normalized in a similar way to the equipment impact (Eq.3-14).
This rank ordering indicates which equipment types contribute most to overexposure and is available as an output from the computer program. The statistical analysis in Section 6 and the results presented in Section 5 however are based on Eq.(3-14).

If a broader assessment basis is desired such as the identification of important areas rather than important equipment types in a plant or industry, then the same model can be used with equipment noise levels being replaced with area noise levels and personnel assignments reflecting plant areas rather than equipment usage. In this case it would not be necessary to identify equipment types contributing to background noise levels.

### 3.4.2 OSHA Model

The purpose of this section is to derive expressions which allow rank ordering of the impact of various equipment types on personnel exposure, using OSHA criteria as a basis.

To begin with, the impact of equipment is considered only for those personnel categories with a daily noise dose in excess of one. Thus we only consider categories k where k is a subset of the original category list and k = 1, .

Thus Equation (3-6) may be rewritten as

$$d_k = \sum_{k=1}^{\ell} f_{kj} \qquad (3\text{-}16)$$

where k is a subset of i, $\ell$ is the total number of personnel categories with a daily noise dose in excess of unity, and where

$$f_{kj} = C_{kj}/T_j \qquad (3\text{-}17)$$

As for the EPA model the noise environment $L_j$ may be associated with one or more equipment types n. Thus the contribution of equipment type n to the daily noise dose $d_k$ is given by

$$f_{kn} = e_{nj} f_{kj} \qquad (3\text{-}18)$$

$e_{nj} = 1$ for equipment noise data and is between 0 and 1 for background noise data.

The relative impact of equipment class n on the total noise impact experienced by personnel category i is written as a partial priority as follows

$$(PP)_{kn} = f_{kn}/d_k \qquad (3\text{-}19)$$

The relative impact of one equipment class n on the exposure problem for all personnel categories in a given industry is defined as:

$$PI_n = \sum_{k=1}^{\ell} \frac{P_k f_{kn}}{d_k} \qquad (3\text{-}20)$$

where $P_k$ is the number of people in personnel category k and where $PI_n$ is the priority index for equipment type n. Note that the number of personnel overexposed in each category is taken into account in this calculation.

The priority index may be normalized to unity as follows:

$$NPI_n = PI_n / \sum PI_n \qquad (3\text{-}21)$$

This $PI_n$ result allows the rank ordering of equipment types in terms of their impact on the exposure problem. The exposure problem is defined as the existence of personnel with a daily noise dose in excess of unity. The amount by which the daily noise dose exceeds unity is not taken into account, although the number of personnel involved is taken into account.

The rank ordering of equipment types in terms of the impact on overall exposure, and where the amount by which the daily noise dose exceeds unity and the number of personnel involved are both taken into account, is also desirable. In this case the priority is referred to as the exposure priority index, and is defined as:

$$EPI_n = \sum_{k=1}^{\ell} P_k f_{kn} \qquad (3\text{-}22)$$

This rank ordering indicates which equipment types contribute most to overexposure and is available as an output from the computer program. The exposure priority index may also be normalized in the same way as for the priority index.

## 3.5 Computer Model

The computer model evaluates the equations described previously for each personnel category and for each equipment type

specified in the input data. The overall results for each individual plant are obtained and then averaged and extrapolated to the entire industry. The results for the Sawmill Industry (SIC 242) and the Foundry Industry (SIC 332) are presented in Section 5 of this report. The output data of interest for the personnel categories are the "Level Weighted Population" (Equation 3-3) and the "Daily Noise Dose" (Equation 3-6) for each personnel category. Each personnel category is listed in the computer output in order of importance, in terms of noise exposure impact. In addition, results for the total level weighted population and total number of people overexposed in each industry considered are presented.

The output data of interest for the equipment types are the priority indices calculated using both EPA (Equation 3-13) and OSHA (Equation 3-20) criteria. Equipment types are listed in the computer output in order of their importance in contributing to the noise exposure problem.

In addition, the computer model at this stage is capable of taking into account the effect of noise control in any specified equipment types as described in Appendix A. This allows the effect of any proposed noise control legislation to be immediately evaluated. Results for an arbitrary example are included in Section 5. The computer model automatically reduces by the correct magnitude, background noise levels which are influenced by equipment types for which noise control is specified. After noise reduction, the relative contributions of equipment types to the background level under consideration are recalculated, prior to the calculation of the equipment priority indices.

The accuracy of the results obtained by extrapolating average results for several plants to an entire industry is discussed in Section 6.

Proposed additions to the computer model capabilities are discussed in detail in Appendix B, Section B.3 and in general terms in Section 7 of this report.

# Section 4
# FIELD DATA ACQUISITION PROGRAM

Section 3.1 discussed in detail the data base requirements needed to describe the personnel noise exposure problem. Both the acoustic and non-acoustic parameters to be measured were identified in general and their relationships to the models were shown in subsequent sections. This section of the report deals with the specific procedures used during the data acquisition program. The objective is to provide the user with the required methodology to repeat these measurements in other plants and industries.

## 4.1 Industries Selected

Two industries were selected for detailed analysis under this program. These are:

1. SIC 242 Sawmills and Planing Mills
2. SIC 332 Iron and Steel Foundries

The selection of these industries was based in part on the familiarity of the contractor with their operations and in part on the willingness of these industries to voluntarily participate in this study.

After consultation with representatives from each industry, a number of "typical" plants were selected for detailed examination. The criteria for the plant selection were as follows:

1. Obtain a representative group in terms of plant size (number of people employed and production levels);

2. Include plants that would span the industry age; i.e. modern plants with new equipment and processes and older plants,

3. Include plants that would contain a representative sample of equipment used in the industry.

The objective of this selection process was to obtain the broadest sample of equipment and operational procedures possible, to ensure that the industry is adequately described. Since the project was limited in the number of plants in each industry which could be surveyed, this procedure for plant selection was intended to not only provide a representative sample but also to ascertain the minimum sample size necessary in each industry for a desired level of accuracy (see Section 6 for further discussion of this subject).

Four plants in each industry were selected originally through this method. Five additional plants in SIC 242 and four in SIC 332 were later added in lieu of surveys in other industries. All volunteer plants are anonymous by agreement between EPA and industry representatives. Thus, each plant is described only by a number.

## 4.2 Field Data Acquisition

All plants in each industry were visited sequentially by the same survey team. An average of 8 - 16 hours is required for a trained individual to complete a plant. The methodology used in both industries was the same. As an illustration of the procedures the sawmill and planing mill industry will be used; however the steps to be followed are similar in other industry environments.

Two basic types of data are required in order to fulfill the requirements of the model as described in Section 3.1. They are:

1. Airborne Noise Data
2. Personnel Work Assignment Data

Although these data are not mutually exclusive (some must be collected together), the procedures for the two data types are discussed separately for clarity. When appropriate, notes concerning the relationship between these data types are included.

### 4.2.1 Airborne Noise Data

The airborne noise data refers to the acoustic (noise) measurements that are necessary to describe the environment in each plant situation. The units of measurement are the "A-weighted" sound level (dBA) which are familiar to most individuals working in occupational noise. Both the EPA and OSHA critera (see Section 2) use the "A-weighted" sound level as the basic descriptor of noise.

#### Instrumentation

The instrumentation required for the survey is a Type II Sound Level Meter or better. Noise measurements are taken with the instrument setting on the "A" scale and slow averaging.

#### Data Forms

Although not essential, it was found useful to develop and use standard forms for recording the measured noise data. The forms suggested here are designed to allow direct conversion into punch cards compatible with the computer program. This avoids the need to transfer field data into the format required for key punching.

The acquisition of the noise level data requires two types of forms. These are:

1. List of Equipment
2. Equipment Noise Data

An example of the "List of Equipment" form is shown in Figure 4-1. This list allows for the orderly assignment and retrieval of equipment code numbers used in the model.

Basically, each equipment type in an industry is assigned a four digit numerical code as shown in Figure 4-1. This code is unique to the equipment or background type and is independent of the industry being surveyed. Thus, survey personnel need to know which codes have been used previously. The gross description of the equipment item is provided by its Generic Name (see column two). Thus Code 1610 describes a cut-off saw in general. If no further breakdown was desired, then Code 1610 would be sufficient to describe all cut-off saws used in the industry.

Due to variations in general configuration, method of operation or operator location it is desirable to further break down some equipment items into sub-categories. In our example for cut-off saws a distinction is made in column three between circular and chain types (change in configuration). This same reasoning is used for edgers to differentiate "manual" types from "automatic" types (method of operation). Finally, the headrig illustrates the breakdown based on operator location by identifying a "sawyer location" and a "tail operator location". The criteria for establishing when a type breakdown is necessary is basically the noise level emission.

A further breakdown is occasionally desirable due to a significant change in the noise emission level between different equipment items of the same type. This breakdown is shown in the fourth column under the heading size/condition. The two most important conditions are the distinction between the equipment operating under either "idle" or "operating" mode

FIGURE 4.1 EXAMPLE OF ENTRIES INTO "LIST OF EQUIPMENT" FORM

| LIST OF EQUIPMENT | NAME | |
|---|---|---|
| SIC CODE: 242 | DATE 3/4/79 | PAGE OF |

| Dig. Dip. Code | Generic Name | Type (Auto., Man., Etc.) | Size / Condition | |
|---|---|---|---|---|
| 10 | CUT-OFF SAW | GENERAL | GENERAL | |
| 11 | BACK/CUT OFF SAW | CUT-OFF SAW | | |
| 12 | CUT-OFF SAW | CIRCULAR | IDLE/ENCLOSED | |
| 13 | CUT-OFF SAW | CIRCULAR | OPERATING/ENCL | |
| 14 | CUT-OFF SAW | CIRCULAR | IDLE | |
| 15 | CUT-OFF SAW | CIRCULAR | OPERATING | |
| 16 | CUT-OFF SAW | CHAIN | IDLE/ENCLOSED | |
| | | | | |
| | | | | |
| 24 | HEADRIG | BANDSAW/SAWYER | | |
| 25 | HEADRIG | | | |
| 26 | HEADRIG | BANDSAW/TAIL | | |
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and the distinction between the equipment being "enclosed" or not. For example Code 1613 (see Figure 4-1) describes a circular cut-off saw which has an acoustical enclosure and was measured under operating conditions (while cutting).

When an industry has been surveyed previously, the "List of Equipment" will already have been generated. In this case, the survey team would only use the existing information to identify the correct code number. In the case of a new industry, enough familiarity with the industry process is required so as to establish the necessary categories. As will be shown later, the model has the ability to analyze the input information based on the detailed equipment type breakdown or to combine selected equipment types with the same generic name into broad classifications in order to analyze general equipment trends. Note that equipment types with the same generic name and likely to be included in the same general classification should be assigned consecutive I.D. codes.

Note that each equipment type has an entry where the generic name is preceeded by the letters "Back". This code represents a "Background Noise Level" which is primarily generated by the equipment in question. While all the other codes apply only at a location where the equipment operator is positioned, the background code identifies any other location usually removed from the equipment where the equipment operation has either a total or partial effect on the noise environment measured. Background noise levels are generally influenced by more than one type of equipment and the definition and measurement of the required data are discussed in detail later in this section.

The second noise level data form is shown in Figure 4-2. This form is used to record the noise level measurements performed during the survey. Figure 4-2 shows an example where the noise level at several locations is measured. Note that it is

FIGURE 4.2 EXAMPLE OF ENTRIES INTO "EQUIPMENT NOISE DATA" FORM

EQUIPMENT NOISE DATA

NAME

SIC CODE : 242

DATE 3/4/79

PAGE OF

| 4Dig. Equip. Code | Equipment or Background Description | $L_{eq}$ (dBA) | Contributions from Major Items of Equipment | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Code | Contr. | Code | Contr. | Code | Contr. |
| 1613 | CUT-OFF/CIR/OPER | 99.0 | | | | | | |
| 1613 | CUT-OFF/CIR/OPER | 101.0 | | | | | | |
| 1612 | CUT-OFF/CIR/IDLE | 84.0 | | | | | | |
| 1636 | EDGER/MAN/OPER | 99.0 | | | | | | |
| 1636 | EDGER/MAN/OPER | 97.0 | | | | | | |
| 1635 | EDGER/MAN/IDLE | 92.0 | | | | | | |
| 1627 | HEADR/TAIL/OPER | 111.0 | | | | | | |
| 1626 | HEADR/TAIL/IDLE | 94.0 | | | | | | |
| 1624 | HEADR/SAWY/IDLE | 82.0 | | | | | | |
| 1625 | HEADR/SAWY/OPER | 85.0 | | | | | | |
| 1621 | BACK/HEADRIG | 85.0 | 1625 | 0.80 | 1624 | 0.20 | | |
| 1630 | BACK/EDGER | 92.0 | 1636 | 0.60 | 1623 | 0.20 | 1613 | 0.20 |

sufficient to identify each measurement by the equipment code only. The generic description is included on the form for convenience only since the program requires the code as the only identification. The entries for equipment noise identify the code which represents the operator location for the equipment under consideration. Noise levels are measured at this location. The entries for background noise identify the code which represents the main equipment source that contributes to the measured level. A further breakdown of the background level in terms of the contributions from different equipment types as shown in Figure 4-2 are also included. The procedure for contribution assignments for background noise data is discussed in detail under Noise Measurements.

Equivalent Sound Level ($L_{eq}$)

By definition, the Equivalent Sound Level ($L_{eq}$) is the steady dBA level which would produce the same A-weighted sound energy over a stated period of time as a specified time-varying sound.

When taking measurements of a machine operating under a specific set of conditions it is assumed that the sound does not vary significantly as a function of time, i.e., less than $\pm$2.0 dBA. The assignment of separate codes to the cut-off saw used in our previous example (see Figure 4-1) recognizes the fact that this source generated different noise levels when idling or cutting.

When operating under a steady set of conditions therefore, our measurements will reflect closely the $L_{eq}$ level desired. In practice, most noise sources are not perfectly steady and vary as a function of time. Some eye averaging must be done to approximate the $L_{eq}$ value. This is accomplished by observing the Sound Level Meter display with the "slow" response selected for a time sufficient to establish an average value.

Noise Measurements

This section provides general guidelines to be followed during the noise measurement survey. The steps provided should allow the survey team to proceed quickly and efficiently through the data acquisition process. The following of these guidelines will also assure a standardized method for data collection.

1. Familiarization with the plant process and layout by conducting a walk-through prior to commencing measurements.

2. If the plant is one continuous process the survey should start at the beginning and follow the process from station-to-station. If not, each area of the plant should be completed before moving to the next one.

3. All noise measurements should be taken at the operator position, except background noise. Measurements should be made at ear height or equivalent.

4. Using the "List of Equipment" form the four-digit code for the equipment to be surveyed should be entered on the "Equipment Noise Data" form.

5. The $L_{eq}$ (dBA) value for each condition identified (i.e., idle, operating) should then be measured and noted on the "Equipment Noise Data" form. Measurements should be taken over a period sufficient to establish an average value.

6. The above procedure should be repeated for the remaining equipment items until all fixed employee locations have been surveyed.

7. Background noise levels are determined by measuring an "average noise level" which can describe an area or a space in the plant. To establish the size of the area which can be described by a single noise level the following procedure should be used:

   (a) The noise environment away from any major equipment noise sources should be sampled with a sound level meter. Walkways, work benches and other employee locations are areas of special interest. As the sample survey is made the variation in sound level from location to location should be noted.

   (b) If the sound level at all locations is relatively steady ($\pm$3.0 dBA) then the entire room or area can be described by a single sound level measurement, providing that item (e) is also true.

   (c) If the sound level in the room or space varies in excess of the criterion ($\pm$3.0 dBA) then the space should be sub-divided into two, four, etc. sub-spaces until the above criterion is met.

   (d) In each background space or sub-space the sound level (dBA) should be measured and entered on the "Equipment Noise Data" form. The equipment item which is the most important contributor to the level just measured is determined by observation and hearing (subjective assessment). The "List of Equipment" form is then referred to and the "Background Equipment Code" which corresponds to the equipment selected is identified and entered on the "Equipment Noise Data" form to identify the noise level measured.

Note: The background noise at any location is the combination of direct and reverberant sound generated by one or more sources of noise. The effect of each source at a given position can be determined by turning all equipment of and then measuring the contribution of each one individually. This, although desirable, is seldom, if ever, practical or possible. Therefore, procedures suggested here rely on a subjective judgment which must be made by the individual performing the survey. This subjective judgment will be used to not only establish which equipment item is the most important contributor to background noise but also to select in some cases two more sources which are important and to assign to each a relative value for their contribution to the measured noise. The selection of the correct relative value is discussed in detail in Section 3.1 of this report. Although, on the surface, this procedure appears very complicated and subject to large error, experience under real plant situations shows that accurate and consistent results are achieved after some initial training.

(e) The "Equipment Noise Data" form has three sets of entries called "Equipment Contribution to Background" following the column used to enter the $L_{eq}$ measured value. These entries are to be used only for background noise measurements and are used as follows:

(i) Identify one, two or three equipment sources which contribute to the background noise at the measurement location. An easy rule of thumb is to list the equipment items which can be "heard" in order of importance. The ear

be "heard" in order of importance. The ear may be used as a filter to make this determination.

(ii) List the "Background Equipment Codes" for each source identified on the "Equipment Noise Data" (see "List of Equipment" for correct Codes). The Generic Name description of the background is always the most important equipment contributor (i.e. 1630 BACK/EDGER (see Figure 4-1)).

(iii) If only one major equipment source is identified since it completely dominates the background, then the relative contribution should be 1.0 dB. That is, when the equipment is reduced by 1.0 dBA, the background noise will also be reduced by the same amount.

(iv) If all three equipment items appear to be equally important, then the relative contributions to background noise should also be the same. Since the total must add to unity, then as a practical matter 0.4 is given to the equipment item whose generic name is used to describe the background noise and the remaining sources are assigned each 0.3 (see Figure 4-2). Note that in the case of only two sources, the relative contribution assignment would be 0.5.

(v) All other cases fall in between the two identified above. That is, the primary source of background noise cannot be larger than 1.0 or smaller than 0.4. If the primary source is

judged to be twice as important as the remaining two then the relative contributions would be 0.6, 0.2 and 0.2 and so on.

Note: As was explained in Section 3.1 the objective of the background noise contribution assignment is to calculate the equipment noise exposure impacts more accurately and to allow for reductions in background noise when the equipment which controls their level is controlled.

### 4.2.2 Personnel Work Assignment

The personnel noise assignment is the second type of data necessary to exercise the computer model. In the previous section we have discussed the methodology necessary to collect the noise level information. This section describes the procedures used to relate worker exposure to those levels.

**Employee Classification**

The first step is to break down the employee force working in the plant into categories consistent with their work assignments and the manner in which they are described in the industry.

Both of these requirements are satisfied by identifying "Job Descriptions" which are common to the industry being surveyed. As was the case with the "List of Equipment", a "List of Jobs" is developed for each industry. A five-digit job code is assigned to each job description as shown in the example for the sawmill and planer mill industry on Figure 4-3. The first two digits are the first two digits of the SIC code for the industry and the last three digits are assigned arbitrarily for a given industry. Since "job descriptions" vary sometimes from plant to

FIGURE 4.3 EXAMPLE OF ENTRIES INTO "LIST OF JOBS" FORM

LIST OF JOBS | NAME

SIC CODE: 242 | DATE 3/4/79 | PAGE OF

| 3 Dig. Job Code | Job Description |
|---|---|
| 117 | DECK SCALER |
| 118 | CUT-OFF SAW OPERATOR |
| 123 | SAWYER |
| 127 | TAIL SAWYER |
| 128 | QUADSAW TAIL SAWYER |
| 131 | GANG SAW OPERATOR |
| 133 | SLAB BOARD PULLER |
| 134 | EDGER OPERATOR |
| 137 | CHIPPER OPERATOR |
| | ETC |
| | ETC |

plant it is desirable to develop a reference list with the help of the industry or several plants to have a consistent methodology.

Units of Measurement

The final personnel work assignment description desired is in terms of the time expended operating a given item of equipment or exposed to a given background noise level. The units used to describe the time period are percentages of the working day where 8 hours = 100%. Numbers of hours (to one decimal place accuracy) are equally acceptable in place of percentages.

Data Forms

In addition to the "List of Jobs" previously described, the procedure utilizes the "Personnel Work Assignment" form. This form is shown on Figure 4-4. The form first identifies the Job Code which is the last three digits of the code described in the List of Jobs. Thus each job category has a unique number code by which it is designated. The number of personnel assigned to a specific job category are followed by the description of their duties and the number of hours of their working day assigned to various equipment and background noise sources. The equipment and background noise sources are identified by their four-digit codes as described earlier.

Personnel Work Assignments

This section provides the general guidelines to be followed during the survey to acquire the personnel work assignment data.

The same procedure can be applied by either: a) sampling each individual worker to establish his/her daily duties or b) arriving at average work assignment values for various job descrip-

FIGURE 4.4 EXAMPLE OF ENTRIES INTO "PERSONNEL WORK ASSIGNMENT" FORM

ERSONNEL WORK ASSIGNMENTS (2 LINES FOR EACH PERSONNEL CATEGORY) | NAME

IC CODE: 242 | PLANT NO. 02 | DATE 3/4/79 | PAGE OF

| B· | Brief Description of Work for Own Benefit | No. of Pers. | Equip. Code | % Time | Equip. Code | % Time | Equip. Code | % Time | Equip. Code | % Time | Equip. Code | % Time | Equip. Code | % Time | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | EDGER OPERATOR | 4 | 1635 | 50.0 | 1636 | 50.0 | | | | | | | | | |
| | | | 0 | | | | | | | | | | | | |
| 7 | TAIL SAWYER | 2 | 1626 | 20.0 | 1627 | 80.0 | | | | | | | | | |
| | | | 0 | | | | | | | | | | | | |
| 3 | SAWYER | 2 | 1624 | 20.0 | 1625 | 80.0 | | | | | | | | | |
| | | | 0 | | | | | | | | | | | | |
| 7 | DECK SCALER | 2 | 1613 | 5.0 | 1621 | 95.0 | | | | | | | | | |
| | | | 0 | | | | | | | | | | | | |
| 1 | SAWMILL SUPERVIS | 1 | 1798 | 50.0 | 1776 | 120.0 | 1621 | 15.0 | 1630 | 15.0 | | | | | |
| | | | 0 | | | | | | | | | | | | |
| 1 | CARPENTER | 2 | 1000 | 50.0 | 1776 | 15.0 | 1621 | 15.0 | 1630 | 10.0 | 1700 | 10.0 | | | |
| | | | 0 | | | | | | | | | | | | |

tions by discussing work assignments with the first line supervisors. In large plants, the later method is more practical. By experience, the following method gives the most consistent results:

1. For each department or area the total number of employees is first acquired (sometimes more than one shift may have to be considered).

2. With the help of the List of Jobs, the job descriptions and job codes present are then identified and entered on the Personnel Work Assignment form. As was pointed out earlier, the job designation from plant to plant may vary; however in most cases, the supervisor of the area will be able to identify the corresponding job title from the List of Jobs.

3. If it is decided to work with the supervisor, the number of workers in each job category and their duties should be identified first of all and entered on the Personnel Work Assignment form. The next task would be the correct definition of the daily job assignments for the plant's workforce. This is the most difficult part of the survey since in many industries, the tasks performed by an individual may vary from day-to-day. The degree of variability may be reduced by remembering that the aim of the data is to describe the long term problem rather than the individual day of the survey. Thus, questions such as a) what are the duties of this worker or group of workers on the average (over two weeks or a month); b) which machines or equipment do they use on the average; c) how often; d) what are the reasons for day-to-day variability? will permit to focus on the most accurate description.

As shown on Figure 4-4 the breakdown required is the equipment or background code followed by the percentage of an eight-hour day the worker either operates an equipment item or spends in a background location. A maximum of ten individual sources can be used to describe the job assignment. Two lines on the data form must be used for each job assignment. If the second line is not required a zero should be entered in Column 27 of that line.

In the assignment of time, background noise is treated in the same manner as equipment sources. When the assignment of a worker to individual equipment sources is completed, the remainder of his working day (8-hours) must be assigned to background noise (when he is not generating noise but is exposed to other sources). This is done by identifying the areas in which he works and using the corresponding background noise code measured earlier.

4. The total percentage of time must add up to 100% if percentages are used and 8 hours if hours and hour fractions are used.

5. Supervisors or workers who do not operate any specific machinery will have <u>all</u> their time assigned to one or more background location codes.

6. If the preceding data is acquired by questioning individual workers, the process is basically the same except that work assignments are given for one individual at a time.

7. For the same job description (and job code) but different job assignment schedules, the information is entered

by repeating the job code, description and work assignment. The computer program, upon inspecting the input data, will recognize that the same job description contains different assignments and will add a two-digit code to the above. Thus, each job description may be further subdivided (by the computer program) into ninety-nine additional categories if necessary. This is discussed in more detail in Section 3 of this report.

The development of a consistent technique for the acquisition of the personnel work assignment data depends, obviously, on some familiarity with the industry in question but more importantly, on field experience gained in conducting these or similar surveys. The experience gained during the BBN survey showed that individuals relatively inexperienced in this type of work very quickly develop the ability to consistently ask the "right" questions and guide the supervisor or worker so extract the desired information.

## Section 5
## RESULTS FOR INDUSTRIES SURVEYED

In this section results of the noise exposure analysis are presented for both the Sawmill Industry and Foundry Industry. The results are extrapolated from the average results for several plants in each industry, using as a basis the ratio of total industry population to the total population of the plants in the sample. The accuracy of the extrapolated results is discussed in the next section. The input data used to obtain the results are contained in Appendices C and D. The analysis results for the individual plants are included in Appendices E and F.

For the personnel noise exposure impact results, the personnel categories were divided into subcategories by the computer program whenever two or more sets of input data, involving different equipment types, were found for the same personnel category. These subcategories are identified by an extra two digits on the right of the three digit job code, allowing a maximum of 99 subcategories for each job category. If the two or more lines of data involved the same equipment types, then the results were averaged and not divided into further subcategories. Thus in the following results there are two different types of table for the personnel noise exposure impacts; the first table type presents the results for individual subcategories represented by a five digit code and the second table type presents the results for each three digit personnel category specified in the input data. The results in the second table type are derived from the first by averaging subcategories which belong to the same category and have the same first three digits in their five digit job code.

Similarly there are two table types for the equipment noise impact and priority indices. The first table type corresponds to individual equipment types referred to in the input noise

level data. The second table type is for general equipment classifications where the results for all equipment types belonging to a particular classification have been averaged. The equipment types belonging to each general classification are indicated on a separate list -- Tables 5-7 and 5-27.

Finally an example of the effect of noise control, for certain equipment types, on both the personnel exposure impact and equipment priority indices, is included for each industry considered.

## 5.1 Sawmill Industry Results - SIC 242

The results presented here represent the entire industry and were derived from data collected in nine different plants, all of which were selected at random. An overview of the noise exposure problem is shown in Figure 5-1 which indicates the number of personnel exposed to equivalent eight hour noise levels equal to or greater than the level indicated on the ordinate axis. The results are presented in detail in the tables to follow.

In Tables 5-1 and 5-2 personnel noise exposure impact results are presented for each five digit personnel subcategory. Table 5-1 shows the level weighted population results derived using EPA criteria (see Section 3) and Table 5-2 shows the daily noise dose results derived using OSHA criteria (see Section 3).The title at the top of the table identifies the SIC code for the industry. One line in each table corresponds to a unique personnel subcategory. The categories are rankordered in terms of the magnitude of their exposure impact.

The first column in each table contains a five digit code, the first three of which correspond to the personnel category code

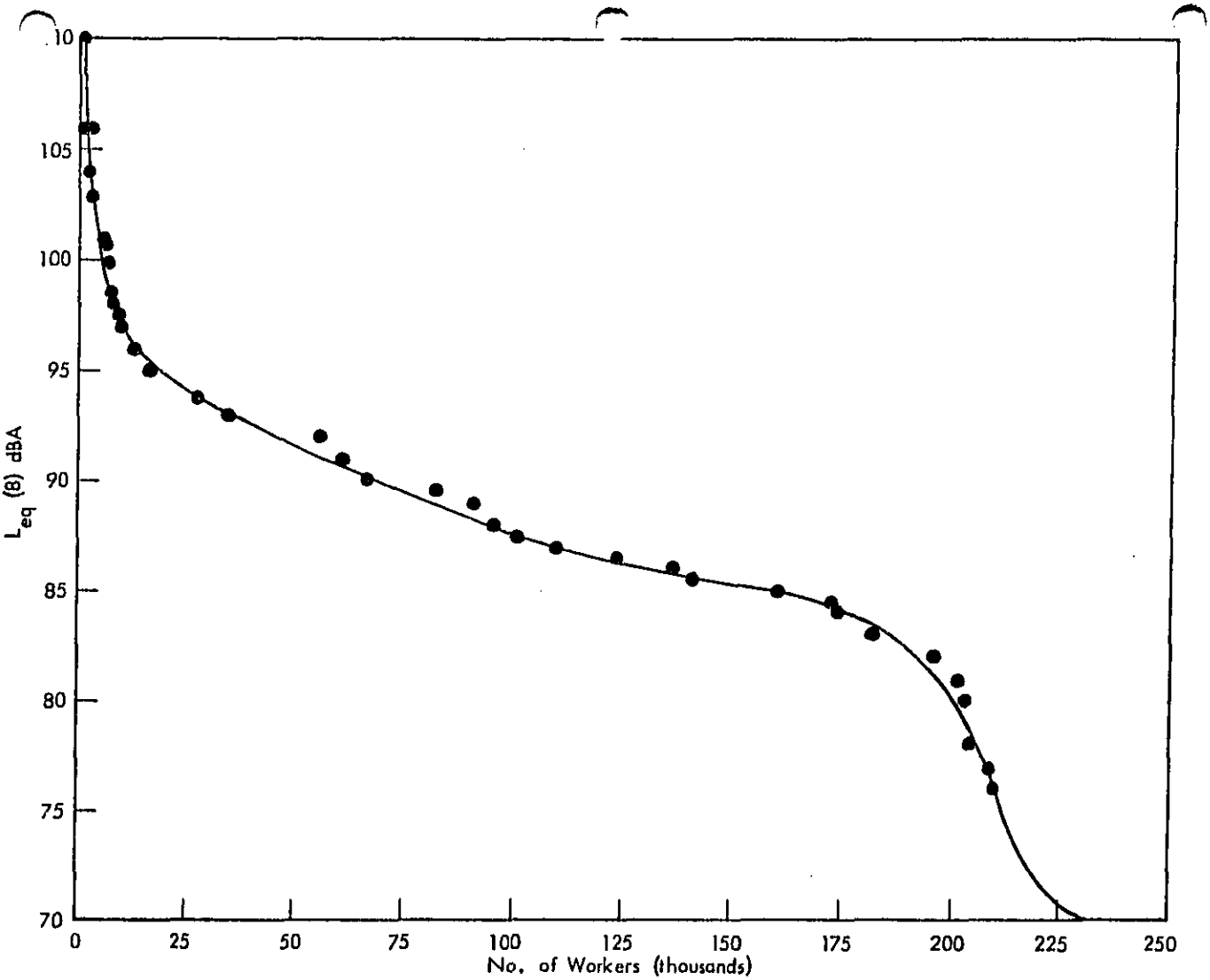


FIGURE 5.1 OVERVIEW OF THE NOISE EXPOSURE PROBLEM IN THE SAWMILL INDUSTRY

ENVIRONMENTAL PROTECTION AGENCY  OSHA JOB NO. 9635

TABLE 5-1 PERSONNEL NOISE EXPOSURE AND IMPACT

EPA CRITERIA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND MEAN | LEVEL M.C. | LEV. WT. EXP. MEAN | LEV. WT. EXP. M.C. |
|---|---|---|---|---|---|---|
| 21100 | MILLWRIGHT/GENERAL | 10252 | 89.7 | 91.9 | 55030 | 73097 |
| 16800 | PLANER SET-UP MAN | 1537 | 109.9 | 113.8 | 46779 | 57869 |
| 22800 | ELECTRICIANS | 7689 | 89.7 | 91.9 | 41272 | 54823 |
| 17305 | GRADER/PLANER MILL | 5126 | 92.8 | 95.4 | 40538 | 53293 |
| 17306 | GRADER/PLANER MILL | 4100 | 92.7 | 94.7 | 32183 | 39860 |
| 15102 | GREEN CHAIN PULLER | 3075 | 95.2 | 97.3 | 31530 | 38276 |
| 16702 | PLANER OPERATOR | 1794 | 101.1 | 106.7 | 30576 | 45070 |
| 13400 | EDGER OPERATOR | 2819 | 94.3 | 103.3 | 26387 | 56580 |
| 16700 | PLANER OPERATOR | 2306 | 94.0 | 97.6 | 20857 | 29410 |
| 12700 | TAIL SAWYER | 1537 | 97.6 | 103.8 | 19668 | 31915 |
| 14000 | RESAW OPERATOR | 2563 | 92.2 | 94.2 | 16887 | 23660 |
| 16703 | PLANER OPERATOR | 2050 | 93.8 | 96.8 | 16056 | 24439 |
| 17605 | DRY CHAIN PULLER | 6663 | 85.2 | 85.7 | 17434 | 19131 |
| 14800 | TRIMMER OPERATOR | 4357 | 87.5 | 95.4 | 17126 | 45298 |
| 21200 | MILLWRIGHT/SAWMILL | 2050 | 93.3 | 93.7 | 17074 | 17681 |
| 20203 | FORKLIFT OPERATOR | 4869 | 86.6 | 90.2 | 16256 | 26125 |
| 21302 | MILLWRIGHT/PLANER | 768 | 102.9 | 106.8 | 14959 | 19450 |
| 20200 | FORKLIFT OPERATOR | 5895 | 84.5 | 88.4 | 13361 | 26333 |
| 17606 | DRY CHAIN PULLER | 5126 | 85.2 | 89.1 | 13332 | 25307 |
| 13701 | CHIPPER OPERATOR | 768 | 100.8 | 104.8 | 12812 | 17041 |
| 17301 | GRADER/PLANER MILL | 1537 | 92.8 | 92.8 | 12191 | 12191 |
| 21103 | MILLWRIGHT/GENERAL | 1281 | 93.9 | 94.3 | 11458 | 11909 |
| 24802 | POWERHOUSE OPERATOR | 3075 | 87.0 | 90.4 | 10990 | 18210 |
| 16804 | PLANER SET-UP MAN | 512 | 104.0 | 107.7 | 10766 | 13723 |
| 17601 | DRY CHAIN PULLER | 3075 | 86.6 | 88.7 | 10395 | 14407 |
| 15400 | STACKER-GREEN | 3331 | 86.0 | 92.0 | 10082 | 24146 |
| 13401 | EDGER OPERATOR | 3588 | 85.5 | 93.3 | 9919 | 30191 |
| 16701 | PLANER OPERATOR | 1025 | 93.9 | 97.5 | 9119 | 12932 |
| 17603 | DRY CHAIN PULLER | 2563 | 86.9 | 89.0 | 9073 | 12615 |
| 13703 | CHIPPER OPERATOR | 512 | 101.2 | 104.9 | 8776 | 11453 |
| 21101 | MILLWRIGHT/GENERAL | 1025 | 93.3 | 95.8 | 8557 | 11108 |
| 21903 | MACHINISTS | 1281 | 91.3 | 91.3 | 8541 | 8541 |
| 16801 | PLANER SET-UP MAN | 512 | 100.4 | 104.0 | 8238 | 10774 |
| 21104 | MILLWRIGHT/GENERAL | 1025 | 92.8 | 96.6 | 8115 | 11429 |
| 14807 | TRIMMER OPERATOR | 1025 | 92.7 | 92.7 | 8062 | 8062 |
| 16802 | PLANER SET-UP MAN | 512 | 99.9 | 103.8 | 7928 | 10624 |
| 14402 | LUMBER DIVERTER | 768 | 95.0 | 97.1 | 7720 | 9386 |
| 20101 | LUMBER CARRIER OPER | 2819 | 85.4 | 87.8 | 7586 | 11585 |
| 14401 | LUMBER DIVERTER | 768 | 94.5 | 96.5 | 7301 | 8863 |
| 17600 | DRY CHAIN PULLER | 4613 | 82.9 | 89.0 | 7240 | 22089 |

ENVIRONMENTAL PROTECTION AGENCY  BBN JOB NO. 9635

TABLE 5-1 PERSONNEL NOISE EXPOSURE AND IMPACT
(Cont'd)

EPA CRITERIA

SIC CODE = 242  AVERAGE FOR INDUSTRY  NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND MEAN | LEVEL M.C. | LEV. WT. MEAN | POP. M.C. |
|---|---|---|---|---|---|---|
| 13801 | HOG OPERATOR | 512 | 98.5 | 101.6 | 7090 | 9082 |
| 12300 | SAWYER | 4869 | 82.6 | 87.0 | 7030 | 17646 |
| 15101 | GREEN CHAIN PULLER | 2306 | 86.0 | 90.2 | 6946 | 13279 |
| 13702 | CHIPPER OPERATOR | 512 | 98.0 | 101.4 | 6764 | 8905 |
| 22804 | ELECTRICIANS | 1281 | 89.2 | 89.6 | 6435 | 6863 |
| 22803 | ELECTRICIANS | 768 | 93.3 | 93.7 | 6404 | 6707 |
| 12800 | QUADSAW TAIL SAWYER | 512 | 97.0 | 97.0 | 6202 | 6202 |
| 16803 | PLANER SET-UP MAN | 256 | 106.0 | 109.8 | 6140 | 7777 |
| 10102 | SAWMILL SUPERVISOR | 768 | 92.9 | 93.3 | 6133 | 6456 |
| 10401 | PLANER SUPERVISOR | 768 | 92.9 | 93.3 | 6133 | 6456 |
| 14806 | TRIMMER OPERATOR | 1025 | 90.4 | 93.1 | 6054 | 8424 |
| 26106 | CLEAN-UP MAN/REGULAR | 512 | 96.7 | 100.3 | 6029 | 8171 |
| 21202 | MILLWRIGHT/SAWMILL | 768 | 92.7 | 93.2 | 6027 | 6356 |
| 20201 | FORKLIFT OPERATOR | 1794 | 86.6 | 90.2 | 5989 | 10362 |
| 15403 | STACKER-GREEN | 1794 | 86.4 | 92.7 | 5841 | 14079 |
| 21201 | MILLWRIGHT/SAWMILL | 1025 | 90.0 | 91.6 | 5737 | 7091 |
| 13700 | CHIPPER OPERATOR | 512 | 95.6 | 100.4 | 5459 | 8271 |
| 10402 | PLANER SUPERVISOR | 1025 | 89.5 | 91.6 | 5422 | 7022 |
| 14802 | TRIMMER OPERATOR | 768 | 91.8 | 94.8 | 5397 | 7564 |
| 10101 | SAWMILL SUPERVISOR | 768 | 91.6 | 92.8 | 5316 | 6115 |
| 14804 | TRIMMER OPERATOR | 768 | 91.6 | 95.0 | 5300 | 7715 |
| 23303 | CARPENTERS | 1025 | 89.2 | 90.1 | 5173 | 5830 |
| 14503 | GREEN CHAIN OPERATOR | 1537 | 86.5 | 91.0 | 5054 | 9803 |
| 15100 | GREEN CHAIN PULLER | 1537 | 86.5 | 91.0 | 5054 | 9803 |
| 15500 | STICKERMAN-GREEN | 2050 | 84.9 | 90.7 | 5044 | 12623 |
| 19100 | SPECIALTY RESAW OPER | 512 | 94.7 | 97.9 | 4956 | 6709 |
| 11701 | DECK SCALER | 512 | 94.1 | 94.6 | 4662 | 4929 |
| 16100 | UNSTACKER-DRY | 1025 | 88.4 | 92.1 | 4621 | 7471 |
| 10103 | SAWMILL SUPERVISOR | 512 | 93.9 | 94.3 | 4583 | 4763 |
| 24502 | OILER | 512 | 93.9 | 94.3 | 4583 | 4763 |
| 13802 | HOG OPERATOR | 512 | 93.4 | 94.5 | 4359 | 4873 |
| 17304 | GRADER/PLANER MILL | 2306 | 83.7 | 86.8 | 4331 | 10906 |
| 21301 | MILLWRIGHT/PLANER | 768 | 90.0 | 91.8 | 4325 | 5454 |
| 17604 | DRY CHAIN PULLER | 1025 | 87.9 | 90.0 | 4291 | 5784 |
| 24501 | OILER | 512 | 93.3 | 95.8 | 4278 | 5554 |
| 10400 | PLANER SUPERVISOR | 768 | 89.9 | 90.9 | 4272 | 4886 |
| 23300 | CARPENTERS | 512 | 93.1 | 93.6 | 4210 | 4416 |
| 12301 | SAWYER | 1025 | 87.8 | 87.8 | 4180 | 4180 |
| 20100 | LUMBER CARRIER OPER | 2306 | 83.5 | 86.2 | 4170 | 7219 |
| 15900 | TRANSFER OPERATOR | 768 | 89.7 | 100.0 | 4147 | 17316 |

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9635

TABLE 5-1 (Cont'd) PERSONNEL NOISE EXPOSURE AND IMPACT

EPA CRITERIA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND MEAN | LEVEL M.C. | LEV. HT. MEAN | POP. M.C. |
|---|---|---|---|---|---|---|
| 26501 | LABORER | 512 | 92.8 | 95.6 | 4082 | 5431 |
| 26602 | HELPER | 512 | 92.8 | 95.6 | 4082 | 5431 |
| 20204 | FORKLIFT OPERATOR | 1281 | 86.1 | 89.4 | 3929 | 6687 |
| 13300 | SLAB BOARD PULLER | 512 | 92.5 | 93.2 | 3924 | 4248 |
| 22801 | ELECTRICIANS | 512 | 92.5 | 95.4 | 3909 | 5327 |
| 10104 | SAWMILL SUPERVISOR | 768 | 89.0 | 90.3 | 3788 | 4521 |
| 14302 | UNSCRAMBLE OPERATOR | 512 | 92.0 | 95.5 | 3703 | 5366 |
| 24401 | FILERS | 3588 | 81.2 | 85.8 | 3411 | 10492 |
| 21102 | MILLWRIGHT/GENERAL | 512 | 91.3 | 91.6 | 3405 | 3548 |
| 15501 | STICKERMAN-GREEN | 1281 | 85.2 | 91.3 | 3315 | 6504 |
| 10100 | SAWMILL SUPERVISOR | 512 | 91.0 | 91.4 | 3299 | 3448 |
| 24400 | FILERS | 512 | 90.9 | 91.3 | 3247 | 3398 |
| 16200 | UNSTACKER PULLER | 2050 | 82.9 | 89.0 | 3217 | 10084 |
| 26202 | CLEAN-UP MAN/DOWN TM | 768 | 87.8 | 90.9 | 3149 | 4666 |
| 12000 | CUT-OFF SAW OPERATOR | 512 | 90.6 | 92.6 | 3109 | 3965 |
| 14803 | TRIMMER OPERATOR | 768 | 87.5 | 92.7 | 3005 | 6239 |
| 26101 | CLEAN-UP MAN/REGULAR | 512 | 90.3 | 91.4 | 2996 | 3454 |
| 19000 | SPECIALTY RESAW OPER | 256 | 96.5 | 103.1 | 2961 | 5062 |
| 19102 | SPECIALTY RESAW OFFB | 512 | 90.0 | 91.4 | 2883 | 3452 |
| 15402 | STACKER-GREEN | 1281 | 84.5 | 90.3 | 2876 | 7545 |
| 26600 | HELPER | 1537 | 83.5 | 87.2 | 2807 | 5711 |
| 24500 | FILER | 512 | 89.6 | 90.4 | 2734 | 3044 |
| 16102 | UNSTACKER-DRY | 512 | 89.4 | 90.1 | 2640 | 2917 |
| 26103 | CLEAN-UP MAN/REGULAR | 512 | 89.2 | 90.5 | 2596 | 3071 |
| 23801 | PIPE-FITTERS | 512 | 89.2 | 90.1 | 2586 | 2915 |
| 13803 | HOG OPERATOR | 256 | 95.0 | 100.6 | 2560 | 4214 |
| 19001 | SPECIALTY RESAW OPER | 256 | 94.6 | 100.4 | 2464 | 4123 |
| 19101 | SPECIALTY RESAW OFFB | 256 | 94.6 | 100.4 | 2464 | 4123 |
| 20202 | FORKLIFT OPERATOR | 768 | 86.3 | 88.6 | 2443 | 3545 |
| 15901 | TRANSFER OPERATOR | 512 | 88.8 | 103.6 | 2433 | 10460 |
| 18200 | TALLYMEN | 768 | 86.2 | 93.0 | 2411 | 6251 |
| 17901 | BANDER OPERATOR | 512 | 88.6 | 89.7 | 2368 | 2772 |
| 18100 | CHECKERS | 1537 | 82.8 | 85.5 | 2359 | 4277 |
| 16500 | RIPSAW OPERATOR | 256 | 94.0 | 94.0 | 2313 | 2313 |
| 16300 | GRADER/SORTING CHAIN | 512 | 88.4 | 92.1 | 2310 | 3735 |
| 16201 | UNSTACKER PULLER | 768 | 86.0 | 86.8 | 2305 | 3665 |
| 14400 | LUMBER DIVERTER | 256 | 93.5 | 95.7 | 2203 | 2756 |
| 19002 | SPECIALTY RESAW OPER | 512 | 88.0 | 90.8 | 2165 | 3210 |
| 23302 | CARPENTERS | 256 | 93.3 | 93.7 | 2134 | 2235 |
| 14805 | TRIMMER OPERATOR | 512 | 87.7 | 95.9 | 2075 | 5611 |

TABLE 5-1 (Cont'd) PERSONNEL NOISE EXPOSURE AND IMPACT

EPA CRITERIA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND LEVEL MEAN | SOUND LEVEL M.C. | LEV. WT. MEAN | LEV. WT. PUP. M.C. |
|---|---|---|---|---|---|---|
| 14801 | TRIMMER OPERATOR | 256 | 92.8 | 95.3 | 2035 | 2646 |
| 11700 | DECK SCALER | 512 | 87.5 | 92.5 | 2002 | 3924 |
| 26105 | CLEAN-UP MAN/REGULAR | 256 | 92.6 | 94.6 | 1974 | 2452 |
| 23301 | CARPENTERS | 256 | 92.5 | 95.4 | 1954 | 2663 |
| 26603 | HELPER | 256 | 92.5 | 95.4 | 1954 | 2663 |
| 18202 | TALLYMEN | 1025 | 83.7 | 88.8 | 1925 | 4847 |
| 18600 | RIPSAW OFFBEARER | 256 | 92.0 | 92.0 | 1851 | 1851 |
| 13800 | HOG OPERATOR | 256 | 92.0 | 92.5 | 1851 | 1956 |
| 24801 | POWERHOUSE OPERATOR | 768 | 84.7 | 87.7 | 1796 | 3111 |
| 24800 | POWERHOUSE OPERATOR | 768 | 84.6 | 87.6 | 1779 | 3045 |
| 22802 | ELECTRICIANS | 256 | 91.1 | 91.4 | 1658 | 1731 |
| 14301 | UNSCRAMBLE OPERATOR | 512 | 86.2 | 90.6 | 1615 | 3114 |
| 18201 | TALLYMEN | 512 | 86.0 | 92.6 | 1551 | 3983 |
| 15404 | STACKER-GREEN | 512 | 85.5 | 91.1 | 1402 | 3313 |
| 17302 | GRADER/PLANER MILL | 256 | 89.8 | 92.4 | 1396 | 1936 |
| 15600 | UNIPAC OPERATOR | 512 | 85.4 | 88.3 | 1397 | 2274 |
| 15503 | STICKERMAN-GREEN | 512 | 85.4 | 91.8 | 1393 | 3626 |
| 16001 | KILN OPERATOR | 512 | 85.3 | 88.8 | 1363 | 2435 |
| 26504 | LABORER | 256 | 89.5 | 89.5 | 1348 | 1348 |
| 23800 | PIPE-FITTERS | 256 | 89.4 | 89.4 | 1331 | 1331 |
| 19600 | MOULDER FEEDER | 256 | 89.3 | 89.3 | 1316 | 1316 |
| 14500 | GREEN CHAIN OPERATOR | 512 | 85.1 | 88.6 | 1311 | 2377 |
| 14502 | GREEN CHAIN OPERATOR | 512 | 84.9 | 89.4 | 1260 | 2664 |
| 26104 | CLEAN-UP MAN/REGULAR | 256 | 88.9 | 89.2 | 1242 | 1295 |
| 15502 | STICKERMAN-GREEN | 512 | 84.7 | 90.2 | 1201 | 2975 |
| 24402 | FILERS | 1281 | 80.9 | 85.6 | 1131 | 3594 |
| 11403 | DEBARKER OPERATOR | 256 | 88.1 | 88.1 | 1106 | 1106 |
| 17300 | GRADER/PLANER MILL | 256 | 88.0 | 94.1 | 1082 | 2333 |
| 26503 | LABORER | 256 | 87.8 | 89.6 | 1046 | 1370 |
| 21600 | SHOPMAN/GENERAL | 256 | 87.7 | 88.9 | 1030 | 1234 |
| 18204 | TALLYMEN | 256 | 87.5 | 89.8 | 1003 | 1396 |
| 19601 | MOULDER FEEDER | 512 | 83.7 | 88.5 | 969 | 2347 |
| 26100 | CLEAN-UP MAN/REGULAR | 256 | 87.3 | 89.2 | 965 | 1285 |
| 11101 | LOG CARRIER OPER | 256 | 87.0 | 87.0 | 921 | 921 |
| 26200 | CLEAN-UP MAN/DOWN TM | 256 | 87.0 | 88.9 | 915 | 1245 |
| 17902 | BANDER OPERATOR | 512 | 83.3 | 84.9 | 889 | 1246 |
| 17903 | BANDER OPERATOR | 768 | 81.7 | 82.9 | 859 | 1185 |
| 26102 | CLEAN-UP MAN/REGULAR | 256 | 86.3 | 88.0 | 813 | 1087 |
| 16301 | GRADER/SORTING CHAIN | 256 | 86.0 | 90.2 | 779 | 1479 |
| 19700 | MOULDER OFFBEARER | 768 | 81.3 | 86.0 | 771 | 3244 |

ENVIRONMENTAL PROTECTION AGENCY  BBN JOB NO. 9635

TABLE 5-1 PERSONNEL NOISE EXPOSURE AND IMPACT
(Cont'd)

EPA CRITERIA

SIC CODE = 242  AVERAGE FOR INDUSTRY  NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND LEVEL MEAN | SOUND LEVEL M.C. | LEV. HT. MEAN | POP. M.C. |
|---|---|---|---|---|---|---|
| 16101 | UNSTACKER-DRY | 256 | 86.0 | 88.8 | 768 | 1221 |
| 21300 | MILLWRIGHT/PLANER | 256 | 85.6 | 86.7 | 720 | 879 |
| 15401 | STACKER-GREEN | 256 | 85.0 | 87.9 | 639 | 1060 |
| 17602 | DRY CHAIN PULLER | 256 | 85.0 | 87.4 | 638 | 980 |
| 17303 | GRADER/PLANER MILL | 256 | 84.6 | 86.6 | 596 | 860 |
| 14300 | UNSCRAMBLE OPERATOR | 256 | 84.5 | 86.1 | 574 | 795 |
| 14501 | GREEN CHAIN OPERATOR | 256 | 84.3 | 85.6 | 551 | 725 |
| 16003 | KILN OPERATOR | 256 | 84.0 | 84.0 | 517 | 517 |
| 12701 | TAIL SAWYER | 256 | 82.8 | 87.3 | 390 | 965 |
| 16002 | KILN OPERATOR | 256 | 82.7 | 84.0 | 379 | 1252 |
| 16000 | KILN OPERATOR | 1025 | 78.7 | 85.0 | 349 | 2542 |
| 11404 | DEBARKER OPERATOR | 2050 | 77.6 | 83.6 | 334 | 3619 |
| 26502 | LABORER | 256 | 81.9 | 84.6 | 301 | 587 |
| 13100 | GANG SAW OPERATOR | 1025 | 77.9 | 79.2 | 208 | 456 |
| 11405 | DEBARKER OPERATOR | 512 | 78.3 | 85.0 | 138 | 1290 |
| 11401 | DEBARKER OPERATOR | 512 | 77.8 | 84.2 | 103 | 1081 |
| 11402 | DEBARKER OPERATOR | 512 | 77.5 | 83.9 | 78 | 1011 |
| 15103 | GREEN CHAIN PULLER | 512 | 76.0 | 76.0 | 12 | 12 |
| 14001 | RESAW OPERATOR | 512 | <75.0 | <75.0 | 0 | 0 |
| 11400 | DEBARKER OPERATOR | 512 | <75.0 | 79.8 | 0 | 292 |
| 20701 | RAILCAR LOADER | 2819 | <75.0 | 79.3 | 0 | 1318 |
| 21900 | MACHINISTS | 512 | <75.0 | 75.7 | 0 | 175 |
| 11406 | DEBARKER OPERATOR | 512 | <75.0 | <75.0 | 0 | 0 |
| 21902 | MACHINISTS | 2050 | <75.0 | <75.0 | 0 | 0 |
| 22300 | MECHANICS | 2050 | <75.0 | <75.0 | 0 | 0 |
| 10700 | POND SORTER | 1537 | <75.0 | <75.0 | 0 | 0 |
| 10800 | LOG SORTER | 512 | <75.0 | <75.0 | 0 | 0 |
| 11100 | LOG CARRIER OPER | 256 | <75.0 | <75.0 | 0 | 0 |
| 16004 | KILN OPERATOR | 768 | <75.0 | <75.0 | 0 | 0 |
| 17900 | BANDER OPERATOR | 512 | <75.0 | <75.0 | 0 | 0 |
| 18203 | TALLYMEN | 1537 | <75.0 | <75.0 | 0 | 0 |
| 20700 | RAILCAR LOADER | 512 | <75.0 | <75.0 | 0 | 0 |
| 21700 | WELDER | 256 | <75.0 | <75.0 | 0 | 0 |
| 21901 | MACHINISTS | 1025 | <75.0 | <75.0 | 0 | 0 |
| 22301 | MECHANICS | 3844 | <75.0 | <75.0 | 0 | 0 |
| 24403 | FILERS | 1537 | <75.0 | <75.0 | 0 | 0 |
| 26201 | CLEAN-UP MAN/DOWN TR | 1025 | <75.0 | <75.0 | 0 | 0 |
| 26500 | LABORER | 512 | <75.0 | <75.0 | 0 | 0 |
| 26601 | HELPER | 256 | <75.0 | <75.0 | 0 | 0 |

ENVIRONMENTAL PROTECTION AGENCY BGN JOB NO. 9035

TABLE 5-2 PERSONNEL NOISE EXPOSURE AND IMPACT

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND LEVEL MEAN | SOUND LEVEL M.C. | DAILY NOISE DOSE MEAN | DAILY NOISE DOSE M.C. |
|---|---|---|---|---|---|---|
| 16800 | PLANER SET-UP MAN | 1537 | 106.4 | 112.1 | 12.74 | 21.38 |
| 16803 | PLANER SET-UP MAN | 256 | 102.3 | 105.8 | 5.52 | 8.98 |
| 16804 | PLANER SET-UP MAN | 512 | 100.5 | 103.3 | 4.28 | 6.35 |
| 13703 | CHIPPER OPERATOR | 512 | 100.3 | 103.9 | 4.19 | 6.82 |
| 13701 | CHIPPER OPERATOR | 768 | 99.0 | 103.2 | 3.50 | 6.24 |
| 16702 | PLANER OPERATOR | 1794 | 97.9 | 102.2 | 2.98 | 5.44 |
| 12700 | TAIL SAWYER | 1537 | 97.6 | 103.7 | 2.87 | 6.66 |
| 12800 | QUADSAW TAIL SAWYER | 512 | 97.0 | 97.0 | 2.64 | 2.64 |
| 21302 | MILLWRIGHT/PLANER | 768 | 96.7 | 103.5 | 2.53 | 4.26 |
| 19000 | SPECIALTY RESAW OPER | 256 | 96.5 | 103.1 | 2.46 | 6.15 |
| 13801 | HOG OPERATOR | 512 | 96.0 | 98.8 | 2.30 | 3.40 |
| 13702 | CHIPPER OPERATOR | 512 | 95.8 | 98.7 | 2.25 | 3.35 |
| 15102 | GREEN CHAIN PULLER | 3079 | 95.3 | 97.3 | 2.07 | 2.76 |
| 16801 | PLANER SET-UP MAN | 512 | 95.0 | 97.6 | 1.99 | 2.85 |
| 14402 | LUMBER DIVERTER | 768 | 94.9 | 95.9 | 1.97 | 2.62 |
| 19100 | SPECIALTY RESAW OFFB | 512 | 94.7 | 97.9 | 1.91 | 2.98 |
| 13700 | CHIPPER OPERATOR | 512 | 94.3 | 97.2 | 1.81 | 2.72 |
| 18500 | RIPSAW OPERATOR | 256 | 94.0 | 94.0 | 1.74 | 1.74 |
| 16700 | PLANER OPERATOR | 2306 | 94.0 | 97.5 | 1.74 | 2.83 |
| 19001 | SPECIALTY RESAW OPER | 256 | 94.0 | 99.2 | 1.73 | 3.58 |
| 19101 | SPECIALTY RESAW OFFB | 256 | 94.0 | 99.2 | 1.73 | 3.58 |
| 11701 | DECK SCALER | 512 | 93.9 | 94.2 | 1.73 | 1.80 |
| 16703 | PLANER OPERATOR | 2050 | 93.7 | 96.6 | 1.68 | 2.51 |
| 16701 | PLANER OPERATOR | 1025 | 93.7 | 97.3 | 1.67 | 2.74 |
| 14401 | LUMBER DIVERTER | 768 | 93.6 | 95.7 | 1.66 | 2.20 |
| 14400 | LUMBER DIVERTER | 256 | 93.5 | 95.7 | 1.63 | 2.20 |
| 13802 | HOG OPERATOR | 512 | 93.3 | 94.2 | 1.57 | 1.79 |
| 24501 | OILER | 512 | 93.2 | 95.1 | 1.56 | 2.03 |
| 21101 | MILLWRIGHT/GENERAL | 1025 | 93.2 | 95.1 | 1.56 | 2.03 |
| 10103 | SAWMILL SUPERVISOR | 512 | 93.0 | 93.4 | 1.52 | 1.60 |
| 24502 | OILER | 512 | 93.0 | 93.4 | 1.52 | 1.60 |
| 21103 | MILLWRIGHT/GENERAL | 1281 | 93.0 | 93.4 | 1.52 | 1.60 |
| 13400 | EDGER OPERATOR | 2819 | 93.0 | 102.5 | 1.52 | 3.64 |
| 13803 | HOG OPERATOR | 256 | 93.0 | 95.7 | 1.52 | 3.32 |
| 17301 | GRADER/PLANER MILL | 1537 | 92.8 | 92.8 | 1.48 | 1.48 |
| 17305 | GRADER/PLANER MILL | 5126 | 92.8 | 95.4 | 1.47 | 2.11 |

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9635

TABLE 5-2 (Cont'd) PERSONNEL NOISE EXPOSURE AND IMPACT

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND LEVEL MEAN | SOUND LEVEL M.C. | DAILY NOISE DOSE MEAN | DAILY NOISE DOSE M.C. |
|---|---|---|---|---|---|---|
| 17306 | GRADER/PLANER MILL | 4100 | 92.7 | 94.7 | 1.46 | 1.91 |
| 21200 | MILLWRIGHT/SAWMILL | 2050 | 92.6 | 92.9 | 1.43 | 1.50 |
| 26105 | CLEAN-UP MAN/REGULAR | 256 | 92.6 | 94.6 | 1.43 | 1.88 |
| 13300 | SLAB BOARD PULLER | 512 | 92.5 | 93.2 | 1.41 | 1.56 |
| 22803 | ELECTRICIANS | 768 | 92.5 | 92.8 | 1.41 | 1.48 |
| 23302 | CARPENTERS | 256 | 92.5 | 92.8 | 1.41 | 1.48 |
| 21104 | MILLWRIGHT/GENERAL | 1025 | 92.3 | 96.1 | 1.38 | 2.33 |
| 14302 | UNSCRAMBLE OPERATOR | 512 | 92.0 | 95.5 | 1.32 | 2.13 |
| 18600 | RIPSAW OFFBEARER | 256 | 92.0 | 92.0 | 1.32 | 1.32 |
| 10102 | SAWMILL SUPERVISOR | 768 | 92.0 | 92.4 | 1.32 | 1.39 |
| 10401 | PLANER SUPERVISOR | 768 | 92.0 | 92.4 | 1.32 | 1.39 |
| 23300 | CARPENTERS | 512 | 92.0 | 92.4 | 1.32 | 1.39 |
| 14801 | TRIMMER OPERATOR | 256 | 91.9 | 94.5 | 1.31 | 1.88 |
| 14802 | TRIMMER OPERATOR | 768 | 91.7 | 94.7 | 1.27 | 1.92 |
| 22801 | ELECTRICIANS | 512 | 91.7 | 94.0 | 1.27 | 1.75 |
| 26501 | LABORER | 512 | 91.7 | 94.0 | 1.27 | 1.75 |
| 26602 | HELPER | 512 | 91.7 | 94.0 | 1.27 | 1.75 |
| 23301 | CARPENTERS | 256 | 91.7 | 94.0 | 1.27 | 1.75 |
| 26603 | HELPER | 256 | 91.7 | 94.0 | 1.27 | 1.75 |
| 26106 | CLEAN-UP MAN/REGULAR | 512 | 91.5 | 95.4 | 1.23 | 2.11 |
| 14804 | TRIMMER OPERATOR | 768 | 91.2 | 94.7 | 1.19 | 1.92 |
| 16802 | PLANER SET-UP MAN | 512 | 91.2 | 95.2 | 1.18 | 2.05 |
| 14000 | RESAW OPERATOR | 2963 | 90.7 | 93.1 | 1.11 | 1.54 |
| 21202 | MILLWRIGHT/SAWMILL | 768 | 90.7 | 91.1 | 1.10 | 1.17 |
| 10101 | SAWMILL SUPERVISOR | 768 | 90.6 | 91.7 | 1.09 | 1.27 |
| 13800 | HOG OPERATOR | 256 | 90.1 | 90.6 | 1.02 | 1.08 |
| 14807 | TRIMMER OPERATOR | 1025 | 90.0 | 90.0 | 1.00 | 1.00 |
| 21903 | MACHINISTS | 1281 | <90.0 | <90.0 | 0.96 | 0.96 |
| 21102 | MILLWRIGHT/GENERAL | 512 | <90.0 | <90.0 | 0.88 | 0.91 |
| 22802 | ELECTRICIANS | 256 | <90.0 | <90.0 | 0.88 | 0.91 |
| 26101 | CLEAN-UP MAN/REGULAR | 512 | <90.0 | 90.1 | 0.88 | 1.01 |
| 10100 | SAWMILL SUPERVISOR | 512 | <90.0 | <90.0 | 0.82 | 0.86 |
| 24400 | FILERS | 512 | <90.0 | <90.0 | 0.82 | 0.86 |
| 15900 | TRANSFER OPERATOR | 768 | <90.0 | 104.0 | 0.80 | 0.95 |
| 10400 | PLANER SUPERVISOR | 768 | <90.0 | <90.0 | 0.80 | 0.92 |
| 17302 | GRADER/PLANER MILL | 256 | <90.0 | 93.4 | 0.74 | 1.06 |

ENVIRONMENTAL PROTECTION AGENCY BSN JOB NO. 9635

TABLE 5-2 PERSONNEL NOISE EXPOSURE AND IMPACT
(Cont'd)

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND LEVEL MEAN | SOUND LEVEL M.C. | DAILY NOISE DOSE MEAN | DAILY NOISE DOSE M.C. |
|---|---|---|---|---|---|---|
| 21201 | MILLWRIGHT/SAWMILL | 1025 | <90.0 | <90.0 | 0.73 | 0.90 |
| 21100 | MILLWRIGHT/GENERAL | 10252 | <90.0 | <90.0 | 0.72 | 0.94 |
| 22800 | ELECTRICIANS | 7669 | <90.0 | <90.0 | 0.72 | 0.94 |
| 10402 | PLANER SUPERVISOR | 1025 | <90.0 | <90.0 | 0.71 | 0.94 |
| 21301 | MILLWRIGHT/PLANER | 768 | <90.0 | <90.0 | 0.71 | 0.94 |
| 14806 | TRIMMER OPERATOR | 1025 | <90.0 | 90.5 | 0.66 | 1.07 |
| 26504 | LABORER | 256 | <90.0 | <90.0 | 0.64 | 0.64 |
| 15901 | TRANSFER OPERATOR | 512 | <90.0 | 101.6 | 0.57 | 4.96 |
| 23801 | PIPE-FITTERS | 512 | <90.0 | <90.0 | 0.55 | 0.62 |
| 23303 | CARPENTERS | 1025 | <90.0 | <90.0 | 0.55 | 0.62 |
| 23800 | PIPE-FITTERS | 256 | <90.0 | <90.0 | 0.52 | 0.52 |
| 17901 | BANDER OPERATOR | 512 | <90.0 | <90.0 | 0.50 | 0.59 |
| 10104 | SAWMILL SUPERVISOR | 768 | <90.0 | <90.0 | 0.49 | 0.60 |
| 26103 | CLEAN-UP MAN/REGULAR | 512 | <90.0 | <90.0 | 0.49 | 0.60 |
| 21600 | SHOPMAN/GENERAL | 256 | <90.0 | <90.0 | 0.44 | 0.51 |
| 26503 | LABORER | 256 | <90.0 | <90.0 | 0.43 | 0.56 |
| 19600 | MOULDER FEEDER | 256 | <90.0 | <90.0 | 0.40 | 0.40 |
| 11403 | DEBARKER OPERATOR | 256 | <90.0 | <90.0 | 0.39 | 0.39 |
| 22804 | ELECTRICIANS | 1281 | <90.0 | <90.0 | 0.39 | 0.42 |
| 24500 | OILER | 512 | <90.0 | <90.0 | 0.38 | 0.45 |
| 12000 | CUT-OFF SAW OPERATOR | 512 | <90.0 | <90.0 | 0.36 | 0.52 |
| 21300 | MILLWRIGHT/PLANER | 256 | <90.0 | <90.0 | 0.31 | 0.36 |
| 26102 | CLEAN-UP MAN/REGULAR | 256 | <90.0 | <90.0 | 0.29 | 0.38 |
| 26104 | CLEAN-UP MAN/REGULAR | 256 | <90.0 | <90.0 | 0.27 | 0.29 |
| 17604 | DRY CHAIN PULLER | 1025 | <90.0 | <90.0 | 0.22 | 0.39 |
| 18204 | TALLYMEN | 256 | <90.0 | <90.0 | 0.22 | 0.39 |
| 16102 | UNSTACKER-DRY | 512 | <90.0 | <90.0 | 0.21 | 0.26 |
| 26200 | CLEAN-UP MAN/DOWN TM | 256 | <90.0 | <90.0 | 0.16 | 0.29 |
| 10700 | POND SORTER | 1537 | <90.0 | <90.0 | 0.00 | 0.0 |
| 10800 | LOG SORTER | 512 | <90.0 | <90.0 | 0.00 | 0.0 |
| 11100 | LOG CARRIER OPER | 256 | <90.0 | <90.0 | 0.00 | 0.0 |
| 11101 | LOG CARRIER OPER | 256 | <90.0 | <90.0 | 0.00 | 0.0 |
| 11400 | DEBARKER OPERATOR | 512 | <90.0 | <90.0 | 0.00 | 0.0 |
| 11401 | DEBARKER OPERATOR | 512 | <90.0 | <90.0 | 0.00 | 0.0 |
| 11402 | DEBARKER OPERATOR | 512 | <90.0 | <90.0 | 0.00 | 0.0 |
| 11404 | DEBARKER OPERATOR | 2050 | <90.0 | <90.0 | 0.00 | 0.0 |

ENVIRONMENTAL PROTECTION AGENCY BGN JOB NO. 9635

TABLE 5-2 (Cont'd) PERSONNEL NOISE EXPOSURE AND IMPACT

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND LEVEL MEAN | SOUND LEVEL M.C. | DAILY NOISE DOSE MEAN | DAILY NOISE DOSE M.C. |
|---|---|---|---|---|---|---|
| 11405 | DEBARKER OPERATOR | 512 | <90.0 | <90.0 | 0.00 | 0.0 |
| 11406 | DEBARKER OPERATOR | 512 | <90.0 | <90.0 | 0.00 | 0.0 |
| 11700 | DECK SCALER | 512 | <90.0 | 92.5 | 0.00 | 1.41 |
| 12300 | SAWYER | 4869 | <90.0 | <90.0 | 0.00 | 0.0 |
| 12301 | SAWYER | 1025 | <90.0 | <90.0 | 0.00 | 0.0 |
| 12701 | TAIL SAWYER | 256 | <90.0 | <90.0 | 0.00 | 0.0 |
| 13100 | GANG SAW OPERATOR | 1025 | <90.0 | <90.0 | 0.00 | 0.0 |
| 13401 | EDGER OPERATOR | 3588 | <90.0 | 92.7 | 0.00 | 1.45 |
| 14001 | RESAW OPERATOR | 512 | <90.0 | <90.0 | 0.00 | 0.0 |
| 14300 | UNSCRAMBLE OPERATOR | 256 | <90.0 | <90.0 | 0.00 | 0.0 |
| 14301 | UNSCRAMBLE OPERATOR | 512 | <90.0 | 90.2 | 0.00 | 1.03 |
| 14500 | GREEN CHAIN OPERATOR | 512 | <90.0 | <90.0 | 0.00 | 0.57 |
| 14501 | GREEN CHAIN OPERATOR | 256 | <90.0 | <90.0 | 0.00 | 0.0 |
| 14502 | GREEN CHAIN OPERATOR | 512 | <90.0 | <90.0 | 0.00 | 0.80 |
| 14503 | GREEN CHAIN OPERATOR | 1537 | <90.0 | 91.0 | 0.00 | 1.14 |
| 14800 | TRIMMER OPERATOR | 4357 | <90.0 | 94.9 | 0.00 | 1.98 |
| 14803 | TRIMMER OPERATOR | 768 | <90.0 | 95.6 | 0.00 | 2.16 |
| 14805 | TRIMMER OPERATOR | 512 | <90.0 | 95.9 | 0.00 | 2.27 |
| 15100 | GREEN CHAIN PULLER | 1537 | <90.0 | 91.0 | 0.00 | 1.14 |
| 15101 | GREEN CHAIN PULLER | 2306 | <90.0 | <90.0 | 0.00 | 0.91 |
| 15103 | GREEN CHAIN PULLER | 512 | <90.0 | <90.0 | 0.00 | 0.0 |
| 15400 | STACKER-GREEN | 3331 | <90.0 | 91.4 | 0.00 | 1.21 |
| 15401 | STACKER-GREEN | 256 | <90.0 | <90.0 | 0.00 | 0.0 |
| 15402 | STACKER-GREEN | 1281 | <90.0 | <90.0 | 0.00 | 0.77 |
| 15403 | STACKER-GREEN | 1794 | <90.0 | 92.7 | 0.00 | 1.46 |
| 15404 | STACKER-GREEN | 512 | <90.0 | <90.0 | 0.00 | 0.95 |
| 15500 | STICKERMAN-GREEN | 2050 | <90.0 | <90.0 | 0.00 | 0.94 |
| 15501 | STICKERMAN-GREEN | 1281 | <90.0 | 93.6 | 0.00 | 1.12 |
| 15502 | STICKERMAN-GREEN | 512 | <90.0 | <90.0 | 0.00 | 0.84 |
| 15503 | STICKERMAN-GREEN | 512 | <90.0 | 91.8 | 0.00 | 1.29 |
| 15600 | UNIPAC OPERATOR | 512 | <90.0 | <90.0 | 0.00 | 0.0 |
| 16000 | KILN OPERATOR | 1025 | <90.0 | <90.0 | 0.00 | 0.0 |
| 16001 | KILN OPERATOR | 512 | <90.0 | <90.0 | 0.00 | 0.72 |
| 16002 | KILN OPERATOR | 256 | <90.0 | <90.0 | 0.00 | 0.0 |
| 16003 | KILN OPERATOR | 256 | <90.0 | <90.0 | 0.00 | 0.0 |
| 16004 | KILN OPERATOR | 768 | <90.0 | <90.0 | 0.00 | 0.0 |

ENVIRONMENTAL PROTECTION AGENCY  OMB JOB NO. 9632

TABLE 5-2 (Cont'd) PERSONNEL NOISE EXPOSURE AND IMPACT

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND LEVEL MEAN | SOUND LEVEL M.C. | DAILY NOISE DOSE MEAN | DAILY NOISE DOSE M.C. |
|---|---|---|---|---|---|---|
| 16100 | UNSTACKER-DRY | 1025 | <90.0 | 92.1 | 0.00 | 1.33 |
| 16101 | UNSTACKER-DRY | 256 | <90.0 | <90.0 | 0.00 | 0.53 |
| 16200 | UNSTACKER PULLER | 2050 | <90.0 | <90.0 | 0.00 | 0.0 |
| 16201 | UNSTACKER PULLER | 768 | <90.0 | <90.0 | 0.00 | 0.53 |
| 16300 | GRADER/SORTING CHAIN | 512 | <90.0 | 92.1 | 0.00 | 1.33 |
| 16301 | GRADER/SORTING CHAIN | 256 | <90.0 | <90.0 | 0.00 | 0.91 |
| 17300 | GRADER/PLANER MILL | 256 | <90.0 | 94.1 | 0.00 | 1.76 |
| 17303 | GRADER/PLANER MILL | 256 | <90.0 | <90.0 | 0.00 | 0.0 |
| 17304 | GRADER/PLANER MILL | 2306 | <90.0 | <90.0 | 0.00 | 0.0 |
| 17600 | DRY CHAIN PULLER | 4613 | <90.0 | <90.0 | 0.00 | 0.0 |
| 17601 | DRY CHAIN PULLER | 3075 | <90.0 | <90.0 | 0.00 | 0.0 |
| 17602 | DRY CHAIN PULLER | 256 | <90.0 | <90.0 | 0.00 | 0.0 |
| 17603 | DRY CHAIN PULLER | 2563 | <90.0 | <90.0 | 0.00 | 0.0 |
| 17605 | DRY CHAIN PULLER | 6663 | <90.0 | <90.0 | 0.00 | 0.0 |
| 17606 | DRY CHAIN PULLER | 5126 | <90.0 | <90.0 | 0.00 | 0.0 |
| 17900 | BANDER OPERATOR | 512 | <90.0 | <90.0 | 0.00 | 0.0 |
| 17902 | BANDER OPERATOR | 512 | <90.0 | <90.0 | 0.00 | 0.0 |
| 17903 | BANDER OPERATOR | 768 | <90.0 | <90.0 | 0.00 | 0.0 |
| 18100 | CHECKERS | 1537 | <90.0 | <90.0 | 0.00 | 0.0 |
| 18200 | TALLYMEN | 768 | <90.0 | 93.0 | 0.00 | 1.52 |
| 18201 | TALLYMEN | 512 | <90.0 | 92.3 | 0.00 | 1.37 |
| 18202 | TALLYMEN | 1025 | <90.0 | <90.0 | 0.00 | 0.0 |
| 18203 | TALLYMEN | 1537 | <90.0 | <90.0 | 0.00 | 0.0 |
| 19002 | SPECIALTY RESAW OPER | 512 | <90.0 | 90.8 | 0.00 | 1.12 |
| 19102 | SPECIALTY RESAW OFFB | 512 | <90.0 | 91.4 | 0.00 | 1.22 |
| 19601 | MOULDER FEEDER | 512 | <90.0 | <90.0 | 0.00 | 0.0 |
| 19700 | MOULDER OFFBEARER | 768 | <90.0 | <90.0 | 0.00 | 0.0 |
| 20100 | LUMBER CARRIER OPER | 2306 | <90.0 | <90.0 | 0.00 | 0.0 |
| 20101 | LUMBER CARRIER OPER | 2819 | <90.0 | <90.0 | 0.00 | 0.0 |
| 20200 | FORKLIFT OPERATOR | 5895 | <90.0 | <90.0 | 0.00 | 0.67 |
| 20201 | FORKLIFT OPERATOR | 1794 | <90.0 | 90.2 | 0.00 | 1.03 |
| 20202 | FORKLIFT OPERATOR | 768 | <90.0 | <90.0 | 0.00 | 0.51 |
| 20203 | FORKLIFT OPERATOR | 4869 | <90.0 | 90.2 | 0.00 | 1.03 |
| 20204 | FORKLIFT OPERATOR | 1281 | <90.0 | <90.0 | 0.00 | 0.82 |
| 20700 | RAILCAR LOADER | 512 | <90.0 | <90.0 | 0.00 | 0.0 |
| 20701 | RAILCAR LOADER | 2819 | <90.0 | <90.0 | 0.00 | 0.0 |

TABLE 5-2 PERSONNEL NOISE EXPOSURE AND IMPACT
(Cont'd)

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND LEVEL MEAN | SOUND LEVEL M.C. | DAILY NOISE DOSE MEAN | DAILY NOISE DOSE M.C. |
|---|---|---|---|---|---|---|
| 21700 | WELDER | 256 | <90.0 | <90.0 | 0.00 | 0.0 |
| 21900 | MACHINISTS | 512 | <90.0 | <90.0 | 0.00 | 0.0 |
| 21901 | MACHINISTS | 1025 | <90.0 | <90.0 | 0.00 | 0.0 |
| 21902 | MACHINISTS | 2050 | <90.0 | <90.0 | 0.00 | 0.0 |
| 22300 | MECHANICS | 2050 | <90.0 | <90.0 | 0.00 | 0.0 |
| 22301 | MECHANICS | 3844 | <90.0 | <90.0 | 0.00 | 0.0 |
| 24401 | FILERS | 3588 | <90.0 | <90.0 | 0.00 | 0.0 |
| 24402 | FILERS | 1281 | <90.0 | <90.0 | 0.00 | 0.0 |
| 24403 | FILERS | 1537 | <90.0 | <90.0 | 0.00 | 0.0 |
| 24800 | POWERHOUSE OPERATOR | 768 | <90.0 | <90.0 | 0.00 | 0.0 |
| 24801 | POWERHOUSE OPERATOR | 768 | <90.0 | <90.0 | 0.00 | 0.0 |
| 24802 | POWERHOUSE OPERATOR | 3075 | <90.0 | <90.0 | 0.00 | 0.70 |
| 26100 | CLEAN-UP MAN/REGULAR | 256 | <90.0 | <90.0 | 0.00 | 0.33 |
| 26201 | CLEAN-UP MAN/DOWN TM | 1025 | <90.0 | <90.0 | 0.00 | 0.0 |
| 26202 | CLEAN-UP MAN/DOWN TM | 768 | <90.0 | 90.9 | 0.00 | 1.14 |
| 26500 | LABORER | 512 | <90.0 | <90.0 | 0.00 | 0.0 |
| 26502 | LABORER | 256 | <90.0 | <90.0 | 0.00 | 0.0 |
| 26600 | HELPER | 1537 | <90.0 | <90.0 | 0.00 | 0.51 |
| 26601 | HELPER | 256 | <90.0 | <90.0 | 0.00 | 0.0 |

used in the input data. The last two digits have been added to separate out personnel who belong to the same personnel category (represented by a three digit code) but who have job assignments involving different equipment types.

The second column labeled "job description" is a brief 20-letter description of the three-digit job category from which the subcategory was derived. The next column indicates the number of personnel to be found in the subcategory described in the previous two columns.

The fourth and fifth columns labeled "sound level" correspond to the mean and estimated worst case equivalent eight-hour sound levels for each subcategory. The equivalent eight-hour sound level is the continuous sound level which would result in the same exposure in an eight-hour period for the particular personnel subcategory. This quantity is identified as the "mean sound level" in the tables and is calculated differently, depending on whether EPA or OSHA criteria are used. Thus the numbers in these columns cannot be expected to agree for the same subcategory in Tables 5-1 and 5-2. As explained in Section 3, the worst case estimate is derived from the mean using both the standard deviation for the sound level measurements and the standard deviation for the time allocated to each job assignment. In some cases there is insufficient data to allow valid calculation of the worst case; in these instances the worst case estimate is the same as the mean.

The sixth and seventh columns in Tables 5-1 and 5-2 are a measure of the personnel noise exposure impact, calculated using EPA criteria in Table 5-1 (Level Weighted Population - $LWP_i$) and OSHA criteria in Table 5-2 (Daily Noise Dose - $d_i$). Again the worst case is calculated from the mean in a similar way to that decribed for the equivalent eight-hour sound level.

As expected the results obtained using the two criteria are not in agreement. The disagreement is attributed to the following reasons:

1. OSHA criteria does not take into account the number of people in each personnel category whereas EPA does.

2. EPA criteria takes into account sound levels between 75 dBA and 90 dBA when calculating exposure; OSHA criteria does not.

3. EPA criteria uses an equivalence of 3 dBA for halving of the exposure time; OSHA uses 5 dBA.

In Tables 5-3 and 5-4 the results for the individual personnel subcategories having five-digit job codes are combined into categories with three-digit job codes by averaging subcategories with the same first three digits. The resulting personnel categories correspond to the categories in the program input data and the corresponding results are simpler to interpret than the more detailed results of Tables 5-1 and 5-2. Tables 5-3 and 5-4 have the same arrangement as Tables 5-1 and 5-2 and no further explanation of items contained in the table is necessary. The personnel categories are rank ordered in terms of their exposure impact, allowing the most important categories to be seen at a glance. As expected, different results are obtained when the OSHA criteria are used in place of the EPA criteria.

Beneath each of Tables 5-3 and 5-4 is a summary of the results showing the number of people overexposed. For reasons listed earlier the number of people with an equivalent eight-hour sound level in excess of 90 dBA (calculated using EPA criteria) is not in agreement with the number of people overexposed, calculated using OSHA criteria (daily noise dose greater than 1.0).

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9635

TABLE 5-3 PERSONNEL NOISE EXPOSURE AND IMPACT AVERAGES

EPA CRITERIA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND MEAN | LEVEL M.C. | LEV. HT. PUP. MEAN | LEV. HT. PUP. M.C. |
|---|---|---|---|---|---|---|
| 173 | GRADER/PLANER MILL | 13837 | 91.0 | 93.6 | 92323 | 121382 |
| 211 | MILLWRIGHT/GENERAL | 14095 | 90.6 | 92.7 | 86567 | 111543 |
| 168 | PLANER SET-UP MAN | 3329 | 105.7 | 109.5 | 79853 | 100769 |
| 167 | PLANER OPERATOR | 7175 | 95.7 | 99.6 | 78610 | 111653 |
| 176 | DRY CHAIN PULLER | 23321 | 85.3 | 88.1 | 62407 | 100916 |
| 228 | ELECTRICIANS | 10506 | 90.0 | 91.9 | 59679 | 75452 |
| 148 | TRIMMER OPERATOR | 9479 | 89.2 | 94.8 | 49056 | 93561 |
| 151 | GREEN CHAIN PULLER | 7430 | 89.2 | 92.3 | 43544 | 61372 |
| 202 | FORKLIFT OPERATOR | 14607 | 85.7 | 89.3 | 41980 | 75054 |
| 134 | EDGER OPERATOR | 6407 | 89.4 | 97.7 | 36306 | 66772 |
| 137 | CHIPPER OPERATOR | 2304 | 99.1 | 103.1 | 33812 | 45672 |
| 212 | MILLWRIGHT/SAWMILL | 3843 | 92.3 | 93.0 | 28839 | 31331 |
| 101 | SAWMILL SUPERVISOR | 3328 | 91.6 | 92.4 | 23122 | 25305 |
| 154 | STACKER-GREEN | 7174 | 85.8 | 91.7 | 20841 | 50144 |
| 127 | TAIL SAWYER | 1793 | 95.5 | 101.5 | 20058 | 32680 |
| 213 | MILLWRIGHT/PLANER | 1792 | 94.9 | 97.5 | 20005 | 25783 |
| 140 | RESAW OPERATOR | 3075 | 89.1 | 90.9 | 16887 | 23680 |
| 144 | LUMBER DIVERTER | 1792 | 94.6 | 96.6 | 17226 | 21006 |
| 261 | CLEAN-UP MAN/REGULAR | 2560 | 90.7 | 92.5 | 16617 | 20617 |
| 138 | HOG OPERATOR | 1536 | 95.2 | 97.6 | 15862 | 20126 |
| 104 | PLANER SUPERVISOR | 2561 | 90.6 | 91.9 | 15828 | 16367 |
| 248 | POWERHOUSE OPERATOR | 4611 | 86.2 | 89.5 | 14566 | 24367 |
| 233 | CARPENTERS | 2049 | 91.1 | 92.1 | 13473 | 15146 |
| 201 | LUMBER CARRIER OPER | 5125 | 84.5 | 87.1 | 11757 | 18804 |
| 245 | OILER | 1536 | 92.3 | 93.5 | 11596 | 13362 |
| 123 | SAWYER | 5894 | 83.5 | 87.2 | 11210 | 21627 |
| 155 | STICKERMAN-GREEN | 4355 | 85.0 | 90.9 | 10955 | 27729 |
| 191 | SPECIALTY RESAW OPER | 1280 | 92.8 | 95.8 | 10304 | 14285 |
| 266 | HELPER | 2561 | 84.4 | 87.5 | 8843 | 13807 |
| 219 | MACHINISTS | 4868 | <75.0 | 77.5 | 8541 | 8716 |
| 145 | GREEN CHAIN OPERATOR | 2817 | 85.7 | 89.8 | 8178 | 15571 |
| 161 | UNSTACKER-DRY | 1793 | 88.3 | 91.0 | 8031 | 11610 |
| 244 | FILERS | 6918 | 78.3 | 81.6 | 7790 | 17485 |
| 190 | SPECIALTY RESAW OPER | 1024 | 91.8 | 96.3 | 7592 | 12396 |
| 182 | TALLYMEN | 4098 | 77.7 | 81.2 | 6891 | 16479 |
| 265 | LABORER | 1792 | 82.1 | 83.6 | 6779 | 8734 |
| 117 | DECK SCALER | 1024 | 90.8 | 93.6 | 6665 | 8053 |
| 159 | TRANSFER OPERATOR | 1280 | 89.3 | 104.4 | 6580 | 27777 |
| 128 | QUADSAW TAIL SAWYER | 512 | 97.0 | 97.0 | 6202 | 6202 |
| 143 | UNSCRAMBLE OPERATOR | 1280 | 86.2 | 91.6 | 5893 | 9276 |

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TABLE 5-3 (Cont'd) PERSONNEL NOISE EXPOSURE AND IMPACT AVERAGES

EPA CRITERIA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND MEAN | LEVEL M.C. | LEV. HT. MEAN | POP. M.C. |
|---|---|---|---|---|---|---|
| 162 | UNSTACKER PULLER | 2818 | 83.7 | 89.0 | 5523 | 13749 |
| 179 | BANDER OPERATOR | 2304 | 79.9 | 80.9 | 4117 | 5203 |
| 262 | CLEAN-UP MAN/DOWN TR | 2049 | 76.3 | 77.7 | 4065 | 6113 |
| 133 | SLAB BOARD PULLER | 512 | 92.5 | 93.2 | 3924 | 4248 |
| 238 | PIPE-FITTERS | 768 | 89.3 | 89.9 | 3918 | 4247 |
| 120 | CUT-OFF SAW OPERATOR | 512 | 90.6 | 92.6 | 3109 | 3965 |
| 163 | GRADER/SORTING CHAIN | 768 | 87.6 | 91.4 | 3090 | 5215 |
| 160 | KILN OPERATOR | 2817 | 77.0 | 80.5 | 2609 | 6747 |
| 181 | CHECKERS | 1537 | 82.8 | 85.5 | 2359 | 4277 |
| 185 | RIPSAW OPERATOR | 256 | 94.0 | 94.0 | 2313 | 2313 |
| 196 | MOULDER FEEDER | 768 | 85.6 | 88.8 | 2286 | 3664 |
| 186 | RIPSAW OFFBEARER | 256 | 92.0 | 92.0 | 1851 | 1851 |
| 114 | DEBARKER OPERATOR | 4866 | 77.0 | 82.3 | 1762 | 8602 |
| 156 | UNIPAC OPERATOR | 512 | 85.4 | 88.3 | 1397 | 22[illegible] |
| 216 | SHOPMAN/GENERAL | 256 | 87.7 | 88.9 | 1030 | 123[illegible] |
| 111 | LOG CARRIER OPER | 512 | 76.0 | 76.0 | 921 | 921 |
| 197 | MOULDER OFFBEARER | 768 | 81.3 | 88.0 | 771 | 3244 |
| 131 | GANG SAW OPERATOR | 1025 | 77.9 | 79.2 | 408 | 456 |
| 207 | RAILCAR LOADER | 3331 | <75.0 | 77.1 | 0 | 1318 |
| 223 | MECHANICS | 5694 | <75.0 | <75.0 | 0 | 0 |
| 107 | POND SORTER | 1537 | <75.0 | <75.0 | 0 | 0 |
| 108 | LOG SORTER | 512 | <75.0 | <75.0 | 0 | 0 |
| 217 | WELDER | 256 | <75.0 | <75.0 | 0 | 0 |

ENVIRONMENTAL PROTECTION AGENCY 68N JOB NO. 9635

TABLE 5-3 PERSONNEL NOISE EXPOSURE AND IMPACT AVERAGES
(Cont'd)

EPA CRITERIA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

**********

| | |
|---|---|
| TOTAL NUMBER OF PERSONNEL | 231709 |
| TOTAL NUMBER OF PERSONNEL WITH LEQ > 75 (MEAN) | 208632 |
| TOTAL NUMBER OF PERSONNEL WITH LEQ > 75 (W.C.) | 212477 |
| TOTAL NUMBER OF PERSONNEL WITH LEQ > 90 (MEAN) | 64588 |
| TOTAL NUMBER OF PERSONNEL WITH LEQ > 90 (W.C.) | 133535 |
| LEVEL WEIGHTED POPULATION (MEAN) | 1076540.0 |
| LEVEL WEIGHTED POPULATION (W.C.) | 1625903.0 |

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ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9635

TABLE 5-4 PERSONNEL NOISE EXPOSURE AND IMPACT AVERAGES

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND LEVEL MEAN | SOUND LEVEL M.C. | DAILY NOISE DOSE MEAN | DAILY NOISE DOSE M.C. |
|---|---|---|---|---|---|---|
| 168 | PLANER SET-UP MAN | 3329 | 104.5 | 108.1 | 7.45 | 12.29 |
| 137 | CHIPPER OPERATOR | 2304 | 97.9 | 101.5 | 3.00 | 4.94 |
| 128 | QUADSAW TAIL SAWYER | 512 | 97.0 | 97.0 | 2.64 | 2.64 |
| 127 | TAIL SAWYER | 1793 | 96.5 | 102.6 | 2.46 | 5.71 |
| 167 | PLANER OPERATOR | 7175 | 95.1 | 98.8 | 2.02 | 3.36 |
| 144 | LUMBER DIVERTER | 1792 | 94.2 | 95.3 | 1.79 | 2.38 |
| 185 | RIPSAW OPERATOR | 256 | 94.0 | 94.0 | 1.74 | 1.74 |
| 138 | HOG OPERATOR | 1536 | 93.9 | 96.5 | 1.71 | 2.46 |
| 213 | MILLWRIGHT/PLANER | 1792 | 92.6 | 95.9 | 1.44 | 2.28 |
| 133 | SLAB BOARD PULLER | 512 | 92.5 | 93.2 | 1.41 | 1.56 |
| 186 | RIPSAW OFFBEARER | 256 | 92.0 | 92.0 | 1.32 | 1.32 |
| 212 | MILLWRIGHT/SAWMILL | 3843 | 91.2 | 91.8 | 1.17 | 1.28 |
| 173 | GRADER/PLANER MILL | 13837 | 91.0 | 93.2 | 1.15 | 1.56 |
| 245 | OILER | 1536 | 91.0 | 92.2 | 1.15 | 1.36 |
| 191 | SPECIALTY RESAW OPER | 1280 | 90.8 | 95.3 | 1.11 | 2.39 |
| 190 | SPECIALTY RESAW OPER | 1024 | 90.3 | 97.9 | 1.05 | 2.99 |
| 101 | SAWMILL SUPERVISOR | 3328 | 90.2 | 93.9 | 1.03 | 1.13 |
| 233 | CARPENTERS | 2049 | <90.0 | 93.4 | 0.94 | 1.06 |
| 140 | RESAW OPERATOR | 3075 | <90.0 | 91.6 | 0.92 | 1.28 |
| 104 | PLANER SUPERVISOR | 2561 | <90.0 | 90.5 | 0.92 | 1.07 |
| 211 | MILLWRIGHT/GENERAL | 14095 | <90.0 | 91.2 | 0.91 | 1.18 |
| 117 | DECK SCALER | 1024 | <90.0 | 93.4 | 0.86 | 1.61 |
| 151 | GREEN CHAIN PULLER | 7430 | <90.0 | 93.7 | 0.86 | 1.66 |
| 228 | ELECTRICIANS | 10506 | <90.0 | <90.0 | 0.76 | 0.96 |
| 261 | CLEAN-UP MAN/REGULAR | 2560 | <90.0 | 90.2 | 0.72 | 1.03 |
| 159 | TRANSFER OPERATOR | 1280 | <90.0 | 103.1 | 0.71 | 6.15 |
| 134 | EDGER OPERATOR | 6407 | <90.0 | 98.6 | 0.67 | 3.30 |
| 238 | PIPE-FITTERS | 768 | <90.0 | <90.0 | 0.54 | 0.59 |
| 143 | UNSCRAMBLE OPERATOR | 1280 | <90.0 | 91.7 | 0.53 | 1.26 |
| 265 | LABORER | 1792 | <90.0 | <90.0 | 0.52 | 0.67 |
| 216 | SHOPMAN/GENERAL | 256 | <90.0 | <90.0 | 0.44 | 0.51 |
| 148 | TRIMMER OPERATOR | 9479 | <90.0 | 94.2 | 0.41 | 1.79 |
| 266 | HELPER | 2561 | <90.0 | <90.0 | 0.38 | 0.63 |
| 120 | CUT-OFF SAW OPERATOR | 512 | <90.0 | <90.0 | 0.36 | 0.52 |
| 219 | MACHINISTS | 4866 | <90.0 | <90.0 | 0.25 | 0.25 |
| 196 | MOULDER FEEDER | 768 | <90.0 | <90.0 | 0.13 | 0.13 |

ENVIRONMENTAL PROTECTION AGENCY B&N JOB NO. 9635

TABLE 5-4 (Cont'd) PERSONNEL NOISE EXPOSURE AND IMPACT AVERAGES

THRESHOLD LEVEL = 90.0 DbA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DbA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND LEVEL MEAN | SOUND LEVEL M.C. | DAILY NOISE DOSE MEAN | DAILY NOISE DOSE M.C. |
|---|---|---|---|---|---|---|
| 179 | BANDER OPERATOR | 2304 | <90.0 | <90.0 | 0.11 | 0.13 |
| 161 | UNSTACKER-DRY | 1793 | <90.0 | <90.0 | 0.06 | 0.92 |
| 244 | FILERS | 6918 | <90.0 | <90.0 | 0.06 | 0.06 |
| 262 | CLEAN-UP MAN/DOWN TM | 2049 | <90.0 | <90.0 | 0.02 | 0.46 |
| 114 | DEBARKER OPERATOR | 4606 | <90.0 | <90.0 | 0.02 | 0.02 |
| 182 | TALLYMEN | 4098 | <90.0 | <90.0 | 0.01 | 0.48 |
| 176 | DRY CHAIN PULLER | 23321 | <90.0 | <90.0 | 0.01 | 0.02 |
| 107 | POND SORTER | 1537 | <90.0 | <90.0 | 0.00 | 0.0 |
| 108 | LOG SORTER | 512 | <90.0 | <90.0 | 0.00 | 0.0 |
| 111 | LOG CARRIER OPER | 512 | <90.0 | <90.0 | 0.00 | 0.0 |
| 123 | SAWYER | 5894 | <90.0 | <90.0 | 0.00 | 0.0 |
| 131 | GANG SAW OPERATOR | 1025 | <90.0 | <90.0 | 0.00 | 0.0 |
| 145 | GREEN CHAIN OPERATOR | 2817 | <90.0 | <90.0 | 0.00 | 0.87 |
| 154 | STACKER-GREEN | 7174 | <90.0 | 90.9 | 0.00 | 1.13 |
| 155 | STICKERMAN-GREEN | 4355 | <90.0 | 90.1 | 0.00 | 1.02 |
| 156 | UNIPAC OPERATOR | 512 | <90.0 | <90.0 | 0.00 | 0.0 |
| 160 | KILN OPERATOR | 2817 | <90.0 | <90.0 | 0.00 | 0.13 |
| 162 | UNSTACKER PULLER | 2818 | <90.0 | <90.0 | 0.00 | 0.15 |
| 163 | GRADER/SORTING CHAIN | 768 | <90.0 | 91.3 | 0.00 | 1.19 |
| 181 | CHECKERS | 1537 | <90.0 | <90.0 | 0.00 | 0.0 |
| 197 | MOULDER OFFBEARER | 768 | <90.0 | <90.0 | 0.00 | 0.0 |
| 201 | LUMBER CARRIER OPER | 5125 | <90.0 | <90.0 | 0.00 | 0.0 |
| 202 | FORKLIFT OPERATOR | 14607 | <90.0 | <90.0 | 0.00 | 0.84 |
| 207 | RAILCAR LOADER | 3331 | <90.0 | <90.0 | 0.00 | 0.0 |
| 217 | WELDER | 256 | <90.0 | <90.0 | 0.00 | 0.0 |
| 223 | MECHANICS | 5894 | <90.0 | <90.0 | 0.00 | 0.0 |
| 248 | POWERHOUSE OPERATOR | 4611 | <90.0 | <90.0 | 0.00 | 0.47 |

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9635

TABLE 5-4 (Cont'd) PERSONNEL NOISE EXPOSURE AND IMPACT AVERAGES

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

**********

TOTAL NUMBER OF PERSONNEL = 231700
TOTAL NUMBER OVEREXPOSED (MEAN) = 57668
TOTAL NUMBER OVEREXPOSED (N.C.) = 92526

**********

Results for the equipment noise impact are listed in Tables 5-5 and 5-6 for individual equipment types specified in the input data (one line for each equipment type). Equipment types having no impact on any personnel are omitted from the tables. A name "BACK.ONLY CONT." in column 2 indicates that equipment was only identified as a contributor to a background level. The contribution of background locations to the equipment impact is also included for each equipment type listed as explained in Section 3. In Tables 5-8 and 5-9 results are given for general equipment classifica tions containing several equipment types as listed in Table 5-7 (one line for each general classification in Tables 5-7, 5-8 and 5-9). Each general classification usually consists of all equipment types with the same generic name. Results for the EPA analysis are contained in Tables 5-5 and 5-8 and results for the OSHA analysis are contained in Tables 5-6 and 5-9.

Referring to Tables 5-5 and 5-6, columns one to six represent the same quantity for both. The first column contains a four-digit equipment code unique to the particular equipment type or background being considered. The second column is a 17-letter description of the equipment generic name. The third column indicates the number of equipment units of this type for which we have sound level measurements. The fourth and fifth columns are the mean and worst case sound levels derived by averaging all measurements for each equipment type. The worst case sound level is derived by adding one standard deviation to the mean. The sixth column shows how many personnel are exposed to this equipment type for all or part of their day.

The seventh and eighth columns in Tables 5-5 and 5-6 are the Priority Index ($PI_n$) and normalized Priority Index ($NPI_n$) respectively for equipment type n described by the code in column 1. The values of $PI_n$ corresponding to the EPA analysis are calculated using Equation 3-13 in Section 3 and values corresponding to the OSHA analysis are calculated using Equation 3-20.

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9635

TABLE 5-5 EQUIPMENT NOISE IMPACT

EPA CRITERIA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO. OF UNITS | MEAN LJ | M.C. LJ | NO. OF PERS. | PRIORITY INDEX | NORM. P.I. |
|---|---|---|---|---|---|---|---|
| 1623 | HEADRIG | 9 | 83.2 | 87.9 | 109114 | 20631.2 | 0.099 |
| 1702 | PLANER | 12 | 112.6 | 116.8 | 97094 | 15827.0 | 0.076 |
| 1741 | DRY CHAIN CONVEYR | 10 | 85.2 | 89.1 | 25874 | 11289.3 | 0.054 |
| 1802 | FORKLIFT | 9 | 86.6 | 90.2 | 28950 | 11105.9 | 0.053 |
| 1716 | PLANER/ENCL | 14 | 92.8 | 95.4 | 80707 | 10526.7 | 0.050 |
| 1670 | TRIMMER | 11 | 87.7 | 95.9 | 138842 | 9733.5 | 0.047 |
| 1682 | GREEN CHAIN CONVY | 15 | 86.5 | 91.0 | 75561 | 8162.1 | 0.039 |
| 1638 | EDGER | 8 | 85.9 | 94.1 | 82224 | 8018.3 | 0.038 |
| 1711 | PLANER/ENCL | 15 | 94.2 | 97.9 | 92741 | 7924.0 | 0.038 |
| 1693 | KILN CHAIN CONVYR | 13 | 82.9 | 89.0 | 46105 | 7723.4 | 0.037 |
| 1690 | KILN CHAIN CONVYR | 17 | 86.4 | 92.7 | 34835 | 7262.4 | 0.035 |
| 1742 | DRY CHAIN CONVEYR | 10 | 86.9 | 89.0 | 51236 | 6745.5 | 0.032 |
| 1647 | RESAW-LARGE | 4 | 93.0 | 95.2 | 59941 | 5235.3 | 0.025 |
| 1636 | EDGER | 4 | 95.5 | 104.5 | 109892 | 5057.0 | 0.024 |
| 1683 | GREEN CHAIN CONVY | 4 | 95.3 | 97.3 | 35083 | 4867.8 | 0.023 |
| 1691 | KILN CHAIN CONVYR | 14 | 85.4 | 91.6 | 31504 | 3876.3 | 0.019 |
| 1692 | KILN CHAIN CONVYR | 7 | 88.4 | 92.1 | 27918 | 3798.1 | 0.018 |
| 1672 | TRIMMER | 8 | 92.0 | 95.5 | 55582 | 3772.3 | 0.018 |
| 1831 | GANG SAW | 2 | 78.0 | 79.4 | 74025 | 3343.1 | 0.016 |
| 1603 | DEBARKER | 7 | 78.3 | 85.0 | 6915 | 3235.4 | 0.016 |
| 1694 | KILN CHAIN CONVYR | 9 | 85.4 | 88.3 | 33300 | 2967.5 | 0.014 |
| 1822 | QUADSAW | 1 | 90.0 | 90.0 | 53526 | 2876.1 | 0.014 |
| 1796 | POWERHOUSE | 3 | 86.3 | 90.4 | 4867 | 2600.9 | 0.012 |
| 1784 | CHIPPER | 16 | 103.1 | 107.0 | 23301 | 2600.0 | 0.012 |
| 1794 | POWERHOUSE | 2 | 87.5 | 92.4 | 4867 | 1996.6 | 0.010 |
| 1764 | RESAW-SPECIALTY | 4 | 96.5 | 103.1 | 51493 | 1459.5 | 0.007 |
| 1695 | KILN CHAIN CONVYR | 5 | 86.2 | 93.0 | 1536 | 1401.5 | 0.007 |
| 1788 | HOG/ENCL | 2 | 95.0 | 96.4 | 38683 | 1374.4 | 0.007 |
| 1687 | KILN | 7 | 83.6 | 89.6 | 3585 | 1324.0 | 0.006 |
| 1627 | HEADRIG | 3 | 97.7 | 104.3 | 1537 | 1321.1 | 0.006 |

ENVIRONMENTAL PROTECTION AGENCY  BBN JOB NO. 9635

TABLE 5-5 (Cont'd)  EQUIPMENT NOISE IMPACT

EPA CRITERIA

SIC CODE = 242  AVERAGE FOR INDUSTRY  NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO.OF UNITS | MEAN L5 | M.C. L5 | NO.OF PERS. | PRIORITY INDEX | NORM. P.I. |
|---|---|---|---|---|---|---|---|
| 1752 | STACK BANDER | 3 | 83.3 | 84.9 | 3073 | 1270.4 | 0.006 |
| 1815 | TRANSFER CARRIER | 2 | 91.0 | 106.6 | 3072 | 1165.1 | 0.006 |
| 1674 | TRIMMER | 1 | 95.0 | 95.0 | 13318 | 1164.4 | 0.006 |
| 1762 | RESAW-SPEC/ENCL | 2 | 88.0 | 90.8 | 38944 | 814.6 | 0.004 |
| 1731 | MOULDER/ENCL | 3 | 81.3 | 88.0 | 768 | 768.0 | 0.004 |
| 1681 | GREEN CHAIN CONVY | 1 | 76.0 | 76.0 | 47389 | 752.4 | 0.004 |
| 1639 | EDGER | 2 | 92.5 | 93.2 | 1024 | 584.6 | 0.003 |
| 1766 | RESAW-SPEC/ENCL | 2 | 90.0 | 91.4 | 2048 | 579.8 | 0.003 |
| 1727 | MOULDER/ENCL | 2 | 84.5 | 89.4 | 768 | 559.8 | 0.003 |
| 1768 | RESAW-SPECIALTY | 3 | 94.7 | 97.9 | 512 | 512.0 | 0.002 |
| 1824 | QUADSAW | 1 | 97.0 | 97.0 | 512 | 512.0 | 0.002 |
| 1612 | CUT-OFF SAW | 2 | 85.0 | 87.8 | 38427 | 500.2 | 0.002 |
| 1622 | HEADRIG | 9 | 89.1 | 83.9 | 6150 | 499.8 | 0.002 |
| 1669 | TRIMMER | 12 | 88.3 | 95.1 | 4613 | 481.8 | 0.002 |
| 1613 | CUT-OFF SAW | 3 | 99.3 | 101.8 | 1024 | 470.4 | 0.002 |
| 1637 | EDGER | 6 | 83.6 | 93.2 | 3588 | 456.0 | 0.002 |
| 1602 | DEBARKER | 7 | 75.4 | 82.3 | 3330 | 436.8 | 0.002 |
| 1654 | RESAW-LARGE | 1 | 74.0 | 74.0 | 10243 | 422.1 | 0.002 |
| 1619 | CUT-OFF SAW | 1 | 95.0 | 95.0 | 38171 | 372.5 | 0.002 |
| 1790 | HOG | 2 | 98.0 | 103.7 | 768 | 369.5 | 0.002 |
| 1617 | CUT-OFF SAW | 4 | 79.8 | 81.9 | 5635 | 310.5 | 0.001 |
| 1713 | BACK. ONLY CONTR. | 0 | 76.0 | 78.0 | 36096 | 306.8 | 0.001 |
| 1782 | CHIPPER/ENCL | 3 | 103.3 | 109.8 | 512 | 301.0 | 0.001 |
| 1646 | RESAW-LARGE | 4 | 88.5 | 92.4 | 2563 | 297.3 | 0.001 |
| 1696 | KILN CHAIN CONVYR | 3 | 88.0 | 94.1 | 256 | 256.0 | 0.001 |
| 1853 | RIPSAW-SPECIALTY | 1 | 92.0 | 92.0 | 256 | 256.0 | 0.001 |
| 1851 | RIPSAW-SPECIALTY | 1 | 94.0 | 94.0 | 256 | 256.0 | 0.001 |
| 1783 | CHIPPER | 9 | 90.0 | 93.0 | 10502 | 239.4 | 0.001 |
| 1626 | HEADRIG | 3 | 97.3 | 99.4 | 1537 | 215.9 | 0.001 |
| 1635 | EDGER | 4 | 88.5 | 95.7 | 2819 | 213.3 | 0.001 |

ENVIRONMENTAL PROTECTION AGENCY

BBN JOB NO. 9635

TABLE 5-5 (Cont'd) EQUIPMENT NOISE IMPACT

EPA CRITERIA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO. OF UNITS | MEAN LJ | M.C. LJ | NO. OF PERS. | PRIORITY INDEX | NORM. P.I. |
|---|---|---|---|---|---|---|---|
| 1751 | STACK BANDER | 3 | 79.0 | 82.6 | 768 | 206.9 | 0.001 |
| 1734 | MOULDER | 1 | 95.0 | 95.0 | 256 | 180.7 | 0.001 |
| 1787 | HOG/ENCL | 1 | 91.0 | 91.0 | 768 | 176.3 | 0.001 |
| 1656 | RESAW-LARGE | 1 | 74.0 | 74.0 | 5840 | 175.3 | 0.001 |
| 1715 | PLANER/ENCL | 1 | 93.0 | 93.0 | 1537 | 160.7 | 0.001 |
| 1710 | PLANER/ENCL | 4 | 91.3 | 96.4 | 3331 | 129.7 | 0.001 |
| 1618 | CUT-OFF SAW | 1 | 94.0 | 94.0 | 256 | 49.3 | 0.000 |
| 1830 | GANG SAW | 2 | 75.5 | 77.6 | 1025 | 44.7 | 0.000 |
| 1726 | MOULDER/ENCL | 2 | 76.5 | 78.6 | 512 | 19.5 | 0.000 |
| 1816 | TRANSFER CARRIER | 1 | 76.0 | 76.0 | 768 | 3.3 | 0.000 |
| 1513 | WHEEL GRINDER | 1 | 79.0 | 79.0 | 3587 | 1.0 | 0.000 |

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9635

TABLE 5-6 EQUIPMENT NOISE CONTROL PRIORITY

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO.OF UNITS | MEAN LJ | M.C. LJ | NO.OF PERS. | PRIORITY INDEX | NORM. P.I. |
|---|---|---|---|---|---|---|---|
| 1716 | PLANER/ENCL | 14 | 92.8 | 95.4 | 28947 | 9662.7 | 0.168 |
| 1711 | PLANER/ENCL | 15 | 94.2 | 97.9 | 27408 | 6605.9 | 0.115 |
| 1702 | PLANER | 12 | 112.8 | 116.8 | 23563 | 6165.4 | 0.107 |
| 1683 | GREEN CHAIN CONVY | 4 | 95.3 | 97.3 | 12806 | 4664.0 | 0.081 |
| 1623 | HEADRIG | 9 | 83.2 | 87.9 | 44046 | 4437.9 | 0.077 |
| 1647 | RESAW-LARGE | 4 | 93.0 | 95.2 | 18095 | 4379.1 | 0.076 |
| 1636 | EDGER | 4 | 95.5 | 104.5 | 37388 | 3939.4 | 0.068 |
| 1784 | CHIPPER | 16 | 103.1 | 107.0 | 2016 | 2420.8 | 0.042 |
| 1636 | EDGER | 8 | 85.9 | 94.1 | 26032 | 2271.9 | 0.039 |
| 1672 | TRIMMER | 8 | 92.0 | 95.5 | 9985 | 2165.6 | 0.038 |
| 1831 | GANG SAW | 2 | 78.0 | 79.4 | 30474 | 1469.1 | 0.025 |
| 1627 | HEADRIG | 3 | 97.7 | 104.3 | 1537 | 1315.4 | 0.023 |
| 1670 | TRIMMER | 11 | 87.7 | 95.9 | 31500 | 932.8 | 0.016 |
| 1822 | QUADSAW | 1 | 90.0 | 90.0 | 30966 | 924.2 | 0.016 |
| 1764 | RESAW-SPECIALTY | 4 | 96.5 | 103.1 | 10503 | 738.3 | 0.013 |
| 1639 | EDGER | 2 | 92.5 | 93.2 | 1024 | 673.0 | 0.012 |
| 1788 | HOG/ENCL | 2 | 95.0 | 96.4 | 13628 | 670.4 | 0.012 |
| 1768 | RESAW-SPECIALTY | 3 | 94.7 | 97.9 | 512 | 512.0 | 0.009 |
| 1824 | QUADSAW | 1 | 97.0 | 97.0 | 512 | 512.0 | 0.009 |
| 1790 | HOG | 2 | 98.0 | 103.7 | 708 | 424.7 | 0.007 |
| 1654 | RESAW-LARGE | 1 | 74.0 | 74.0 | 8195 | 316.2 | 0.006 |
| 1851 | RIPSAW-SPECIALTY | 1 | 94.0 | 94.0 | 256 | 256.0 | 0.004 |
| 1853 | RIPSAW-SPECIALTY | 1 | 92.0 | 92.0 | 256 | 256.0 | 0.004 |
| 1787 | HOG/ENCL | 1 | 91.0 | 91.0 | 708 | 230.2 | 0.004 |
| 1626 | HEADRIG | 3 | 97.3 | 99.4 | 1537 | 221.6 | 0.004 |
| 1782 | CHIPPER/ENCL | 3 | 103.3 | 109.8 | 512 | 179.9 | 0.003 |

TABLE 5-6 (Cont'd) EQUIPMENT NOISE CONTROL PRIORITY

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO.OF UNITS | MEAN LJ | M.C. LJ | NO.OF PERS. | PRIORITY INDEX | NORM. P.I. |
|---|---|---|---|---|---|---|---|
| 1710 | PLANER/ENCL | 4 | 91.3 | 96.4 | 3331 | 167.8 | 0.003 |
| 1658 | RESAW-LARGE | 1 | 74.0 | 74.0 | 5690 | 164.6 | 0.003 |
| 1715 | PLANER/ENCL | 1 | 93.0 | 93.0 | 1537 | 157.9 | 0.003 |
| 1612 | CUT-OFF SAW | 2 | 85.0 | 87.8 | 13060 | 107.8 | 0.002 |
| 1682 | GREEN CHAIN CONVY | 15 | 86.5 | 91.0 | 7937 | 75.8 | 0.001 |
| 1713 | BACK. ONLY CONTR. | 0 | 76.0 | 76.0 | 9735 | 59.0 | 0.001 |
| 1613 | CUT-OFF SAW | 3 | 99.3 | 101.8 | 512 | 54.1 | 0.001 |
| 1619 | CUT-OFF SAW | 1 | 95.0 | 95.0 | 13060 | 53.9 | 0.001 |
| 1762 | RESAW-SPEC/ENCL | 2 | 88.0 | 90.8 | 9735 | 29.5 | 0.001 |
| 1742 | DRY CHAIN CONVEYR | 10 | 86.9 | 89.0 | 7937 | 21.6 | 0.000 |
| 1681 | GREEN CHAIN CONVY | 1 | 76.0 | 76.0 | 7937 | 10.8 | 0.000 |

TABLE 5-7

LIST OF GENERALIZED EQUIPMENT CODES

| CODE | BEGIN | END | GENERAL DESCRIPTION |
|---|---|---|---|
| 1600 | 1600 | 1609 | DEBARKER |
| 1610 | 1610 | 1619 | CUT-OFF |
| 1620 | 1620 | 1628 | HEADRIG |
| 1629 | 1629 | 1643 | EDGER |
| 1644 | 1644 | 1663 | RESAW/CANTER |
| 1664 | 1664 | 1678 | TRIMMER |
| 1679 | 1679 | 1684 | GREEN CHAIN |
| 1685 | 1685 | 1687 | KILN |
| 1688 | 1688 | 1698 | KILN CHAIN |
| 1699 | 1699 | 1723 | PLANER |
| 1724 | 1724 | 1738 | MOULDER |
| 1739 | 1739 | 1746 | DRY CHAIN |
| 1747 | 1747 | 1748 | RAIL CAR LOAD |
| 1749 | 1749 | 1758 | STACK SANDER |
| 1759 | 1759 | 1775 | RESAW/SPECIALTY |
| 1776 | 1776 | 1778 | CONVEYOR/GEN |
| 1779 | 1779 | 1784 | CHIPPER |
| 1785 | 1785 | 1791 | HOG |
| 1792 | 1792 | 1797 | POWERHOUSE |
| 1798 | 1798 | 1799 | SAWMILL OFFICE |
| 1800 | 1800 | 1807 | FORKLIFT |
| 1808 | 1808 | 1809 | LOG CARRIER |
| 1810 | 1810 | 1812 | LUMBER CARRIER |
| 1813 | 1813 | 1818 | TRANSFER CARRIER |
| 1819 | 1819 | 1827 | QUADSAW |
| 1828 | 1828 | 1847 | GANG SAW |
| 1848 | 1848 | 1867 | RIP SAW/SPECIALTY |
| 1868 | 1868 | 1869 | STORAGE |
| 1870 | 1870 | 1871 | BASEMENT |
| 1872 | 1872 | 1873 | MACHINE SHOP |
| 1874 | 1874 | 1875 | CARPENTRY SHOP |
| 1876 | 1876 | 1877 | ELECTRIC SHOP |
| 1878 | 1878 | 1879 | PIPE SHOP |
| 1880 | 1880 | 1881 | FILEROOM |
| 1882 | 1882 | 1883 | MECHANIC SHOP/GARAGE |

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9635

TABLE 5-8 EQUIPMENT NOISE IMPACT AVERAGES

EPA CRITERIA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO.OF UNITS | MEAN LJ | M.C. LJ | NO.OF PERS. | PRIORITY INDEX | NORM. P.I. |
|---|---|---|---|---|---|---|---|
| 1699 | PLANER | 46 | 98.3 | 102.0 | 312306 | 34874.8 | 0.167 |
| 1686 | KILN CHAIN | 68 | 85.7 | 91.4 | 175454 | 27287.2 | 0.131 |
| 1620 | HEADRIG | 24 | 85.2 | 90.0 | 118338 | 22668.0 | 0.109 |
| 1739 | DRY CHAIN | 20 | 86.0 | 89.2 | 77110 | 18034.7 | 0.086 |
| 1800 | FORKLIFT | 9 | 86.6 | 90.2 | 34587 | 16384.6 | 0.079 |
| 1664 | TRIMMER | 33 | 88.5 | 96.1 | 212355 | 15192.1 | 0.073 |
| 1629 | EDGER | 26 | 87.6 | 96.1 | 199547 | 14329.2 | 0.069 |
| 1679 | GREEN CHAIN | 20 | 87.7 | 91.9 | 158033 | 13802.4 | 0.066 |
| 1644 | RESAW/LARGE | 14 | 86.6 | 89.4 | 78637 | 6130.0 | 0.029 |
| 1810 | LUMBER CARRIER | 8 | 85.4 | 87.8 | 17677 | 5205.4 | 0.025 |
| 1792 | POWERHOUSE | 9 | 86.8 | 91.2 | 9734 | 4597.4 | 0.022 |
| 1600 | DEBARKER | 17 | 76.0 | 82.8 | 21516 | 4138.6 | 0.020 |
| 1819 | QUADSAW | 3 | 94.0 | 94.0 | 54038 | 3388.1 | 0.016 |
| 1828 | GANG SAW | 4 | 76.8 | 78.6 | 75050 | 3387.8 | 0.016 |
| 1759 | RESAW/SPECIALTY | 15 | 94.3 | 98.6 | 92997 | 3369.9 | 0.016 |
| 1779 | CHIPPER | 30 | 98.9 | 102.7 | 34315 | 3140.4 | 0.015 |
| 1776 | CONVEYOR/GEN | 5 | 87.8 | 90.9 | 93488 | 2737.5 | 0.013 |
| 1785 | HOG | 8 | 95.1 | 100.5 | 40219 | 1920.2 | 0.009 |
| 1610 | CUT-OFF | 16 | 84.3 | 93.2 | 83513 | 1702.8 | 0.008 |
| 1724 | MOULDER | 10 | 86.8 | 91.7 | 2304 | 1536.0 | 0.007 |
| 1749 | STACK BANDER | 6 | 81.2 | 83.9 | 3841 | 1477.3 | 0.007 |
| 1685 | KILN | 7 | 83.6 | 89.6 | 3585 | 1324.0 | 0.006 |
| 1813 | TRANSFER CARRIER | 3 | 86.0 | 101.6 | 3840 | 1168.4 | 0.006 |
| 1846 | RIP SAW/SPECIALTY | 4 | 88.0 | 88.0 | 512 | 512.0 | 0.002 |
| 1808 | LOG CARRIER | 1 | 90.0 | 90.0 | 256 | 256.0 | 0.001 |
| 1798 | SAWMILL OFFICE | 1 | 70.0 | 70.0 | 768 | 4.6 | 0.000 |

ENVIRONMENTAL PROTECTION AGENCY  88N JOB NO. 9639

TABLE 5-9 EQUIPMENT NOISE CONTROL PRIORITY AVERAGES

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 242  AVERAGE FOR INDUSTRY  NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO. OF UNITS | MEAN LJ | M.C. LJ | NO. OF PERS. | PRIORITY INDEX | NORM. P.I. |
|---|---|---|---|---|---|---|---|
| 1694 | PLANER | 46 | 98.3 | 102.0 | 94521 | 22818.7 | 0.396 |
| 1629 | EDGER | 26 | 87.6 | 90.1 | 67863 | 6884.2 | 0.119 |
| 1620 | HEADRIG | 24 | 85.2 | 90.0 | 47120 | 5974.9 | 0.104 |
| 1644 | RESAW/LARGE | 14 | 86.2 | 89.4 | 35343 | 4861.9 | 0.084 |
| 1679 | GREEN CHAIN | 20 | 87.7 | 91.9 | 28080 | 4750.6 | 0.082 |
| 1664 | TRIMMER | 33 | 88.5 | 96.1 | 41741 | 3096.4 | 0.054 |
| 1779 | CHIPPER | 30 | 96.9 | 102.7 | 5632 | 2606.7 | 0.045 |
| 1828 | GANG SAW | 4 | 76.8 | 78.8 | 30474 | 1469.1 | 0.025 |
| 1819 | QUADSAW | 3 | 94.0 | 94.0 | 31498 | 1436.2 | 0.025 |
| 1785 | HOG | 8 | 95.1 | 100.5 | 15364 | 1325.4 | 0.023 |
| 1759 | RESAW/SPECIALTY | 15 | 94.3 | 98.6 | 20750 | 1279.8 | 0.022 |
| 1848 | RIP SAW/SPECIALTY | 4 | 88.0 | 88.0 | 512 | 512.0 | 0.009 |
| 1776 | CONVEYOR/GEN | 5 | 87.8 | 90.9 | 30726 | 378.6 | 0.007 |
| 1610 | CUT-OFF | 16 | 84.3 | 93.2 | 26832 | 215.8 | 0.004 |
| 1739 | DRY CHAIN | 20 | 86.0 | 89.2 | 7937 | 21.6 | 0.000 |

The results shown in Tables 5-8 and 5-9 are similar to those in Tables 5-5 and 5-6, except that each line represents a general equipment classification which includes the equipment types listed in Table 5-7. Thus each result is an average over several equipment types in the same general classification. Note that for some categories the number of personnel affected by the general equipment type can sometimes exceed the total industry population. This is because more than one equipment type from the same general classification affects the same portions of the population, resulting in some personnel being counted more than once.

As a demonstration of the capability of the computer model, an example showing the effect on personnel noise exposure impact, of specified amounts of noise control for some given equipment types, is now discussed.

A list containing equipment types to be treated and the amount of noise reduction to be used for each type is included in the computer model as input data and is reproduced in Table 5-10.

The effect of the noise reductions on the equipment average noise levels is included in Tables 5-11 and 5-12; Table 5-11 for individual equipment or background types and Table 5-12 for general equipment classifications, each of which includes several equipment types. The background noise levels are <u>not</u> averaged with the equipment noise levels for the generalized equipment categories. The first column in each table contains a four-digit equipment code and the second column contains a 17-letter general description of the equipment or background type or classification, one line of table for each equipment type in Table 5-11 and one line for each general equipment classification in Table 5-12. The third column indicates the number of noise measurements we have for the particular equipment type or classification. Columns four, five and six are, respectively, the mean noise

TABLE 5-10

INPUT NOISE REDUCTION DATA

EACH LINE SHOWS THE NOISE REDUCTION
SPECIFICATIONS FOR A RANGE OF EQUIPMENT CODES

| CODE FOR BEGINNING OF RANGE | CODE FOR END OF RANGE | NOISE REDUCTION |
|---|---|---|
| 1699 | 1723 | 10 |
| 1629 | 1643 | 7 |
| 1620 | 1628 | 5 |
| 1644 | 1663 | 5 |
| 1679 | 1684 | 5 |
| 1664 | 1678 | 7 |
| 1779 | 1784 | 10 |

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9035

TABLE 5-11 EFFECT OF EQUIPMENT NOISE CONTROL

BACKGROUND AND EQUIPMENT NOISE DATA AVERAGES (LEQ)

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO. OF SAMPLES | MEAN LEQ (DBA) BEFORE | AFTER | NOISE RED. (DBA) |
|---|---|---|---|---|---|
| 1702 | PLANER | 12 | 112.8 | 102.8 | 10.0 |
| 1735 | MOULDER | 2 | 103.5 | 103.5 | 0.0 |
| 1782 | CHIPPER/ENCL | 3 | 103.3 | 93.3 | 10.0 |
| 1784 | CHIPPER | 15 | 103.1 | 93.1 | 10.0 |
| 1763 | RESAW-SPECIALTY | 2 | 100.0 | 100.0 | 0.0 |
| 1613 | CUT-OFF SAW | 3 | 99.3 | 99.3 | 0.0 |
| 1781 | CHIPPER/ENCL | 2 | 98.0 | 88.0 | 10.0 |
| 1790 | HOG | 2 | 96.0 | 96.0 | 0.0 |
| 1627 | HEADRIG | 3 | 97.7 | 92.7 | 5.0 |
| 1626 | HEADRIG | 3 | 97.3 | 92.3 | 5.0 |
| 1824 | QUADSAW | 1 | 97.0 | 97.0 | 0.0 |
| 1764 | RESAW-SPECIALTY | 4 | 96.5 | 96.5 | 0.0 |
| 1780 | BACK/CHIPPER | 4 | 96.3 | 87.7 | 8.6 |
| 1645 | BACK/RESAW | 5 | 95.8 | 91.8 | 4.0 |
| 1636 | EDGER | 4 | 95.5 | 88.5 | 7.0 |
| 1683 | GREEN CHAIN CONVY | 4 | 95.3 | 90.3 | 5.0 |
| 1619 | CUT-OFF SAW | 1 | 95.0 | 95.0 | 0.0 |
| 1649 | RESAW-LARGE | 1 | 95.0 | 90.0 | 5.0 |
| 1674 | TRIMMER | 1 | 95.0 | 88.0 | 7.0 |
| 1734 | MOULDER | 1 | 95.0 | 95.0 | 0.0 |
| 1788 | HOG/ENCL | 2 | 95.0 | 95.0 | 0.0 |
| 1823 | QUADSAW | 1 | 95.0 | 95.0 | 0.0 |
| 1829 | BACK/GANG SAW | 2 | 95.0 | 94.4 | 0.6 |
| 1768 | RESAW-SPECIALTY | 3 | 94.7 | 94.7 | 0.0 |
| 1789 | HOG | 3 | 94.7 | 94.7 | 0.0 |
| 1767 | RESAW-SPECIALTY | 2 | 94.5 | 94.5 | 0.0 |
| 1711 | PLANER/ENCL | 15 | 94.2 | 84.2 | 10.0 |
| 1618 | CUT-OFF SAW | 1 | 94.0 | 94.0 | 0.0 |
| 1820 | BACK/QUAD SAW | 1 | 94.0 | 93.4 | 0.6 |
| 1851 | RIPSAW-SPECIALTY | 1 | 94.0 | 94.0 | 0.0 |
| 1630 | BACK/EDGER | 9 | 93.6 | 87.8 | 5.8 |
| 1621 | BACK/HEADRIG | 8 | 93.5 | 89.2 | 4.3 |
| 1647 | RESAW-LARGE | 4 | 93.0 | 88.0 | 5.0 |
| 1715 | PLANER/ENCL | 1 | 93.0 | 83.0 | 10.0 |
| 1716 | PLANER/ENCL | 14 | 92.8 | 82.8 | 10.0 |
| 1700 | BACK/PLANER | 9 | 92.6 | 83.8 | 8.8 |
| 1639 | EDGER | 2 | 92.5 | 85.5 | 7.0 |
| 1672 | TRIMMER | 6 | 92.0 | 85.0 | 7.0 |

TABLE 5-11 (Cont'd) EFFECT OF EQUIPMENT NOISE CONTROL

BACKGROUND AND EQUIPMENT NOISE DATA AVERAGES (LEQ)

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO. OF SAMPLES | MEAN LEQ (DBA) BEFORE | AFTER | NOISE RED. (DBA) |
|---|---|---|---|---|---|
| 1725 | BACK/MOULDER | 1 | 92.0 | 92.0 | 0.0 |
| 1853 | RIPSAW-SPECIALTY | 1 | 92.0 | 92.0 | 0.0 |
| 1710 | PLANER/ENCL | 4 | 91.3 | 81.3 | 10.0 |
| 1671 | TRIMMER | 1 | 91.0 | 84.0 | 7.0 |
| 1760 | BACK/SPEC RESAW | 3 | 91.0 | 90.1 | 0.9 |
| 1787 | HOG/ENCL | 1 | 91.0 | 91.0 | 0.0 |
| 1815 | TRANSFER CARRIER | 2 | 91.0 | 91.0 | 0.0 |
| 1665 | BACK/TRIMMER | 13 | 90.6 | 84.2 | 6.4 |
| 1648 | RESAW-LARGE | 1 | 90.0 | 85.0 | 5.0 |
| 1766 | RESAW-SPEC/ENCL | 2 | 90.0 | 90.0 | 0.0 |
| 1783 | CHIPPER | 9 | 90.0 | 80.0 | 10.0 |
| 1822 | QUADSAW | 1 | 90.0 | 90.0 | 0.0 |
| 1871 | BACK/BASEMENT | 11 | 89.1 | 85.1 | 4.0 |
| 1635 | EDGER | 4 | 88.5 | 81.5 | 7.0 |
| 1646 | RESAW-LARGE | 4 | 88.5 | 83.5 | 5.0 |
| 1692 | KILN CHAIN CONVYR | 7 | 88.4 | 88.4 | 0.0 |
| 1696 | KILN CHAIN CONVYR | 3 | 88.0 | 88.0 | 0.0 |
| 1762 | RESAW-SPEC/ENCL | 2 | 88.0 | 88.0 | 0.0 |
| 1670 | TRIMMER | 11 | 87.7 | 80.7 | 7.0 |
| 1601 | BACK/DEBARKER | 4 | 87.5 | 87.2 | 0.3 |
| 1794 | PUWERHOUSE | 2 | 87.5 | 87.5 | 0.0 |
| 1742 | DRY CHAIN CONVEYR | 10 | 86.9 | 86.9 | 0.0 |
| 1802 | FORKLIFT | 9 | 86.6 | 86.6 | 0.0 |
| 1682 | GREEN CHAIN CONVY | 15 | 86.5 | 81.5 | 5.0 |
| 1690 | KILN CHAIN CONVYR | 17 | 86.4 | 86.4 | 0.0 |
| 1796 | PUWERHUUSE | 3 | 86.3 | 86.3 | 0.0 |
| 1669 | TRIMMER | 12 | 86.3 | 79.3 | 7.0 |
| 1695 | KILN CHAIN CONVYR | 5 | 86.2 | 86.2 | 0.0 |
| 1636 | EDGER | 8 | 85.9 | 78.9 | 7.0 |
| 1694 | KILN CHAIN CONVYR | 9 | 85.4 | 85.4 | 0.0 |
| 1691 | KILN CHAIN CONVYR | 14 | 85.4 | 85.4 | 0.0 |
| 1741 | DRY CHAIN CONVEYR | 10 | 85.2 | 85.2 | 0.0 |
| 1612 | CUT-OFF SAW | 2 | 85.0 | 85.0 | 0.0 |
| 1793 | BACK/PUWERHOUSE | 3 | 84.7 | 84.7 | 0.0 |
| 1727 | MOULDER/ENCL | 2 | 84.5 | 84.5 | 0.0 |
| 1814 | BACK/TRANSFER RM | 1 | 84.0 | 83.0 | 1.0 |
| 1849 | BACK/SPEC RIPSAW | 1 | 84.0 | 84.0 | 0.0 |
| 1850 | RIPSAW-SPECIALTY | 1 | 84.0 | 84.0 | 0.0 |

TABLE 5-11 EFFECT OF EQUIPMENT NOISE CONTROL
(Cont'd)

BACKGROUND AND EQUIPMENT NOISE DATA AVERAGES (LEQ)

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO. OF SAMPLES | MEAN LEQ (DBA) BEFORE | AFTER | NOISE RED. (DBA) |
|---|---|---|---|---|---|
| 1686 | BACK/KILN&CNTL RM | 6 | 83.7 | 83.6 | 0.1 |
| 1689 | BACK/KILN CHAIN | 6 | 83.7 | 82.9 | 0.8 |
| 1637 | EDGER | 8 | 83.6 | 76.6 | 7.0 |
| 1687 | KILN | 7 | 83.6 | 83.6 | 0.0 |
| 1752 | STACK BANDER | 3 | 83.3 | 83.3 | 0.0 |
| 1623 | HEADRIG | 9 | 83.2 | 78.2 | 5.0 |
| 1680 | BACK/GREEN CHAIN | 7 | 83.1 | 78.9 | 4.3 |
| 1799 | BACK/OFFICE/SAWML | 1 | 83.0 | 78.1 | 4.9 |
| 1693 | KILN CHAIN CONVYR | 13 | 82.9 | 82.9 | 0.0 |
| 1740 | BACK/DRY CHAIN | 6 | 82.8 | 81.0 | 1.8 |
| 1852 | RIPSAW-SPECIALTY | 1 | 82.0 | 82.0 | 0.0 |
| 1731 | MOULDER/ENCL | 3 | 81.3 | 81.3 | 0.0 |
| 1881 | BACK/FILEROOM | 12 | 81.2 | 76.5 | 4.7 |
| 1622 | HEADRIG | 9 | 79.1 | 74.1 | 5.0 |
| 1513 | WHEEL GRINDER | 1 | 79.0 | 79.0 | 0.0 |
| 1751 | STACK BANDER | 3 | 79.0 | 79.0 | 0.0 |
| 1603 | DEBARKER | 7 | 78.3 | 78.3 | 0.0 |
| 1831 | GANG SAW | 2 | 78.0 | 78.0 | 0.0 |
| 1616 | CUT-OFF SAW | 5 | 77.8 | 77.8 | 0.0 |
| 1726 | MOULDER/ENCL | 2 | 76.5 | 76.5 | 0.0 |
| 1713 | BACK. ONLY CONTR. | 0 | 76.0 | 67.2 | 8.8 |
| 1681 | GREEN CHAIN CONVY | 1 | 76.0 | 71.0 | 5.0 |
| 1816 | TRANSFER CARRIER | 1 | 76.0 | 76.0 | 0.0 |
| 1617 | CUT-OFF SAW | 4 | 75.8 | 75.8 | 0.0 |
| 1830 | GANG SAW | 2 | 75.5 | 75.5 | 0.0 |
| 1602 | DEBARKER | 7 | 75.4 | 75.4 | 0.0 |
| 1877 | BACK/ELECT SHOP | 1 | 75.0 | 75.0 | 0.0 |
| 1879 | BACK/PIPE SHOP | 2 | 75.0 | 74.6 | 0.4 |
| 1654 | RESAW-LARGE | 1 | 74.0 | 69.0 | 5.0 |
| 1655 | RESAW-LARGE | 1 | 74.0 | 69.0 | 5.0 |
| 1658 | RESAW-LARGE | 1 | 74.0 | 69.0 | 5.0 |
| 1659 | RESAW-LARGE | 1 | 74.0 | 69.0 | 5.0 |
| 1607 | DEBARKER | 1 | 72.0 | 72.0 | 0.0 |
| 1873 | BACK/MACHINE SHOP | 7 | 71.9 | 71.3 | 0.5 |
| 1883 | BACK/MECHANIC SHP | 6 | 67.5 | 67.5 | 0.0 |
| 1606 | DEBARKER | 1 | 65.0 | 65.0 | 0.0 |
| 1869 | BACK/STORAGE | 1 | 65.0 | 65.0 | 0.0 |
| 1875 | BACK/CARPNTR SHOP | 1 | 65.0 | 65.0 | 0.0 |

ENVIRONMENTAL PROTECTION AGENCY GEN JOB NO. 9035

TABLE 5-12 EFFECT OF EQUIPMENT NOISE CONTROL

EQUIPMENT NOISE DATA AVERAGES (LEQ) GENERALIZED

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO. OF SAMPLES | MEAN LEQ (DbA) BEFORE | AFTER | NOISE RED. (DbA) |
|---|---|---|---|---|---|
| 1779 | CHIPPER | 30 | 98.9 | 88.9 | 10.0 |
| 1699 | PLANER | 45 | 98.3 | 88.3 | 10.0 |
| 1785 | HOG | 8 | 95.1 | 95.1 | 0.0 |
| 1759 | RESAW/SPECIALTY | 15 | 94.3 | 94.3 | 0.0 |
| 1819 | QUADSAW | 3 | 94.0 | 94.0 | 0.0 |
| 1808 | LOG CARRIER | 1 | 90.0 | 90.0 | 0.0 |
| 1664 | TRIMMER | 33 | 88.5 | 81.5 | 7.0 |
| 1846 | RIP SAW/SPECIALTY | 4 | 88.0 | 88.0 | 0.0 |
| 1776 | CONVEYOR/GEN | 5 | 87.0 | 87.0 | 0.0 |
| 1679 | GREEN CHAIN | 20 | 87.7 | 82.7 | 5.0 |
| 1629 | EDGER | 26 | 87.6 | 80.6 | 7.0 |
| 1724 | MOULDER | 10 | 86.8 | 86.8 | 0.0 |
| 1792 | PUNCHHOUSE | 5 | 86.6 | 86.6 | 0.0 |
| 1800 | FORKLIFT | 9 | 86.6 | 86.6 | 0.0 |
| 1644 | RESAW/LARGE | 14 | 86.2 | 81.2 | 5.0 |
| 1739 | DRY CHAIN | 20 | 86.0 | 86.0 | 0.0 |
| 1813 | TRANSFER CARRIER | 3 | 86.0 | 86.0 | 0.0 |
| 1688 | KILN CHAIN | 66 | 85.7 | 85.7 | 0.0 |
| 1810. | LUMBER CARRIER | 3 | 85.4 | 85.4 | 0.0 |
| 1620 | HEADRIG | 24 | 85.2 | 80.2 | 5.0 |
| 1610 | CUT-OFF | 15 | 84.3 | 84.3 | 0.0 |
| 1685 | KILN | 7 | 83.6 | 83.6 | 0.0 |
| 1749 | STACK BANDER | 6 | 81.2 | 81.2 | 0.0 |
| 1828 | GANG SAW | 4 | 76.8 | 76.8 | 0.0 |
| 1600 | DEBARKER | 17 | 76.0 | 76.0 | 0.0 |
| 1747 | RAIL CAR LOAD | 3 | 72.7 | 72.7 | 0.0 |
| 1798 | SAWMILL OFFICE | 1 | 70.0 | 70.0 | 0.0 |

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9635

TABLE 5-13
EFFECT OF NOISE CONTROL ON PERSONNEL EXPOSURE AVERAGES

EPA CRITERIA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO.OF PERS. | --- LEVEL WEIGHTED POPULATION --- BEFORE MEAN | BEFORE M.C. | AFTER MEAN | AFTER M.C. | CHANGE MEAN | CHANGE M.C. |
|---|---|---|---|---|---|---|---|---|
| 173 | GRADER/PLANER MILL | 13837 | 92323 | 121382 | 42236 | 38896 | 70087 | 82486 |
| 211 | MILLWRIGHT/GENERAL | 14095 | 86567 | 111593 | 40789 | 65241 | 45778 | 46352 |
| 168 | PLANER SET-UP MAN | 3329 | 79853 | 100769 | 37173 | 51646 | 42680 | 49123 |
| 167 | PLANER OPERATOR | 7175 | 78610 | 111853 | 22563 | 41598 | 56047 | 70255 |
| 176 | DRY CHAIN PULLER | 23321 | 62407 | 100916 | 51360 | 99641 | 1047 | 1275 |
| 228 | ELECTRICIANS | 10506 | 59679 | 75462 | 26780 | 40266 | 32899 | 35196 |
| 148 | TRIMMER OPERATOR | 9479 | 49056 | 93561 | 13669 | 39538 | 35387 | 54023 |
| 151 | GREEN CHAIN PULLER | 7430 | 43544 | 61372 | 21605 | 33675 | 21939 | 27697 |
| 202 | FORKLIFT OPERATOR | 14607 | 41960 | 75054 | 41317 | 74603 | 663 | 451 |
| 134 | EDGER OPERATOR | 6407 | 36306 | 86772 | 11856 | 43623 | 24450 | 43149 |
| 137 | CHIPPER OPERATOR | 2304 | 33812 | 45672 | 12917 | 19686 | 20895 | 25[illegible] |
| 212 | MILLWRIGHT/SAWMILL | 3843 | 28839 | 31331 | 15070 | 16192 | 13769 | 15[illegible] |
| 101 | SAWMILL SUPERVISOR | 3328 | 23122 | 25305 | 13082 | 16613 | 10040 | 8692 |
| 154 | STACKER-GREEN | 7174 | 20841 | 50144 | 19714 | 49818 | 1127 | 326 |
| 127 | TAIL SAWYER | 1793 | 20058 | 32880 | 11983 | 22136 | 8075 | 10742 |
| 213 | MILLWRIGHT/PLANER | 1792 | 20005 | 25783 | 7586 | 11416 | 12419 | 14367 |
| 140 | RESAW OPERATOR | 3075 | 18887 | 23680 | 9486 | 12963 | 9399 | 10717 |
| 144 | LUMBER DIVERTER | 1792 | 17226 | 21006 | 9514 | 12177 | 7712 | 8829 |
| 261 | CLEAN-UP MAN/REGULAR | 2560 | 16617 | 20817 | 7124 | 9622 | 9493 | 11195 |
| 138 | HOG OPERATOR | 1536 | 15862 | 20126 | 12745 | 17505 | 3117 | 2621 |
| 104 | PLANER SUPERVISOR | 2561 | 15828 | 18367 | 6293 | 6221 | 9535 | 10146 |
| 248 | POWERHOUSE OPERATOR | 4611 | 14566 | 24367 | 14565 | 24367 | 1 | 0 |
| 233 | CARPENTERS | 2049 | 13473 | 15146 | 7489 | 9607 | 5984 | 5539 |
| 201 | LUMBER CARRIER OPER | 5125 | 11757 | 18804 | 11757 | 18804 | 0 | 0 |
| 245 | OILER | 1536 | 11596 | 13362 | 7664 | 11147 | 3932 | 2215 |
| 123 | SAWYER | 5894 | 11210 | 21827 | 4669 | 9880 | 6541 | 11947 |
| 155 | STICKERMAN-GREEN | 4355 | 10955 | 27729 | 10533 | 27574 | 422 | 155 |
| 191 | SPECIALTY RESAW OFFB | 1280 | 10304 | 14265 | 10076 | 14212 | 228 | 73 |
| 266 | HELPER | 2561 | 8843 | 13807 | 6946 | 12494 | 1897 | 1313 |
| 219 | MACHINISTS | 4868 | 8541 | 8716 | 5402 | 5511 | 3139 | 3205 |
| 145 | GREEN CHAIN OPERATOR | 2817 | 8178 | 15571 | 2785 | 7421 | 5393 | 8150 |
| 161 | UNSTACKER-DRY | 1793 | 8031 | 11610 | 7486 | 12133 | 545 | -523 |
| 244 | FILERS | 6918 | 7790 | 17485 | 1882 | 6011 | 5908 | 11474 |
| 190 | SPECIALTY RESAW OPER | 1024 | 7592 | 12396 | 7364 | 12323 | 226 | 73 |
| 182 | TALLYMEN | 4098 | 6891 | 16479 | 6309 | 16558 | 582 | -79 |
| 265 | LABORER | 1792 | 6779 | 8734 | 3956 | 6257 | 2823 | 2482 |
| 117 | DECK SCALER | 1024 | 6665 | 8853 | 5119 | 7483 | 1546 | 1[illegible]0 |
| 159 | TRANSFER OPERATOR | 1280 | 6560 | 27777 | 6527 | 27773 | 33 | 4 |

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9635

TABLE 5-13 (Cont'd)
EFFECT OF NOISE CONTROL ON PERSONNEL EXPOSURE AVERAGES

EPA CRITERIA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | --- LEVEL WEIGHTED POPULATION --- BEFORE MEAN | BEFORE M.C. | AFTER MEAN | AFTER M.C. | CHANGE MEAN | CHANGE M.C. |
|---|---|---|---|---|---|---|---|---|
| 128 | QUADSAW TAIL SAWYER | 512 | 6202 | 6202 | 6202 | 6202 | 0 | 0 |
| 143 | UNSCRAMBLE OPERATOR | 1280 | 5893 | 9276 | 2315 | 4525 | 3578 | 4751 |
| 162 | UNSTACKER PULLER | 2818 | 5523 | 13749 | 5337 | 13629 | 186 | 120 |
| 179 | BANDER OPERATOR | 2304 | 4117 | 5203 | 2680 | 3704 | 1437 | 1499 |
| 262 | CLEAN-UP MAN/DUMM TM | 2049 | 4065 | 6113 | 3648 | 5595 | 417 | 518 |
| 133 | SLAB BOARD PULLER | 512 | 3924 | 4248 | 1412 | 1609 | 2512 | 2639 |
| 238 | PIPE-FITTERS | 768 | 3918 | 4247 | 2433 | 2947 | 1485 | 1300 |
| 120 | CUT-OFF SAW OPERATOR | 512 | 3109 | 3965 | 3109 | 3965 | 0 | 0 |
| 663 | GRADER/ DRTLNG CHAIN | 768 | 30 0 | 521 | 606 | 4H37 | 4N4 | 97N |
| 160 | KILN OPERATOR | 2817 | 2609 | 6747 | 2499 | 6705 | 110 | 42 |
| 181 | CHECKERS | 1537 | 2359 | 4277 | 1404 | 3871 | 955 | 406 |
| 185 | RIPSAW OPERATOR | 256 | 2313 | 2313 | 2313 | 2313 | 0 | 0 |
| 196 | MOULDER FEEDER | 768 | 2206 | 3664 | 2286 | 3664 | 0 | 0 |
| 186 | RIPSAW OFFBEARER | 256 | 1851 | 1851 | 1851 | 1851 | 0 | 0 |
| 114 | DEBARKER OPERATOR | 4866 | 1762 | 8602 | 1762 | 8602 | 0 | 0 |
| 156 | UNIPAC OPERATOR | 512 | 1397 | 2274 | 1397 | 2274 | 0 | 0 |
| 216 | SHOPMAN/GENERAL | 256 | 1050 | 1234 | 356 | 583 | 672 | 651 |
| 111 | LOG CARRIER OPER | 512 | 921 | 921 | 921 | 921 | 0 | 0 |
| 197 | MOULDER OFFBEARER | 768 | 771 | 3244 | 771 | 3244 | 0 | 0 |
| 131 | GANG SAW OPERATOR | 1025 | 208 | 456 | 208 | 456 | 0 | 0 |
| 207 | RAILCAR LOADER | 3331 | 0 | 1318 | 0 | 1318 | 0 | 0 |
| 223 | MECHANICS | 5894 | 0 | 0 | 0 | 0 | 0 | 0 |
| 107 | POND SORTER | 1537 | 0 | 0 | 0 | 0 | 0 | 0 |
| 108 | LOG SORTER | 512 | 0 | 0 | 0 | 0 | 0 | 0 |
| 217 | WELDER | 256 | 0 | 0 | 0 | 0 | 0 | 0 |

level ($L_{eq}$ dBA) before noise control, the mean noise level after noise control and the difference between the two. Note that background noise levels are not reduced by the same amount as the equipment types which dominate them. This is because more than one equipment type contributes to each background level.

The effect of the specified noise reductions on the personnel noise exposure impact is shown in Table 5-13 for EPA criteria and Table 5-14 for OSHA criteria. Only results corresponding to Tables 5-3 and 5-4 and representing personnel categories subcategories with five-digit codes are not shown to avoid unnecessary detail. The effect of the specified equipment noise reductions on the equivalent eight-hour sound levels ($L_{eq}(8)$) are shown in Tables 5-15 and 5-16. In Table 5-15 $L_{eq}(8)$ is calculated for each personnel category using EPA criteria and the results in Table 5-16 are calculated using OSHA criteria. Again results for personnel subcategories (with 5-digit codes) which make up the personnel categories shown in Tables 5-15 and 5-16 are not shown separately here, but they are produced by the computer model. A summary of the results listed in Tables 5-13 to 5-16 appears in Table 5-17 for EPA results and 5-18 for OSHA results.

The equipment noise impact following the implementation of the specified noise reductions is shown in Table 5-19 for EPA criteria results and Table 5-20 for OSHA criteria results. In Tables 5-19 and 5-20 only results for the general equipment classifications are presented. The results for the individual equipment types are produced by the computer model but are not included here.

TABLE 5-14
EFFECT OF NOISE CONTROL ON PERSONNEL EXPOSURE AVERAGES

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | DAILY NOISE DOSE BEFORE MEAN | BEFORE M.C. | AFTER MEAN | AFTER M.C. | CHANGE MEAN | CHANGE M.C. |
|---|---|---|---|---|---|---|---|---|
| 168 | PLANER SET-UP MAN | 3329 | 7.45 | 12.29 | 1.66 | 2.87 | 5.80 | 9.43 |
| 137 | CHIPPER OPERATOR | 2304 | 3.00 | 4.94 | 0.62 | 1.10 | 2.38 | 3.84 |
| 128 | QUADSAW TAIL SAWYER | 512 | 2.64 | 2.64 | 2.64 | 2.64 | 0.0 | 0.0 |
| 127 | TAIL SAWYER | 1793 | 2.46 | 5.71 | 1.23 | 2.85 | 1.23 | 2.85 |
| 167 | PLANER OPERATOR | 7175 | 2.02 | 3.38 | 0.08 | 0.24 | 1.94 | 3.14 |
| 144 | LUMBER DIVERTER | 1792 | 1.79 | 2.36 | 0.78 | 1.08 | 1.01 | 1.31 |
| 185 | RIPSAW OPERATOR | 256 | 1.74 | 1.74 | 1.74 | 1.74 | 0.0 | 0.0 |
| 138 | HOG OPERATOR | 1536 | 1.71 | 2.46 | 1.24 | 1.92 | 0.48 | 0.54 |
| 213 | MILLWRIGHT/PLANER | 1792 | 1.44 | 2.28 | 0.27 | 0.46 | 1.17 | 1.82 |
| 133 | SLAB BOARD PULLER | 512 | 1.41 | 1.56 | 0.00 | 0.0 | 1.41 | 1.56 |
| 186 | RIPSAW OFFBEARER | 256 | 1.32 | 1.32 | 1.32 | 1.32 | 0.0 | 0.0 |
| 212 | MILLWRIGHT/SAWMILL | 3843 | 1.17 | 1.28 | 0.19 | 0.23 | 0.99 | 1.05 |
| 173 | GRADER/PLANER MILL | 13837 | 1.15 | 1.56 | 0.00 | 0.03 | 1.15 | 1.53 |
| 245 | OILER | 1536 | 1.15 | 1.36 | 0.44 | 0.78 | 0.72 | 0.58 |
| 191 | SPECIALTY RESAW OFFB | 1280 | 1.11 | 2.39 | 1.01 | 2.29 | 0.10 | 0.10 |
| 190 | SPECIALTY RESAW OPER | 1024 | 1.05 | 2.99 | 0.92 | 2.87 | 0.12 | 0.12 |
| 101 | SAWMILL SUPERVISOR | 3328 | 1.03 | 1.13 | 0.22 | 0.44 | 0.81 | 0.69 |
| 233 | CARPENTERS | 2049 | 0.94 | 1.06 | 0.18 | 0.36 | 0.76 | 0.70 |
| 140 | RESAW OPERATOR | 3075 | 0.92 | 1.28 | 0.00 | 0.64 | 0.92 | 0.64 |
| 104 | PLANER SUPERVISOR | 2561 | 0.92 | 1.07 | 0.14 | 0.17 | 0.78 | 0.90 |
| 211 | MILLWRIGHT/GENERAL | 14095 | 0.91 | 1.18 | 0.12 | 0.50 | 0.79 | 0.69 |
| 117 | DECK SCALER | 1024 | 0.86 | 1.81 | 0.09 | 0.81 | 0.77 | 0.80 |
| 151 | GREEN CHAIN PULLER | 7430 | 0.86 | 1.66 | 0.43 | 0.57 | 0.43 | 1.09 |
| 228 | ELECTRICIANS | 10506 | 0.76 | 0.96 | 0.06 | 0.32 | 0.70 | 0.64 |
| 261 | CLEAN-UP MAN/REGULAR | 2560 | 0.72 | 1.03 | 0.11 | 0.23 | 0.61 | 0.81 |
| 159 | TRANSFER OPERATOR | 1280 | 0.71 | 6.15 | 0.71 | 6.15 | 0.0 | 0.0 |
| 134 | EDGER OPERATOR | 6407 | 0.67 | 3.30 | 0.00 | 0.94 | 0.67 | 2.36 |
| 238 | PIPE-FITTERS | 768 | 0.54 | 0.59 | 0.16 | 0.31 | 0.38 | 0.28 |
| 143 | UNSCRAMBLE OPERATOR | 1280 | 0.53 | 1.26 | 0.00 | 0.0 | 0.53 | 1.26 |
| 265 | LABORER | 1792 | 0.52 | 0.67 | 0.14 | 0.26 | 0.38 | 0.41 |
| 216 | SHOPMAN/GENERAL | 256 | 0.44 | 0.91 | 0.00 | 0.15 | 0.44 | 0.36 |
| 148 | TRIMMER OPERATOR | 9479 | 0.41 | 1.79 | 0.00 | 0.02 | 0.41 | 1.77 |
| 266 | HELPER | 2561 | 0.38 | 0.83 | 0.11 | 0.55 | 0.27 | 0.28 |
| 120 | CUT-OFF SAW OPERATOR | 512 | 0.36 | 0.52 | 0.36 | 0.52 | 0.0 | 0.0 |

TABLE 5-14 (Cont'd)
EFFECT OF NOISE CONTROL ON PERSONNEL EXPOSURE AVERAGES

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO.OF PERS. | DAILY NOISE DOSE BEFORE MEAN | BEFORE M.C. | AFTER MEAN | AFTER M.C. | CHANGE MEAN | CHANGE M.C. |
|---|---|---|---|---|---|---|---|---|
| 219 | MACHINISTS | 4868 | 0.25 | 0.25 | 0.08 | 0.08 | 0.17 | 0.17 |
| 196 | MOULDER FEEDER | 768 | 0.13 | 0.13 | 0.13 | 0.13 | 0.0 | 0.0 |
| 179 | BANDER OPERATOR | 2304 | 0.11 | 0.13 | 0.00 | 0.0 | 0.11 | 0.13 |
| 161 | UNSTACKER-DRY | 1793 | 0.06 | 0.92 | 0.00 | 1.16 | 0.06 | -0.24 |
| 244 | FILERS | 6918 | 0.06 | 0.06 | 0.01 | 0.01 | 0.05 | 0.05 |
| 262 | CLEAN-UP MAN/DUMN TM | 2049 | 0.02 | 0.46 | 0.00 | 0.45 | 0.02 | 0.01 |
| 114 | DEBARKER OPERATOR | 4866 | 0.02 | 0.02 | 0.02 | 0.02 | 0.0 | 0.0 |
| 182 | TALLYMEN | 4098 | 0.01 | 0.46 | 0.00 | 0.53 | 0.01 | -0.05 |
| 176 | DRY CHAIN PULLER | 23321 | 0.01 | 0.02 | 0.00 | 0.0 | 0.01 | 0.02 |
| 107 | POND SORTER | 1537 | 0.00 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 |
| 108 | LOG SORTER | 512 | 0.00 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 |
| 111 | LOG CARRIER OPER | 512 | 0.00 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 |
| 123 | SAWYER | 5894 | 0.00 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 |
| 131 | GANG SAW OPERATOR | 1025 | 0.00 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 |
| 145 | GREEN CHAIN OPERATOR | 2817 | 0.00 | 0.87 | 0.00 | 0.0 | 0.0 | 0.87 |
| 154 | STACKER-GREEN | 7174 | 0.00 | 1.13 | 0.00 | 1.13 | 0.0 | 0.0 |
| 155 | STICKERMAN-GREEN | 4355 | 0.00 | 1.02 | 0.00 | 1.02 | 0.0 | 0.0 |
| 156 | UNIPAC OPERATOR | 512 | 0.00 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 |
| 160 | KILN OPERATOR | 2817 | 0.00 | 0.13 | 0.00 | 0.13 | 0.0 | 0.0 |
| 162 | UNSTACKER PULLER | 2818 | 0.00 | 0.15 | 0.00 | 0.15 | 0.0 | 0.0 |
| 163 | GRADER/SORTING CHAIN | 768 | 0.00 | 1.19 | 0.00 | 0.89 | 0.0 | 0.30 |
| 181 | CHECKERS | 1537 | 0.00 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 |
| 197 | MOULDER OFFBEARER | 768 | 0.00 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 |
| 201 | LUMBER CARRIER OPER | 5125 | 0.00 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 |
| 202 | FORKLIFT OPERATOR | 14607 | 0.00 | 0.84 | 0.00 | 0.84 | 0.0 | 0.0 |
| 207 | RAILCAR LOADER | 3331 | 0.00 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 |
| 217 | WELDER | 256 | 0.00 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 |
| 223 | MECHANICS | 5894 | 0.00 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 |
| 248 | POWERHOUSE OPERATOR | 4611 | 0.00 | 0.47 | 0.00 | 0.47 | 0.0 | 0.0 |

ENVIRONMENTAL PROTECTION AGENCY BON JOB NO. 9635

EPA CRITERIA

TABLE 5-15
EFFECT OF NOISE CONTROL ON PERSONNEL EXPOSURE AVERAGES

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO.OF PERS. | SOUND LEVEL BEFORE MEAN | BEFORE M.C. | AFTER MEAN | AFTER M.C. | CHANGE MEAN | CHANGE M.C. |
|---|---|---|---|---|---|---|---|---|
| 168 | PLANER SET-UP MAN | 3329 | 105.7 | 109.5 | 95.7 | 99.5 | 10.0 | 10.0 |
| 137 | CHIPPER OPERATOR | 2304 | 99.1 | 103.1 | 89.9 | 93.4 | 9.2 | 9.7 |
| 128 | QUADSAW TAIL SAWYER | 512 | 97.0 | 97.0 | 97.0 | 97.0 | 0.0 | 0.0 |
| 167 | PLANER OPERATOR | 7175 | 95.7 | 99.6 | 85.8 | 89.7 | 9.9 | 10.0 |
| 127 | TAIL SAWYER | 1793 | 95.5 | 101.5 | 90.5 | 96.5 | 5.0 | 5.0 |
| 138 | HOG OPERATOR | 1536 | 95.2 | 97.6 | 93.1 | 96.1 | 2.0 | 1.5 |
| 213 | MILLWRIGHT/PLANER | 1792 | 94.9 | 97.5 | 86.8 | 89.7 | 8.1 | 7.9 |
| 144 | LUMBER DIVERTER | 1792 | 94.6 | 96.5 | 89.6 | 91.5 | 5.0 | 5.2 |
| 185 | RIPSAW OPERATOR | 256 | 94.0 | 94.0 | 94.0 | 94.0 | 0.0 | 0.0 |
| 191 | SPECIALTY RESAW OFFB | 1280 | 92.8 | 95.8 | 92.6 | 95.7 | 0.2 | 0.0 |
| 133 | SLAB BOARD PULLER | 512 | 92.5 | 93.2 | 85.5 | 86.2 | 7.0 | 7.0 |
| 212 | MILLWRIGHT/SAWMILL | 3843 | 92.3 | 93.0 | 87.4 | 87.8 | 4.9 | 5.2 |
| 245 | OILER | 1536 | 92.3 | 93.5 | 88.8 | 91.6 | 3.4 | 1.9 |
| 186 | RIPSAW OFFBEARER | 256 | 92.0 | 92.0 | 92.0 | 92.0 | 0.0 | 0.0 |
| 190 | SPECIALTY RESAW OPER | 1024 | 91.6 | 96.3 | 91.5 | 96.2 | 0.2 | 0.1 |
| 101 | SAWMILL SUPERVISOR | 3328 | 91.6 | 92.4 | 87.3 | 88.9 | 4.2 | 3.5 |
| 233 | CARPENTERS | 2049 | 91.1 | 92.1 | 86.9 | 88.5 | 4.2 | 3.6 |
| 173 | GRADER/PLANER MILL | 13837 | 91.0 | 93.6 | 83.0 | 85.4 | 8.0 | 8.1 |
| 117 | DECK SCALER | 1024 | 90.8 | 93.6 | 89.0 | 92.1 | 1.8 | 1.5 |
| 261 | CLEAN-UP MAN/REGULAR | 2560 | 90.7 | 92.5 | 85.2 | 86.9 | 5.5 | 5.5 |
| 104 | PLANER SUPERVISOR | 2561 | 90.6 | 91.9 | 84.4 | 86.1 | 6.3 | 5.8 |
| 211 | MILLWRIGHT/GENERAL | 14095 | 90.6 | 92.7 | 85.4 | 88.3 | 5.2 | 4.5 |
| 120 | CUT-OFF SAW OPERATOR | 512 | 90.6 | 92.6 | 90.6 | 92.6 | 0.0 | 0.0 |
| 228 | ELECTRICIANS | 10506 | 90.0 | 91.9 | 84.9 | 87.3 | 5.1 | 4.6 |
| 134 | EDGER OPERATOR | 6407 | 89.4 | 97.7 | 82.4 | 90.7 | 7.0 | 7.0 |
| 159 | TRANSFER OPERATOR | 1280 | 89.3 | 104.4 | 89.3 | 104.4 | 0.1 | 0.0 |
| 238 | PIPE-FITTERS | 768 | 89.3 | 89.9 | 86.1 | 87.3 | 3.2 | 2.5 |
| 148 | TRIMMER OPERATOR | 9479 | 89.2 | 94.8 | 82.3 | 87.9 | 7.0 | 7.0 |
| 151 | GREEN CHAIN PULLER | 7430 | 89.2 | 92.3 | 84.3 | 87.3 | 5.0 | 5.0 |
| 140 | RESAW OPERATOR | 3075 | 89.1 | 90.9 | 84.1 | 85.9 | 5.0 | 5.0 |
| 161 | UNSTACKER-DRY | 1793 | 88.3 | 91.0 | 87.9 | 91.4 | 0.5 | 0.0 |
| 143 | UNSCRAMBLE OPERATOR | 1280 | 88.2 | 91.6 | 83.3 | 86.8 | 4.9 | 4.8 |
| 216 | SHOPMAN/GENERAL | 256 | 87.7 | 88.9 | 82.5 | 84.5 | 5.2 | 4.3 |
| 163 | GRADER/SORTING CHAIN | 768 | 87.6 | 91.4 | 86.2 | 89.3 | 1.4 | 2.1 |
| 248 | POWERHOUSE OPERATOR | 4011 | 86.2 | 89.5 | 86.2 | 89.5 | 0.0 | 0.0 |
| 154 | STACKER-GREEN | 7174 | 85.8 | 91.7 | 85.4 | 91.6 | 0.3 | 0.1 |
| 145 | GREEN CHAIN OPERATOR | 2817 | 85.7 | 89.8 | 81.2 | 85.2 | 4.5 | 4.6 |
| 202 | FORKLIFT OPERATOR | 14007 | 85.7 | 89.5 | 85.6 | 89.3 | 0.1 | 0.0 |

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9635

EPA CRITERIA

TABLE 5-15 (Cont'd)
EFFECT OF NOISE CONTROL ON PERSONNEL EXPOSURE AVERAGES

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND LEVEL BEFORE MEAN | BEFORE M.C. | AFTER MEAN | AFTER M.C. | CHANGE MEAN | CHANGE M.C. |
|---|---|---|---|---|---|---|---|---|
| 196 | MOULDER FEEDER | 768 | 85.6 | 88.6 | 85.6 | 88.8 | 0.0 | 0.0 |
| 156 | UNIPAC OPERATOR | 512 | 85.4 | 88.3 | 85.4 | 88.3 | 0.0 | 0.0 |
| 176 | DRY CHAIN PULLER | 23321 | 85.3 | 88.1 | 85.2 | 88.0 | 0.1 | 0.1 |
| 155 | STICKERMAN-GREEN | 4355 | 85.0 | 90.9 | 84.8 | 90.9 | 0.2 | 0.0 |
| 201 | LUMBER CARRIER OPER | 5125 | 84.5 | 87.1 | 84.5 | 87.1 | 0.0 | 0.0 |
| 266 | HELPER | 2561 | 84.4 | 87.5 | 83.5 | 86.9 | 0.9 | 0.5 |
| 162 | UNSTACKER PULLER | 2818 | 83.7 | 89.0 | 83.6 | 88.9 | 0.1 | 0.1 |
| 123 | SAWYER | 5894 | 83.5 | 87.2 | 79.3 | 82.9 | 4.2 | 4.2 |
| 181 | CHECKERS | 1537 | 82.8 | 85.5 | 81.0 | 85.0 | 1.8 | 0.5 |
| 265 | LABORER | 1792 | 82.1 | 83.6 | 79.4 | 81.5 | 2.7 | 2.0 |
| 197 | MOULDER OFFBEARER | 768 | 81.3 | 88.0 | 81.3 | 88.0 | 0.0 | 0.0 |
| 179 | BANDER OPERATOR | 2304 | 79.9 | 80.9 | 78.8 | 79.8 | 1.1 | 1.1 |
| 244 | FILERS | 6918 | 78.3 | 81.6 | <75.0 | 77.8 | 3.3 | 3.8 |
| 131 | GANG SAW OPERATOR | 1025 | 77.9 | 79.2 | 77.9 | 79.2 | 0.0 | 0.0 |
| 182 | TALLYMEN | 4098 | 77.7 | 81.2 | 77.4 | 81.2 | 0.3 | 0.0 |
| 160 | KILN OPERATOR | 2817 | 77.0 | 80.5 | 76.9 | 80.5 | 0.1 | 0.0 |
| 114 | DEBARKER OPERATOR | 4866 | 77.0 | 82.3 | 77.0 | 82.3 | 0.0 | 0.0 |
| 262 | CLEAN-UP MAN/DOWN TM | 2049 | 76.3 | 77.7 | 75.9 | 77.3 | 0.4 | 0.4 |
| 111 | LOG CARRIER OPER | 512 | 76.0 | 76.0 | 76.0 | 76.0 | 0.0 | 0.0 |
| 219 | MACHINISTS | 4868 | <75.0 | 77.5 | <75.0 | 76.2 | 0.0 | 1.3 |
| 207 | RAILCAR LOADER | 3331 | <75.0 | 77.1 | <75.0 | 77.1 | 0.0 | 0.0 |
| 223 | MECHANICS | 5894 | <75.0 | <75.0 | <75.0 | <75.0 | 0.0 | 0.0 |
| 107 | POND SORTER | 1537 | <75.0 | <75.0 | <75.0 | <75.0 | 0.0 | 0.0 |
| 108 | LOG SORTER | 512 | <75.0 | <75.0 | <75.0 | <75.0 | 0.0 | 0.0 |
| 217 | WELDER | 256 | <75.0 | <75.0 | <75.0 | <75.0 | 0.0 | 0.0 |

ENVIRONMENTAL PROTECTION AGENCY  BBN JOB NO. 9635

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

TABLE 5-16
EFFECT OF NOISE CONTROL ON PERSONNEL EXPOSURE AVERAGES

SIC CODE = 242  AVERAGE FOR INDUSTRY  NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO.OF PERS. | SOUND LEVEL BEFORE MEAN | BEFORE M.C. | AFTER MEAN | AFTER M.C. | CHANGE MEAN | CHANGE M.C. |
|---|---|---|---|---|---|---|---|---|
| 168 | PLANER SET-UP MAN | 3329 | 104.5 | 108.1 | 93.7 | 97.6 | 10.8 | 10.5 |
| 137 | CHIPPER OPERATOR | 2304 | 97.9 | 101.5 | <90.0 | 90.7 | 7.9 | 10.8 |
| 128 | QUADSAW TAIL SAWYER | 512 | 97.0 | 97.0 | 97.0 | 97.0 | 0.0 | 0.0 |
| 127 | TAIL SAWYER | 1793 | 96.5 | 102.6 | 91.5 | 97.6 | 5.0 | 5.0 |
| 167 | PLANER OPERATOR | 7175 | 95.1 | 98.8 | <90.0 | <90.0 | 5.1 | 8.8 |
| 144 | LUMBER DIVERTER | 1792 | 94.2 | 96.3 | <90.0 | 90.5 | 4.2 | 5.7 |
| 185 | RIPSAW OPERATOR | 256 | 94.0 | 94.0 | 94.0 | 94.0 | 0.0 | 0.0 |
| 138 | HOG OPERATOR | 1536 | 93.9 | 96.5 | 91.5 | 94.7 | 2.3 | 1.8 |
| 213 | MILLWRIGHT/PLANER | 1792 | 92.6 | 95.4 | <90.0 | <90.0 | 2.6 | 5.9 |
| 133 | SLAB BOARD PULLER | 512 | 92.5 | 93.2 | <90.0 | <90.0 | 2.5 | 3.2 |
| 186 | RIPSAW OFFBEARER | 256 | 92.0 | 92.0 | 92.0 | 92.0 | 0.0 | 0.0 |
| 212 | MILLWRIGHT/SAWMILL | 3843 | 91.2 | 91.8 | <90.0 | <90.0 | 1.2 | 1.8 |
| 173 | GRADER/PLANER MILL | 13837 | 91.0 | 93.2 | <90.0 | <90.0 | 1.0 | 3.2 |
| 245 | OILER | 1536 | 91.0 | 92.2 | <90.0 | <90.0 | 1.0 | 2.2 |
| 191 | SPECIALTY RESAW OPER | 1280 | 90.8 | 96.3 | 90.1 | 96.0 | 0.7 | 0.3 |
| 190 | SPECIALTY RESAW OPER | 1024 | 90.3 | 97.9 | <90.0 | 97.6 | 0.3 | 0.3 |
| 101 | SAWMILL SUPERVISOR | 3328 | 90.2 | 90.9 | <90.0 | <90.0 | 0.2 | 0.9 |
| 233 | CARPENTERS | 2049 | <90.0 | 90.4 | <90.0 | 82.8 | 0.0 | 0.4 |
| 140 | RESAW OPERATOR | 3075 | <90.0 | 91.8 | <90.0 | 86.8 | 0.0 | 1.8 |
| 104 | PLANER SUPERVISOR | 2561 | <90.0 | 90.5 | <90.0 | 77.1 | 0.0 | 0.5 |
| 211 | MILLWRIGHT/GENERAL | 14095 | <90.0 | 91.2 | <90.0 | 84.9 | 0.0 | 1.2 |
| 117 | DECK SCALER | 1024 | <90.0 | 93.4 | <90.0 | 88.5 | 0.0 | 3.4 |
| 151 | GREEN CHAIN PULLER | 7430 | <90.0 | 93.7 | <90.0 | 85.9 | 0.0 | 3.7 |
| 228 | ELECTRICIANS | 10506 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 261 | CLEAN-UP MAN/REGULAR | 2560 | <90.0 | 90.2 | <90.0 | 79.3 | 0.0 | 0.2 |
| 159 | TRANSFER OPERATOR | 1280 | <90.0 | 103.1 | <90.0 | 103.1 | 0.0 | 0.0 |
| 134 | EDGER OPERATOR | 6407 | <90.0 | 98.6 | <90.0 | 89.6 | 0.0 | 8.6 |
| 238 | PIPE-FITTERS | 768 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 143 | UNSCRAMBLE OPERATOR | 1280 | <90.0 | 91.7 | <90.0 | 0.0 | 0.0 | 1.7 |
| 265 | LABORER | 1792 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 216 | SHOPMAN/GENERAL | 256 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 148 | TRIMMER OPERATOR | 9479 | <90.0 | 94.2 | <90.0 | 82.5 | 0.0 | 4.2 |
| 266 | HELPER | 2561 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 120 | CUT-OFF SAW OPERATOR | 512 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9635

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

TABLE 5-16 (Cont'd)

EFFECT OF NOISE CONTROL ON PERSONNEL EXPOSURE AVERAGES

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO.OF PERS. | SOUND LEVEL BEFORE MEAN | BEFORE M.C. | AFTER MEAN | AFTER M.C. | CHANGE MEAN | CHANGE M.C. |
|---|---|---|---|---|---|---|---|---|
| 219 | MACHINISTS | 4868 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 196 | MOULDER FEEDER | 768 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 179 | BANDER OPERATOR | 2304 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 161 | UNSTACKER-DRY | 1793 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 244 | FILERS | 6918 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 262 | CLEAN-UP MAN/DOWN TM | 2049 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 114 | DEBARKER OPERATOR | 4866 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 182 | TALLYMEN | 4098 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 176 | DRY CHAIN PULLER | 23321 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 107 | POND SORTER | 1537 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 108 | LOG SORTER | 512 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 111 | LOG CARRIER OPER | 512 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 123 | SAWYER | 5894 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 131 | GANG SAW OPERATOR | 1025 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 145 | GREEN CHAIN OPERATOR | 2817 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 154 | STACKER-GREEN | 7174 | <90.0 | 90.9 | <90.0 | 90.9 | 0.0 | 0.0 |
| 155 | STICKERMAN-GREEN | 4355 | <90.0 | 90.1 | <90.0 | 90.1 | 0.0 | 0.0 |
| 156 | UNIPAC OPERATOR | 512 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 160 | KILN OPERATOR | 2817 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 162 | UNSTACKER PULLER | 2818 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 163 | GRADER/SORTING CHAIN | 768 | <90.0 | 91.3 | <90.0 | 89.1 | 0.0 | 1.3 |
| 181 | CHECKERS | 1537 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 197 | MOULDER OFFBEARER | 768 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 201 | LUMBER CARRIER OPER | 5125 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 202 | FORKLIFT OPERATOR | 14607 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 207 | RAILCAR LOADER | 3331 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 217 | WELDER | 256 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 223 | MECHANICS | 5894 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 248 | POWERHOUSE OPERATOR | 4611 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |

TABLE 5-17

EFFECT OF NOISE CONTROL ON PERSONNEL EXPOSURE

EPA CRITERIA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| | BEFORE CHANGE | AFTER CHANGE |
|---|---|---|
| TOTAL NO. OF PERSONNEL | 231700 | 231700 |
| TOTAL NO OF PERS. WITH LEQ>75 (MEAN) | 208632 | 208119 |
| TOTAL NO OF PERS. WITH LEQ>75 (W.C.) | 212477 | 211964 |
| TOTAL NO OF PERS. WITH LEQ>90 (MEAN) | 64588 | 18966 |
| TOTAL NO OF PERS. WITH LEQ>90 (W.C.) | 133535 | 57925 |
| LEVEL WEIGHTED POPULATION (MEAN) | 1078540.0 | 590931.2 |
| LEVEL WEIGHTED POPULATION (W.C.) | 1625903.0 | 1036873.9 |

ENVIRONMENTAL PROTECTION AGENCY  BBN JOB NO. 9635

TABLE 5-18

EFFECT OF NOISE CONTROL ON PERSONNEL EXPOSURE

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 242  AVERAGE FOR INDUSTRY  NO DATES SPECIFIED

| | BEFORE CHANGE | AFTER CHANGE |
|---|---|---|
| TOTAL NUMBER OF PERSONNEL = | 231700 | 231700 |
| TOTAL NUMBER OVEREXPOSED (MEAN) = | 57668 | 9995 |
| TOTAL NUMBER OVEREXPOSED (M.C.) = | 42526 | 41265 |

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9635

TABLE 5-19 EQUIPMENT NOISE IMPACT AVERAGES

EPA CRITERIA

AFTER NOISE CONTROL ON SELECTED EQUIPMENT

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO. OF UNITS | MEAN LJ | M.C. LJ | NO. OF PERS. | PRIORITY INDEX | NORM. P.I. |
|---|---|---|---|---|---|---|---|
| 1686 | KILN CHAIN | 68 | 85.7 | 91.4 | 175454 | 28967.8 | 0.139 |
| 1699 | PLANER | 46 | 88.3 | 91.9 | 312306 | 27894.2 | 0.134 |
| 1620 | HEADRIG | 24 | 80.2 | 85.0 | 116338 | 23319.9 | 0.112 |
| 1739 | DRY CHAIN | 20 | 86.0 | 89.2 | 77110 | 18795.5 | 0.090 |
| 1800 | FORKLIFT | 9 | 86.6 | 90.2 | 34587 | 16577.4 | 0.080 |
| 1664 | TRIMMER | 33 | 81.5 | 89.1 | 212355 | 13377.5 | 0.064 |
| 1679 | GREEN CHAIN | 20 | 82.7 | 86.9 | 157521 | 12648.0 | 0.061 |
| 1629 | EDGER | 26 | 80.8 | 89.1 | 199547 | 11963.6 | 0.058 |
| 1644 | RESAW/LARGE | 14 | 81.2 | 84.4 | 78637 | 5729.7 | 0.028 |
| 1828 | GANG SAW | 4 | 76.8 | 78.6 | 75050 | 5692.4 | 0.027 |
| 1610 | LUMBER CARRIER | 8 | 85.4 | 87.8 | 17677 | 5309.8 | 0.026 |
| 1819 | QUADSAW | 3 | 94.0 | 94.0 | 54036 | 5025.9 | 0.024 |
| 1759 | RESAW/SPECIALTY | 15 | 94.3 | 96.6 | 92997 | 4615.1 | 0.022 |
| 1792 | POWERHOUSE | 5 | 86.8 | 91.2 | 9734 | 4800.6 | 0.022 |
| 1776 | CONVEYOR/GEN | 5 | 87.8 | 90.9 | 93488 | 4423.3 | 0.021 |
| 1600 | DEBARKER | 17 | 76.0 | 82.8 | 21516 | 4350.0 | 0.021 |
| 1785 | HOG | 8 | 95.1 | 100.5 | 40219 | 3388.1 | 0.016 |
| 1610 | CUT-OFF | 16 | 84.3 | 93.2 | 83513 | 2613.0 | 0.013 |
| 1779 | CHIPPER | 30 | 88.9 | 92.7 | 34315 | 2267.6 | 0.011 |
| 1749 | STACK BANDER | 6 | 81.2 | 83.9 | 3841 | 1612.3 | 0.008 |
| 1724 | MOULDER | 10 | 86.8 | 91.7 | 2304 | 1536.0 | 0.007 |
| 1685 | KILN | 7 | 83.6 | 89.6 | 3585 | 1328.5 | 0.006 |
| 1813 | TRANSFER CARRIER | 3 | 86.0 | 101.6 | 3840 | 1184.4 | 0.006 |
| 1848 | RIP SAW/SPECIALTY | 4 | 88.0 | 88.0 | 512 | 512.0 | 0.002 |
| 1808 | LOG CARRIER | 1 | 90.0 | 90.0 | 256 | 256.0 | 0.001 |
| 1798 | SAWMILL OFFICE | 1 | 70.0 | 70.0 | 768 | 11.3 | 0.000 |

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9635

TABLE 5-20 EQUIPMENT NOISE CONTROL PRIORITY AVERAGES

AFTER NOISE CONTROL ON SELECTED EQUIPMENT

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 242 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO.OF UNITS | MEAN LJ | M.C. LJ | NO.OF PERS. | PRIORITY INDEX | NORM. P.I. |
|---|---|---|---|---|---|---|---|
| 1679. | GREEN CHAIN | 20 | 82.7 | 86.9 | 3075 | 3075.0 | 0.308 |
| 1699 | PLANER | 46 | 88.3 | 91.9 | 3330 | 1793.0 | 0.179 |
| 1620 | HEADRIG | 24 | 80.2 | 85.0 | 3074 | 1537.0 | 0.154 |
| 1759 | RESAW/SPECIALTY | 15 | 94.3 | 96.6 | 1280 | 1280.0 | 0.128 |
| 1785 | HOG | 8 | 95.1 | 100.5 | 1792 | 1107.4 | 0.111 |
| 1848 | RIP SAW/SPECIALTY | 4 | 88.0 | 88.0 | 512 | 512.0 | 0.051 |
| 1819 | QUADSAW | 3 | 94.0 | 94.0 | 512 | 512.0 | 0.051 |
| 1779 | CHIPPER | 30 | 88.9 | 92.7 | 512 | 172.6 | 0.017 |

## 5.2 Foundry Industry Results - SIC 332

The results presented here were derived from data collected in seven different plants, all of which were selected at random. Figure 5-2 is an overview of the noise exposure problem and indicates the number of workers exposed to equivalent eight-hour noise levels equal to or greater than the value shown on the ordinate axis.

The results are presented in detail in Tables 5-21 to 5-40. These tables are similar to Tables 5-1 to 5-20 in Section 5.1 for the Sawmill Industry and need no further explanation.

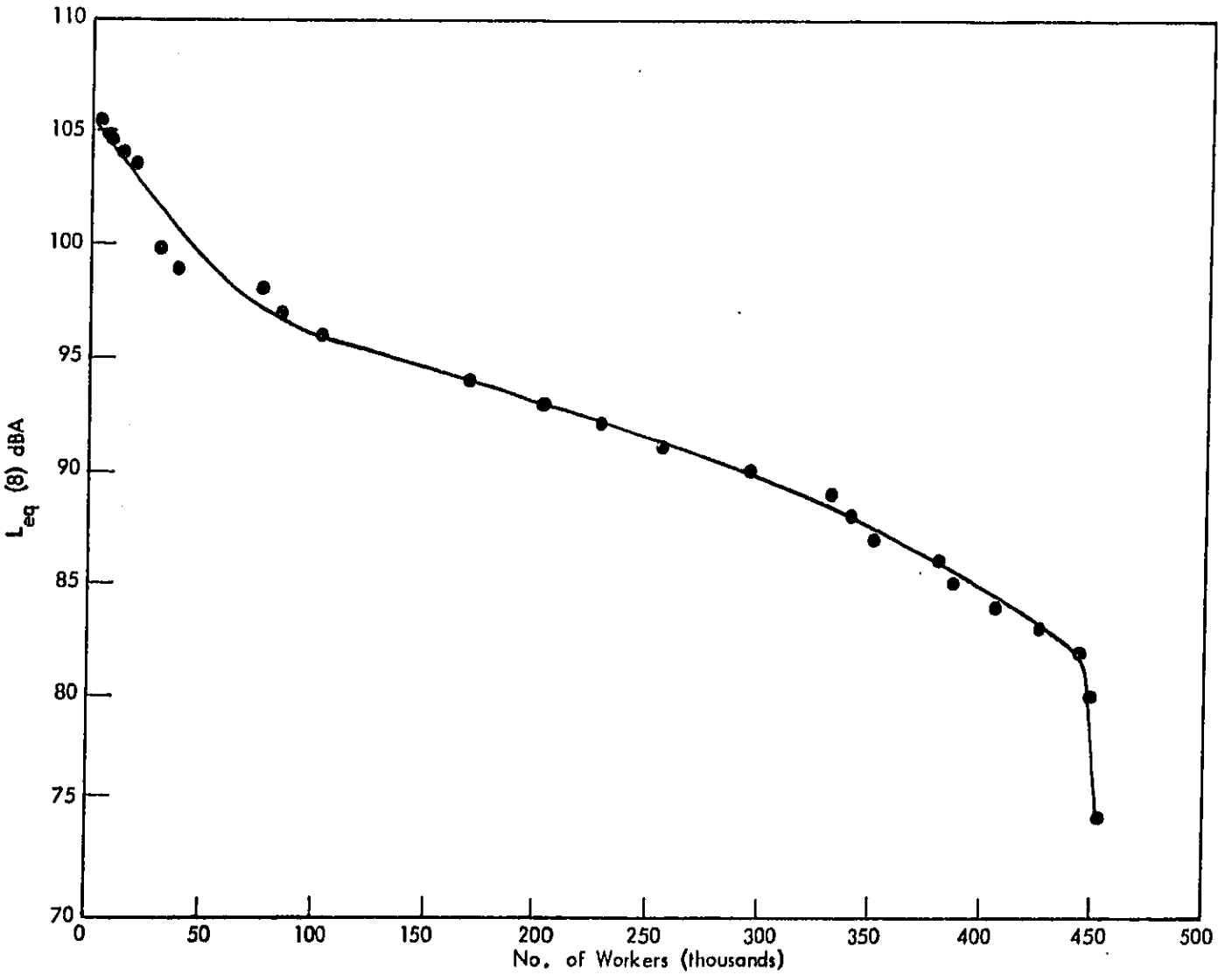


FIGURE 5.2 OVERVIEW OF THE NOISE EXPOSURE PROBLEM IN THE FOUNDRY INDUSTRY

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9635

TABLE 5-21 PERSONNEL NOISE EXPOSURE AND IMPACT

EPA CRITERIA

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND LEVEL MEAN | SOUND LEVEL M.C. | LEV. WT. POP. MEAN | LEV. WT. POP. M.C. |
|---|---|---|---|---|---|---|
| 27502 | PN GRINDER OPER | 53004 | 94.1 | 96.2 | 483086 | 597364 |
| 34004 | SQUEZ/JOLT MOLDER OP | 15388 | 98.4 | 104.9 | 211516 | 343924 |
| 30304 | ARC WELDER/A | 8549 | 98.3 | 102.1 | 116028 | 156488 |
| 30200 | ARC-AIR OPERATOR | 5129 | 103.5 | 107.3 | 103976 | 133500 |
| 30301 | ARC WELDER/A | 8549 | 96.7 | 100.4 | 100429 | 137419 |
| 27500 | PN GRINDER OPER | 11113 | 93.7 | 94.9 | 96808 | 110441 |
| 34003 | SQUEZ/JOLT MOLDER OP | 5984 | 98.4 | 104.9 | 82220 | 133737 |
| 31003 | ARC AIR GOUGER | 3419 | 104.9 | 105.7 | 76368 | 97128 |
| 34300 | MOLDMASTER OPERATOR | 5129 | 98.1 | 100.1 | 68540 | 80649 |
| 32600 | ARC FURNACE OPERATOR | 4274 | 98.9 | 102.8 | 61252 | 82457 |
| 42101 | SHELL CORE OPERATOR | 6839 | 93.6 | 95.0 | 59201 | 68248 |
| 28001 | WHEEL GRINDER OPER | 5129 | 98.2 | 105.1 | 57446 | 101462 |
| 28200 | TRIM GRINDER OPER | 3419 | 99.9 | 99.9 | 52984 | 52984 |
| 44300 | SHAKEOUT TABLE OPER | 3419 | 99.8 | 102.8 | 52781 | 66223 |
| 28101 | STAND STONE GRINDER | 8549 | 90.7 | 93.1 | 52557 | 69847 |
| 27503 | PN GRINDER OPER | 5129 | 93.1 | 95.5 | 41792 | 53976 |
| 27700 | PN DISC GRINDER OPER | 3419 | 97.0 | 99.9 | 41319 | 52940 |
| 28000 | WHEEL GRINDER OPER | 4274 | 94.5 | 100.4 | 40458 | 69018 |
| 36701 | POURER | 3419 | 96.6 | 100.2 | 39912 | 54494 |
| 31004 | ARC AIR GOUGER | 1709 | 105.5 | 109.3 | 39748 | 50281 |
| 31002 | ARC AIR GOUGER | 1709 | 104.9 | 108.7 | 38226 | 48364 |
| 31800 | GAS BURNER | 1709 | 104.6 | 108.4 | 37371 | 47643 |
| 31900 | POWDER BURNER | 1709 | 104.6 | 108.4 | 37371 | 47643 |
| 44000 | SHAKEOUT OPERATOR | 6839 | 89.7 | 92.5 | 37069 | 52435 |
| 31000 | ARC AIR GOUGER | 1709 | 104.3 | 108.1 | 36801 | 46705 |
| 45000 | DUMPOUT/SHAKEOUT OP | 1709 | 103.9 | 103.9 | 35784 | 35784 |
| 31001 | ARC AIR GOUGER | 1709 | 103.5 | 107.3 | 34625 | 44484 |
| 50500 | CUT-OFF WHEEL OPER | 2564 | 98.0 | 98.0 | 33934 | 33934 |
| 42103 | SHELL CORE OPERATOR | 4274 | 92.2 | 93.6 | 31682 | 36852 |
| 42203 | NO-BAKE CORE OPER | 4274 | 92.2 | 93.6 | 31682 | 36852 |
| 32500 | FURNACE OPERATOR | 3419 | 93.6 | 93.6 | 29435 | 29435 |
| 36704 | POURER | 5129 | 89.9 | 92.6 | 28609 | 39928 |
| 28102 | STAND STONE GRINDER | 4274 | 91.3 | 92.9 | 28418 | 34149 |
| 27901 | SWING GRINDER OPER | 3419 | 92.8 | 93.4 | 27055 | 28604 |
| 42102 | SHELL CORE OPERATOR | 3419 | 92.7 | 94.0 | 26902 | 30724 |
| 20203 | FORKLIFT OPERATOR | 1709 | 100.0 | 100.0 | 26681 | 26681 |
| 50400 | RADIAL SAW OPERATOR | 1709 | 99.9 | 99.9 | 26492 | 26492 |
| 36601 | MELTER/POURER | 5129 | 89.2 | 93.5 | 25900 | 44050 |
| 34002 | SQUEZ/JOLT MOLDER OP | 4274 | 90.3 | 93.9 | 24999 | 30041 |
| 50501 | CUT-OFF WHEEL OPER | 1709 | 99.1 | 99.1 | 24729 | 24729 |

ENVIRONMENTAL PROTECTION AGENCY  OMB JOB NO. 9635

TABLE 5-21 (Cont'd) PERSONNEL NOISE EXPOSURE AND IMPACT

EPA CRITERIA

SIC CODE = 332  AVERAGE FOR INDUSTRY  NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND MEAN | LEVEL M.C. | LEV. WT. MEAN | POP. M.C. |
|---|---|---|---|---|---|---|
| 33800 | SHELLMOLDER OPERATOR | 3419 | 91.7 | 93.8 | 23941 | 30246 |
| 34103 | FLOOR MOLDER | 3419 | 91.6 | 95.2 | 23615 | 34716 |
| 26402 | SERVICEMAN | 3419 | 91.0 | 91.0 | 21968 | 21968 |
| 40400 | MACHINE BLASTER | 3419 | 91.0 | 91.0 | 21968 | 21968 |
| 50502 | CUT-OFF WHEEL OPER | 1709 | 97.5 | 100.1 | 21666 | 26996 |
| 44002 | SHAKEOUT OPERATOR | 3419 | 90.9 | 93.5 | 21524 | 29235 |
| 36700 | POURER | 6839 | 86.1 | 88.5 | 21159 | 31187 |
| 44301 | SHAKEOUT TABLE OPER | 1709 | 97.2 | 102.7 | 21139 | 32687 |
| 27800 | PN CONE GRINDER OPER | 2564 | 93.1 | 95.1 | 21083 | 25829 |
| 50503 | CUT-OFF WHEEL OPER | 1709 | 97.0 | 99.5 | 20690 | 25758 |
| 34104 | FLOOR MOLDER | 3419 | 90.6 | 94.7 | 20683 | 33214 |
| 33001 | LADLE PRE-HEATER | 1709 | 96.9 | 105.8 | 20539 | 40680 |
| 28104 | STAND STONE GRINDER | 3419 | 90.4 | 92.4 | 20310 | 25943 |
| 26600 | HELPER | 5129 | 87.6 | 88.3 | 20278 | 22591 |
| 27902 | SWING GRINDER OPER | 2564 | 92.6 | 93.1 | 19850 | 21042 |
| 42600 | CORE SETTER | 2564 | 92.5 | 92.5 | 19571 | 19571 |
| 43301 | CORE ROOM WORKER | 14533 | 82.2 | 85.9 | 19023 | 42887 |
| 43300 | CORE ROOM WORKER | 5984 | 86.2 | 88.6 | 18633 | 27513 |
| 46701 | WHEELABRATOR OPER | 3419 | 89.6 | 95.2 | 18317 | 34760 |
| 26406 | SERVICEMAN | 3419 | 89.4 | 92.1 | 17746 | 25005 |
| 39500 | SANDSLINGER OPERATOR | 1709 | 95.1 | 99.2 | 17348 | 25045 |
| 26501 | LABORER | 5129 | 86.6 | 88.7 | 17162 | 24005 |
| 33901 | AUTO-MOLDER OPERATOR | 1709 | 94.6 | 96.7 | 16456 | 20142 |
| 33900 | AUTO-MOLDER OPERATOR | 1709 | 94.6 | 96.7 | 16442 | 20133 |
| 34001 | SQUEZ/JOLT MOLDER OP | 2564 | 90.7 | 95.6 | 15892 | 29995 |
| 50600 | TABOR CUT-OFF SAW OP | 1709 | 94.1 | 94.1 | 15591 | 15591 |
| 36800 | MELTER/POURER | 2564 | 89.9 | 94.3 | 14190 | 23832 |
| 34000 | SQUEZ/JOLT MOLDER OP | 1709 | 93.2 | 96.6 | 14146 | 23763 |
| 34102 | FLOOR MOLDER | 3419 | 87.9 | 87.9 | 14132 | 14132 |
| 33700 | HI PRESS. MOLDER OP | 1709 | 93.2 | 93.2 | 14114 | 14114 |
| 45900 | SHIFTER | 2564 | 89.5 | 90.7 | 13523 | 15645 |
| 34105 | FLOOR MOLDER | 1709 | 92.6 | 94.1 | 13280 | 15625 |
| 50200 | BAND SAW OPERATOR | 1709 | 92.5 | 92.5 | 13021 | 13021 |
| 40300 | HAND BLASTER | 1709 | 92.3 | 92.3 | 12837 | 12837 |
| 20300 | WORKSAVER OPERATOR | 5129 | 84.8 | 86.4 | 12319 | 16532 |
| 46101 | INSPECTOR | 854 | 98.6 | 98.6 | 11943 | 11943 |
| 40202 | ROTOBLAST OPERATOR | 1709 | 91.4 | 94.7 | 11482 | 16038 |
| 20202 | FORKLIFT OPERATOR | 1709 | 91.4 | 93.9 | 11475 | 15203 |
| 46703 | WHEELABRATOR OPER | 854 | 98.1 | 98.1 | 11362 | 11362 |
| 44001 | SHAKEOUT OPERATOR | 1709 | 91.1 | 94.2 | 11136 | 15016 |

ENVIRONMENTAL PROTECTION AGENCY BBN Job No. 9635

TABLE 5-21 PERSONNEL NOISE EXPOSURE AND IMPACT
(Cont'd)

EPA CRITERIA

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND LEVEL MEAN | SOUND LEVEL M.C. | LEV. WT. POP. MEAN | LEV. WT. POP. M.C. |
|---|---|---|---|---|---|---|
| 40201 | ROTOBLAST OPERATOR | 1709 | 91.0 | 94.3 | 10984 | 15676 |
| 46700 | WHEELABRATOR OPER | 2564 | 88.0 | 89.7 | 10913 | 13867 |
| 36702 | POURER | 1709 | 91.0 | 91.0 | 10902 | 10902 |
| 28100 | STAND STONE GRINDER | 1709 | 90.7 | 92.6 | 10488 | 13210 |
| 36703 | POURER | 1709 | 90.4 | 90.4 | 10136 | 10136 |
| 28103 | STAND STONE GRINDER | 1709 | 90.4 | 92.4 | 10087 | 12923 |
| 42200 | NO-BAKE CORE OPER | 4274 | 84.6 | 84.9 | 9813 | 10550 |
| 46000 | OVERHEAD CRANE OPER | 1709 | 90.0 | 90.0 | 9617 | 9617 |
| 32700 | INDUCT. FURNACE OPER | 1709 | 90.0 | 94.3 | 9581 | 15945 |
| 46702 | WHEELABRATOR OPER | 1709 | 89.5 | 94.1 | 8982 | 15563 |
| 40203 | ROTOBLAST OPERATOR | 1709 | 89.4 | 93.5 | 8881 | 14707 |
| 53400 | PRESS OPERATOR | 5129 | 83.0 | 84.0 | 8207 | 10387 |
| 40500 | SPIRALBLAST OPERATOR | 854 | 94.5 | 94.5 | 8162 | 8162 |
| 46002 | OVERHEAD CRANE OPER | 1709 | 88.8 | 88.8 | 8120 | 8120 |
| 30300 | ARC WELDER/A | 2564 | 86.2 | 88.8 | 8053 | 8936 |
| 42900 | OIL-BAKE COREMAKER | 1709 | 88.6 | 88.6 | 7697 | 7697 |
| 32900 | CUPOLA FURNACE OPER | 1709 | 86.4 | 93.0 | 7666 | 13921 |
| 42104 | SHELL CORE OPERATOR | 854 | 93.6 | 95.6 | 7412 | 8540 |
| 30302 | ARC WELDER/A | 3419 | 84.1 | 89.5 | 7129 | 9458 |
| 46001 | OVERHEAD CRANE OPER | 1709 | 87.9 | 87.9 | 7071 | 7071 |
| 35000 | MOLD WASH WORKER | 854 | 92.5 | 92.5 | 6527 | 6527 |
| 27900 | SWING GRINDER OPER | 854 | 92.3 | 92.8 | 6425 | 6782 |
| 33100 | LADLE SKIMMER | 1709 | 87.3 | 90.1 | 6417 | 9782 |
| 27600 | PN DRILL GRINDER OP | 854 | 91.8 | 94.3 | 6060 | 7976 |
| 34100 | FLOOR MOLDER | 3419 | 83.3 | 87.1 | 5941 | 12558 |
| 48003 | OVERHEAD CRANE OPER | 1709 | 86.8 | 86.8 | 5915 | 5915 |
| 20200 | FORKLIFT OPERATOR | 1709 | 86.2 | 86.6 | 5371 | 7654 |
| 25404 | SERVICEMAN | 1709 | 86.1 | 90.5 | 5301 | 10263 |
| 32701 | INDUCT. FURNACE OPER | 854 | 90.0 | 95.0 | 5171 | 8508 |
| 26405 | SERVICEMAN | 1709 | 86.0 | 86.6 | 5166 | 7890 |
| 38800 | SANDMULLER OPERATOR | 854 | 90.5 | 90.5 | 5155 | 5155 |
| 27501 | PN GRINDER OPER | 854 | 90.4 | 92.2 | 5086 | 6288 |
| 38503 | MULLER OPER | 854 | 90.2 | 92.3 | 4969 | 6376 |
| 38502 | MULLER OPER | 854 | 90.0 | 92.1 | 4789 | 6249 |
| 32800 | FURNACE CHARGER | 854 | 89.9 | 92.6 | 4768 | 6654 |
| 26409 | SERVICEMAN | 3419 | 82.4 | 83.4 | 4711 | 5069 |
| 40200 | ROTOBLAST OPERATOR | 854 | 89.8 | 90.9 | 4669 | 5407 |
| 26503 | LABORER | 1709 | 85.4 | 85.5 | 4616 | 5644 |
| 40204 | ROTOBLAST OPERATOR | 854 | 89.0 | 91.7 | 4570 | 5961 |
| 46200 | CUPOLA OPERATOR | 854 | 89.4 | 93.4 | 4457 | 7263 |

ENVIRONMENTAL PROTECTION AGENCY  BBN JOB NO. 9635

TABLE 5-21 (Cont'd)  PERSONNEL NOISE EXPOSURE AND IMPACT

EPA CRITERIA

SIC CODE = 332  AVERAGE FOR INDUSTRY  NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND MEAN | LEVEL M.C. | LEV. HT. MEAN | POP. M.C. |
|---|---|---|---|---|---|---|
| 42700 | CORE GLUER | 854 | 89.4 | 90.5 | 4432 | 5115 |
| 30303 | ARC WELDER/A | 1709 | 85.0 | 87.1 | 4299 | 6260 |
| 38504 | MULLER OPER | 854 | 89.1 | 91.3 | 4234 | 5674 |
| 33101 | LADLE SKIMMER | 1709 | 84.9 | 86.2 | 4222 | 7493 |
| 38501 | MULLER OPER | 854 | 88.9 | 90.9 | 4137 | 5397 |
| 26401 | SERVICEMAN | 1709 | 84.7 | 86.6 | 4033 | 5764 |
| 33000 | LADLE PRE-HEATER | 1709 | 84.6 | 85.9 | 3901 | 5037 |
| 26400 | SERVICEMAN | 1709 | 84.1 | 84.1 | 3550 | 3550 |
| 26403 | SERVICEMAN | 1709 | 83.9 | 85.0 | 3386 | 4295 |
| 26500 | LABORER | 854 | 87.2 | 87.6 | 3162 | 3372 |
| 26407 | SERVICEMAN | 1709 | 83.6 | 87.6 | 3132 | 6839 |
| 26410 | SERVICEMAN | 1709 | 83.5 | 88.1 | 3069 | 7372 |
| 26502 | LABORER | 1709 | 83.5 | 88.1 | 3069 | 7372 |
| 33002 | LADLE PRE-HEATER | 1709 | 83.5 | 88.1 | 3069 | 7372 |
| 34101 | FLOOR MOLDER | 1709 | 83.5 | 88.1 | 3069 | 7372 |
| 27000 | FOREMAN | 854 | 86.9 | 89.4 | 3028 | 4425 |
| 30700 | ACETYLENE WELDER | 854 | 86.0 | 87.5 | 2874 | 3328 |
| 34200 | PACEMAKER MOLDR OPER | 854 | 86.5 | 89.3 | 2834 | 4358 |
| 46100 | INSPECTOR | 1709 | 83.0 | 84.2 | 2731 | 3632 |
| 42100 | SHELL CORE OPERATOR | 854 | 85.5 | 87.4 | 2361 | 3309 |
| 26408 | SERVICEMAN | 1709 | 81.2 | 82.3 | 1668 | 2273 |
| 42202 | NO-BAKE CORE OPER | 854 | 83.8 | 91.7 | 1667 | 5991 |
| 38500 | MULLER OPER | 854 | 83.5 | 84.4 | 1543 | 1687 |
| 42201 | NO-BAKE CORE OPER | 854 | 79.7 | 85.7 | 465 | 2920 |
| 20201 | FORKLIFT OPERATOR | 1709 | <75.0 | 78.1 | 0 | 419 |
| 26504 | LABORER | 1709 | <75.0 | <75.0 | 0 | 0 |

ENVIRONMENTAL PROTECTION AGENCY  BDN JOB NO. 9635

TABLE 5-22  PERSONNEL NOISE EXPOSURE AND IMPACT

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 332  AVERAGE FOR INDUSTRY  NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND LEVEL MEAN | SOUND LEVEL M.C. | DAILY NOISE DOSE MEAN | DAILY NOISE DOSE M.C. |
|---|---|---|---|---|---|---|
| 31004 | ARC AIR GOUGER | 1709 | 105.0 | 105.8 | 8.05 | 13.50 |
| 31002 | ARC AIR GOUGER | 1709 | 103.9 | 107.7 | 6.83 | 11.60 |
| 31003 | ARC AIR GOUGER | 3419 | 103.9 | 107.7 | 6.83 | 11.60 |
| 45000 | DUMPOUT/SHAKEOUT OP | 1709 | 103.5 | 103.5 | 6.52 | 6.52 |
| 31800 | GAS BURNER | 1709 | 103.3 | 107.1 | 6.34 | 10.77 |
| 31900 | POWDER BURNER | 1709 | 103.3 | 107.1 | 6.34 | 10.77 |
| 31000 | ARC AIR GOUGER | 1709 | 102.7 | 106.6 | 5.85 | 9.94 |
| 30200 | ARC-AIR OPERATOR | 5129 | 101.4 | 105.3 | 4.88 | 8.28 |
| 31001 | ARC AIR GOUGER | 1709 | 101.4 | 105.3 | 4.88 | 8.28 |
| 44300 | SHAKEOUT TABLE OPER | 3419 | 98.9 | 102.0 | 3.45 | 5.25 |
| 50501 | CUT-OFF WHEEL OPER | 1709 | 98.4 | 98.4 | 3.20 | 3.20 |
| 28200 | TRIM GRINDER OPER | 3419 | 98.3 | 98.3 | 3.17 | 3.17 |
| 50400 | RADIAL SAW OPERATOR | 1709 | 98.3 | 98.3 | 3.17 | 3.17 |
| 32600 | ARC FURNACE OPERATOR | 4274 | 98.0 | 101.9 | 3.02 | 5.16 |
| 34004 | SQUEEZ/JOLT MOLDER OP | 15308 | 97.4 | 103.9 | 2.78 | 5.83 |
| 34003 | SQUEEZ/JOLT MOLDER OP | 5964 | 97.4 | 103.9 | 2.78 | 5.83 |
| 20203 | FORKLIFT OPERATOR | 1709 | 97.3 | 97.3 | 2.77 | 2.77 |
| 34300 | MOLDMASTER OPERATOR | 5129 | 96.9 | 98.7 | 2.61 | 3.32 |
| 50502 | CUT-OFF WHEEL OPER | 1709 | 96.4 | 97.1 | 2.44 | 3.52 |
| 50500 | CUT-OFF WHEEL OPER | 2564 | 96.3 | 96.3 | 2.40 | 2.40 |
| 46703 | WHEELABRATOR OPER | 854 | 96.1 | 96.1 | 2.34 | 2.34 |
| 28001 | WHEEL GRINDER OPER | 5129 | 95.4 | 102.5 | 2.11 | 5.03 |
| 50503 | CUT-OFF WHEEL OPER | 1709 | 95.3 | 98.0 | 2.09 | 3.02 |
| 46101 | INSPECTOR | 854 | 95.2 | 95.2 | 2.06 | 2.06 |
| 27700 | PN DISC GRINDER OPER | 3419 | 94.7 | 97.6 | 1.92 | 2.93 |
| 44301 | SHAKEOUT TABLE OPER | 1709 | 94.4 | 100.0 | 1.84 | 4.03 |
| 33900 | AUTO-MOLDER OPERATOR | 1709 | 93.9 | 96.0 | 1.71 | 2.30 |
| 33901 | AUTO-MOLDER OPERATOR | 1709 | 93.9 | 96.0 | 1.71 | 2.30 |
| 36701 | POURER | 3419 | 93.7 | 97.5 | 1.68 | 2.83 |
| 28000 | WHEEL GRINDER OPER | 4274 | 93.5 | 98.8 | 1.63 | 3.39 |
| 50600 | TABOR CUT-OFF SAW OP | 1709 | 93.4 | 93.4 | 1.60 | 1.60 |
| 30304 | ARC WELDER/A | 8549 | 92.7 | 96.6 | 1.46 | 2.49 |
| 42101 | SHELL CORE OPERATOR | 6839 | 92.4 | 93.6 | 1.40 | 1.70 |
| 42104 | SHELL CORE OPERATOR | 854 | 92.4 | 93.6 | 1.40 | 1.70 |
| 33001 | LADLE PRE-HEATER | 1709 | 92.1 | 101.2 | 1.35 | 4.73 |
| 27901 | SWING GRINDER OPER | 3419 | 92.1 | 92.6 | 1.33 | 1.44 |

ENVIRONMENTAL PROTECTION AGENCY BEN JOB NO. 9635

TABLE 5-22 (Cont'd) PERSONNEL NOISE EXPOSURE AND IMPACT

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND LEVEL MEAN | SOUND LEVEL M.C. | DAILY NOISE DOSE MEAN | DAILY NOISE DOSE M.C. |
|---|---|---|---|---|---|---|
| 27502 | PN GRINDER OPER | 53004 | 92.0 | 93.8 | 1.32 | 1.70 |
| 33700 | HI PRESS. MOLDER OP | 1709 | 92.0 | 92.0 | 1.31 | 1.31 |
| 27500 | PN GRINDER OPER | 11113 | 91.4 | 93.0 | 1.22 | 1.51 |
| 42600 | CORE SETTER | 2564 | 91.4 | 91.4 | 1.21 | 1.21 |
| 40500 | SPIRALBLAST OPERATOR | 854 | 91.4 | 91.4 | 1.21 | 1.21 |
| 32500 | FURNACE OPERATOR | 3419 | 91.3 | 91.3 | 1.20 | 1.20 |
| 27902 | SWING GRINDER OPER | 2564 | 91.1 | 91.7 | 1.16 | 1.26 |
| 27600 | PN DRILL GRINDER OP | 854 | 91.0 | 93.6 | 1.15 | 1.64 |
| 39500 | SANDSLINGER OPERATOR | 1709 | 91.0 | 94.9 | 1.14 | 1.96 |
| 40202 | ROTOBLAST OPERATOR | 1709 | 90.8 | 94.2 | 1.12 | 1.79 |
| 28102 | STAND STONE GRINDER | 4274 | 90.5 | 92.0 | 1.07 | 1.31 |
| 27800 | PN CONE GRINDER OPER | 2564 | 90.4 | 92.6 | 1.06 | 1.44 |
| 27503 | PN GRINDER OPER | 5129 | 90.3 | 93.1 | 1.05 | 1.54 |
| 50200 | BAND SAW OPERATOR | 1709 | 90.3 | 90.3 | 1.04 | 1.04 |
| 44001 | SHAKEOUT OPERATOR | 1709 | 90.1 | 93.4 | 1.01 | 1.60 |
| 40300 | HAND BLASTER | 1709 | 90.0 | 90.0 | 1.00 | 1.00 |
| 42102 | SHELL CORE OPERATOR | 3419 | 90.0 | 91.4 | 1.00 | 1.22 |
| 42103 | SHELL CORE OPERATOR | 4274 | 90.0 | 91.4 | 1.00 | 1.22 |
| 42203 | NO-BAKE CORE OPER | 4274 | 90.0 | 91.4 | 1.00 | 1.22 |
| 27900 | SWING GRINDER OPER | 854 | <90.0 | 90.6 | 1.00 | 1.08 |
| 26402 | SERVICEMAN | 3419 | <90.0 | <90.0 | 0.99 | 0.99 |
| 40201 | ROTOBLAST OPERATOR | 1709 | <90.0 | 93.3 | 0.99 | 1.58 |
| 40400 | MACHINE BLASTER | 3419 | <90.0 | <90.0 | 0.99 | 0.99 |
| 28101 | STAND STONE GRINDER | 8549 | <90.0 | 92.4 | 0.98 | 1.39 |
| 30301 | ARC WELDER/A | 8549 | <90.0 | 93.6 | 0.98 | 1.66 |
| 46701 | WHELLABRATOR OPER | 3419 | <90.0 | 94.7 | 0.87 | 1.91 |
| 35000 | MOLD WASH WORKER | 854 | <90.0 | <90.0 | 0.87 | 0.87 |
| 33800 | SHELLMOLDER OPERATOR | 3419 | <90.0 | 91.2 | 0.83 | 1.18 |
| 32701 | INDUCT. FURNACE OPER | 854 | <90.0 | 93.6 | 0.80 | 1.64 |
| 38502 | MULLER OPER | 854 | <90.0 | 90.5 | 0.76 | 1.08 |
| 38503 | MULLER OPER | 854 | <90.0 | 90.5 | 0.76 | 1.08 |
| 44002 | SHAKEOUT OPERATOR | 3419 | <90.0 | 91.3 | 0.76 | 1.20 |
| 34105 | FLOOR MOLDER | 1709 | <90.0 | <90.0 | 0.74 | 0.92 |
| 28100 | STAND STONE GRINDER | 1709 | <90.0 | 90.3 | 0.74 | 1.04 |
| 28103 | STAND STONE GRINDER | 1709 | <90.0 | 90.3 | 0.74 | 1.04 |
| 28104 | STAND STONE GRINDER | 3419 | <90.0 | 90.3 | 0.74 | 1.04 |

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9035

TABLE 5-22 (Cont'd) PERSONNEL NOISE EXPOSURE AND IMPACT

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND LEVEL MEAN | SOUND LEVEL M.C. | DAILY NOISE DOSE MEAN | DAILY NOISE DOSE M.C. |
|---|---|---|---|---|---|---|
| 32700 | INDUCT. FURNACE OPER | 1709 | <90.0 | 92.4 | 0.69 | 1.40 |
| 36800 | MELTER/POURER | 2564 | <90.0 | 92.4 | 0.69 | 1.40 |
| 40203 | ROTOBLAST OPERATOR | 1709 | <90.0 | 92.0 | 0.66 | 1.32 |
| 38504 | MULLER OPER | 854 | <90.0 | <90.0 | 0.65 | 0.92 |
| 44000 | SHAKEOUT OPERATOR | 6839 | <90.0 | <90.0 | 0.63 | 1.00 |
| 46702 | WHEELABRATOR OPER | 1709 | <90.0 | 92.1 | 0.62 | 1.35 |
| 27501 | PN GRINDER OPER | 854 | <90.0 | <90.0 | 0.62 | 0.87 |
| 34103 | FLOOR MOLDER | 3419 | <90.0 | 91.0 | 0.61 | 1.15 |
| 34104 | FLOOR MOLDER | 3419 | <90.0 | 91.0 | 0.61 | 1.15 |
| 34000 | SQUEEZ/JOLT MOLDER OP | 1709 | <90.0 | 92.6 | 0.60 | 1.46 |
| 36801 | MELTER/POURER | 5129 | <90.0 | 91.1 | 0.57 | 1.17 |
| 38501 | MULLER OPER | 854 | <90.0 | <90.0 | 0.54 | 0.77 |
| 26606 | SERVICEMAN | 3419 | <90.0 | <90.0 | 0.53 | 0.84 |
| 20202 | FORKLIFT OPERATOR | 1709 | <90.0 | <90.0 | 0.46 | 0.66 |
| 34002 | SQUEEZ/JOLT MOLDER OP | 4274 | <90.0 | <90.0 | 0.41 | 0.65 |
| 36702 | POURER | 1709 | <90.0 | <90.0 | 0.40 | 0.40 |
| 36703 | POURER | 1709 | <90.0 | <90.0 | 0.40 | 0.40 |
| 42700 | CORE BLOWER | 854 | <90.0 | <90.0 | 0.40 | 0.49 |
| 34001 | SQUEEZ/JOLT MOLDER OP | 2564 | <90.0 | <90.0 | 0.40 | 0.96 |
| 40204 | ROTOBLAST OPERATOR | 854 | <90.0 | <90.0 | 0.40 | 0.63 |
| 40200 | ROTOBLAST OPERATOR | 854 | <90.0 | <90.0 | 0.35 | 0.47 |
| 32800 | FURNACE CHARGER | 854 | <90.0 | <90.0 | 0.34 | 0.70 |
| 36704 | POURER | 5129 | <90.0 | <90.0 | 0.34 | 0.70 |
| 38800 | SANDMULLER OPERATOR | 854 | <90.0 | <90.0 | 0.30 | 0.30 |
| 42900 | OIL-BAKE COREMAKER | 1709 | <90.0 | <90.0 | 0.16 | 0.16 |
| 26501 | LABORER | 5129 | <90.0 | <90.0 | 0.11 | 0.23 |
| 45900 | SHIFTER | 2564 | <90.0 | <90.0 | 0.11 | 0.23 |
| 42200 | NO-BAKE CORE OPER | 4274 | <90.0 | <90.0 | 0.04 | 0.05 |
| 20200 | FORKLIFT OPERATOR | 1709 | <90.0 | <90.0 | 0.00 | 0.43 |
| 20201 | FORKLIFT OPERATOR | 1709 | <90.0 | <90.0 | 0.00 | 0.0 |
| 20300 | WORKSAVER OPERATOR | 5129 | <90.0 | <90.0 | 0.00 | 0.23 |
| 26400 | SERVICEMAN | 1709 | <90.0 | <90.0 | 0.00 | 0.0 |
| 26401 | SERVICEMAN | 1709 | <90.0 | <90.0 | 0.00 | 0.29 |
| 26403 | SERVICEMAN | 1709 | <90.0 | <90.0 | 0.00 | 0.0 |
| 26404 | SERVICEMAN | 1709 | <90.0 | <90.0 | 0.00 | 0.83 |
| 26405 | SERVICEMAN | 1709 | <90.0 | <90.0 | 0.00 | 0.57 |

TABLE 5-22 (Cont'd) PERSONNEL NOISE EXPOSURE AND IMPACT

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND LEVEL MEAN | SOUND LEVEL M.C. | DAILY NOISE DOSE MEAN | DAILY NOISE DOSE M.C. |
|---|---|---|---|---|---|---|
| 26407 | SERVICEMAN | 1709 | <90.0 | <90.0 | 0.00 | 0.42 |
| 26408 | SERVICEMAN | 1709 | <90.0 | <90.0 | 0.00 | 0.0 |
| 26409 | SERVICEMAN | 3419 | <90.0 | <90.0 | 0.00 | 0.0 |
| 26410 | SERVICEMAN | 1709 | <90.0 | <90.0 | 0.00 | 0.0 |
| 26500 | LABORER | 854 | <90.0 | <90.0 | 0.00 | 0.07 |
| 26502 | LABORER | 1709 | <90.0 | <90.0 | 0.00 | 0.0 |
| 26503 | LABORER | 1709 | <90.0 | <90.0 | 0.00 | 0.14 |
| 26504 | LABORER | 1709 | <90.0 | <90.0 | 0.00 | 0.0 |
| 26600 | HELPER | 5129 | <90.0 | <90.0 | 0.00 | 0.14 |
| 27000 | FOREMAN | 854 | <90.0 | <90.0 | 0.00 | 0.37 |
| 30300 | ARC WELDER/A | 2564 | <90.0 | <90.0 | 0.00 | 0.0 |
| 30302 | ARC WELDER/A | 3419 | <90.0 | <90.0 | 0.00 | 0.17 |
| 30303 | ARC WELDER/A | 1709 | <90.0 | <90.0 | 0.00 | 0.34 |
| 30700 | ACETYLENE WELDER | 854 | <90.0 | <90.0 | 0.00 | 0.0 |
| 32900 | CUPOLA FURNACE OPER | 1709 | <90.0 | 91.9 | 0.00 | 1.30 |
| 33000 | LADLE PRE-HEATER | 1709 | <90.0 | <90.0 | 0.00 | 0.14 |
| 33002 | LADLE PRE-HEATER | 1709 | <90.0 | <90.0 | 0.00 | 0.0 |
| 33100 | LADLE SKIMMER | 1709 | <90.0 | <90.0 | 0.00 | 0.72 |
| 33101 | LADLE SKIMMER | 1709 | <90.0 | <90.0 | 0.00 | 0.42 |
| 34100 | FLOOR MOLDER | 3419 | <90.0 | <90.0 | 0.00 | 0.0 |
| 34101 | FLOOR MOLDER | 1709 | <90.0 | <90.0 | 0.00 | 0.0 |
| 34102 | FLOOR MOLDER | 3419 | <90.0 | <90.0 | 0.00 | 0.0 |
| 34200 | PACEMAKER MOLDR OPER | 854 | <90.0 | <90.0 | 0.00 | 0.58 |
| 36700 | POURER | 6839 | <90.0 | <90.0 | 0.00 | 0.43 |
| 38500 | MULLER OPER | 854 | <90.0 | <90.0 | 0.00 | 0.0 |
| 42100 | SHELL CORE OPERATOR | 854 | <90.0 | <90.0 | 0.00 | 0.29 |
| 42201 | NO-BAKE CORE OPER | 854 | <90.0 | <90.0 | 0.00 | 0.0 |
| 42202 | NO-BAKE CORE OPER | 854 | <90.0 | 91.7 | 0.00 | 1.27 |
| 43300 | CORE ROOM WORKER | 5984 | <90.0 | <90.0 | 0.00 | 0.43 |
| 43301 | CORE ROOM WORKER | 14533 | <90.0 | <90.0 | 0.00 | 0.0 |
| 46100 | INSPECTOR | 1709 | <90.0 | <90.0 | 0.00 | 0.11 |
| 46200 | CUPOLA OPERATOR | 854 | <90.0 | 91.9 | 0.00 | 1.30 |
| 46700 | WHELLABRATOR OPER | 2564 | <90.0 | <90.0 | 0.00 | 0.43 |
| 48000 | OVERHEAD CRANE OPER | 1709 | <90.0 | <90.0 | 0.00 | 0.0 |
| 48001 | OVERHEAD CRANE OPER | 1709 | <90.0 | <90.0 | 0.00 | 0.0 |
| 48002 | OVERHEAD CRANE OPER | 1709 | <90.0 | <90.0 | 0.00 | 0.0 |

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9635

TABLE 5-22 (Cont'd) PERSONNEL NOISE EXPOSURE AND IMPACT

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND LEVEL MEAN | SOUND LEVEL M.C. | DAILY NOISE DOSE MEAN | DAILY NOISE DOSE M.C. |
|---|---|---|---|---|---|---|
| 48003 | OVERHEAD CRANE OPER | 1709 | <90.0 | <90.0 | 0.00 | 0.0 |
| 53400 | PRESS OPERATOR | 5129 | <90.0 | <90.0 | 0.00 | 0.0 |

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9635

TABLE 5-23 PERSONNEL NOISE EXPOSURE AND IMPACT AVERAGES

EPA CRITERIA

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND MEAN | LEVEL M.C. | LEV. WT. POP. MEAN | M.C. |
|---|---|---|---|---|---|---|
| 275 | PN GRINDER OPER | 70100 | 93.9 | 95.9 | 626773 | 768070 |
| 340 | SQUEZ/JOLT MOLDER OP | 29919 | 96.3 | 102.3 | 346776 | 569463 |
| 303 | ARC WELDER/A | 24790 | 93.6 | 95.6 | 235939 | 316564 |
| 310 | ARC AIR GOUGER | 10255 | 104.6 | 106.5 | 225570 | 287184 |
| 421 | SHELL CORE OPERATOR | 16240 | 92.6 | 94.0 | 127559 | 147676 |
| 281 | STAND STONE GRINDER | 19660 | 90.7 | 92.8 | 121862 | 156074 |
| 367 | POURER | 18605 | 89.9 | 92.2 | 110720 | 140650 |
| 302 | ARC-AIR OPERATOR | 5129 | 103.5 | 107.3 | 103976 | 133500 |
| 505 | CUT-OFF WHEEL OPER | 7691 | 97.9 | 99.1 | 101020 | 111418 |
| 280 | WHEEL GRINDER OPER | 9403 | 95.4 | 101.9 | 97905 | 170481 |
| 341 | FLOOR MOLDER | 17094 | 86.3 | 91.2 | 80723 | 117619 |
| 443 | SHAKEOUT TABLE OPER | 5128 | 99.0 | 102.8 | 73921 | 99111 |
| 264 | SERVICEMAN | 23929 | 85.6 | 87.6 | 73735 | 101293 |
| 440 | SHAKEOUT OPERATOR | 11967 | 90.3 | 93.0 | 69730 | 97488 |
| 343 | MOLDMASTER OPERATOR | 5129 | 95.1 | 100.1 | 66540 | 80649 |
| 326 | ARC FURNACE OPERATOR | 4274 | 98.9 | 102.8 | 61252 | 82457 |
| 279 | SWING GRINDER OPER | 6837 | 92.7 | 93.2 | 53331 | 56029 |
| 282 | TRIM GRINDER OPER | 3419 | 99.9 | 99.9 | 52984 | 52984 |
| 467 | WHELLABRATOR OPER | 8546 | 90.0 | 93.6 | 49576 | 75573 |
| 422 | NO-BAKE CORE OPER | 10256 | 87.3 | 89.2 | 43628 | 56315 |
| 202 | FORKLIFT OPERATOR | 8836 | 87.8 | 90.1 | 43528 | 50158 |
| 277 | PN DISC GRINDER OPER | 3419 | 97.0 | 99.9 | 41319 | 52940 |
| 402 | ROTOBLAST OPERATOR | 6835 | 90.4 | 93.5 | 40587 | 56592 |
| 368 | MELTER/POURER | 7693 | 89.4 | 93.6 | 40091 | 67882 |
| 433 | CORE ROOM WORKER | 20517 | 83.4 | 86.7 | 37857 | 70401 |
| 318 | GAS BURNER | 1709 | 104.6 | 106.4 | 37371 | 47643 |
| 319 | POWDER BURNER | 1709 | 104.6 | 106.4 | 37371 | 47643 |
| 450 | DUMPOUT/SHAKEOUT OP | 1709 | 103.9 | 103.9 | 35784 | 35784 |
| 339 | AUTO-MOLDER OPERATOR | 3418 | 94.6 | 96.7 | 32899 | 40276 |
| 480 | OVERHEAD CRANE OPER | 6836 | 88.4 | 88.4 | 30725 | 30725 |
| 325 | FURNACE OPERATOR | 3419 | 93.6 | 93.6 | 29435 | 29435 |
| 265 | LABORER | 11110 | 82.6 | 84.5 | 28010 | 40395 |
| 330 | LADLE PRE-HEATER | 5127 | 88.3 | 93.3 | 27510 | 53090 |
| 504 | RADIAL SAW OPERATOR | 1709 | 99.9 | 99.9 | 26492 | 26492 |
| 338 | SHELLMOLDER OPERATOR | 3419 | 91.7 | 93.6 | 23941 | 30246 |
| 404 | MACHINE BLASTER | 3419 | 91.0 | 91.0 | 21968 | 21968 |
| 278 | PN CONE GRINDER OPER | 2564 | 93.1 | 95.1 | 21083 | 25829 |
| 266 | HELPER | 5129 | 87.6 | 88.3 | 20278 | 22591 |
| 365 | MULLER OPER | 4270 | 86.3 | 90.2 | 19674 | 25585 |
| 426 | CORE SETTER | 2564 | 92.5 | 92.5 | 19571 | 19571 |

TABLE 5-23 PERSONNEL NOISE EXPOSURE AND IMPACT AVERAGES (Cont'd)

EPA CRITERIA

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND MEAN | LEVEL M.C. | LEV. WT. POP. MEAN | LEV. WT. POP. M.C. |
|---|---|---|---|---|---|---|
| 395 | SANDSLINGER OPERATOR | 1709 | 95.1 | 99.2 | 17348 | 25045 |
| 506 | TABOR CUT-OFF SAW OP | 1709 | 94.1 | 94.1 | 15591 | 15591 |
| 327 | INDUCT. FURNACE OPER | 2563 | 90.2 | 94.5 | 14753 | 24454 |
| 461 | INSPECTOR | 2563 | 88.2 | 89.0 | 14674 | 15576 |
| 337 | MI PRESS. MOLDER OP | 1709 | 93.2 | 93.2 | 14114 | 14114 |
| 459 | SHIFTER | 2564 | 89.5 | 90.7 | 13523 | 15045 |
| 502 | BAND SAW OPERATOR | 1709 | 92.5 | 92.5 | 13021 | 13021 |
| 403 | HAND BLASTER | 1709 | 92.3 | 92.3 | 12837 | 12837 |
| 203 | WORKSAVER OPERATOR | 5129 | 84.8 | 85.4 | 12319 | 16532 |
| 331 | LADLE SKIMMER | 3416 | 86.1 | 89.2 | 10640 | 17275 |
| 534 | PRESS OPERATOR | 5129 | 83.0 | 84.0 | 8207 | 10387 |
| 405 | SPIRALBLAST OPERATOR | 854 | 94.5 | 94.5 | 8162 | 8162 |
| 429 | OIL-BAKE COREMAKER | 1709 | 88.6 | 88.6 | 7697 | 7697 |
| 329 | CUPOLA FURNACE OPER | 1709 | 86.4 | 93.0 | 7666 | 13921 |
| 350 | MOLD WASH WORKER | 854 | 92.5 | 92.5 | 6527 | 6527 |
| 276 | PN DRILL GRINDER OP | 854 | 91.8 | 94.3 | 6060 | 7976 |
| 368 | SANDMULLER OPERATOR | 854 | 90.5 | 93.5 | 5155 | 5155 |
| 328 | FURNACE CHARGER | 854 | 89.9 | 92.6 | 4768 | 6654 |
| 462 | CUPOLA OPERATOR | 854 | 89.4 | 93.4 | 4457 | 7263 |
| 427 | CORE GLUER | 854 | 89.4 | 90.5 | 4432 | 5115 |
| 270 | FOREMAN | 854 | 86.9 | 89.4 | 3028 | 4425 |
| 307 | ACETYLENE WELDER | 854 | 86.6 | 87.5 | 2674 | 3328 |
| 342 | PACEMAKER MOLDR OPER | 854 | 86.5 | 89.3 | 2634 | 4356 |

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9635

TABLE 5-23 PERSONNEL NOISE EXPOSURE AND IMPACT AVERAGES
(Cont'd)

EPA CRITERIA

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

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| | |
|---|---|
| TOTAL NUMBER OF PERSONNEL | 453956 |
| TOTAL NUMBER OF PERSONNEL WITH LEQ > 75 (MEAN) | 450538 |
| TOTAL NUMBER OF PERSONNEL WITH LEQ > 75 (W.C.) | 452248 |
| TOTAL NUMBER OF PERSONNEL WITH LEQ > 90 (MEAN) | 290669 |
| TOTAL NUMBER OF PERSONNEL WITH LEQ > 90 (W.C.) | 337690 |
| LEVEL WEIGHTED POPULATION (MEAN) | 3553913.0 |
| LEVEL WEIGHTED POPULATION (W.C.) | 4667870.0 |

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ENVIRONMENTAL PROTECTION AGENCY  OBN JOB NO. 9635

TABLE 5-24 PERSONNEL NOISE EXPOSURE AND IMPACT AVERAGES

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND LEVEL MEAN | SOUND LEVEL M.C. | DAILY NOISE DOSE MEAN | DAILY NOISE DOSE M.C. |
|---|---|---|---|---|---|---|
| 310 | ARC AIR GOUGER | 10255 | 103.5 | 107.4 | 6.54 | 11.09 |
| 450 | DUMPOUT/SHAKEOUT OP | 1709 | 103.5 | 103.5 | 6.52 | 6.52 |
| 318 | GAS BURNER | 1709 | 103.3 | 107.1 | 6.34 | 10.77 |
| 319 | POWDER BURNER | 1709 | 103.3 | 107.1 | 6.34 | 10.77 |
| 302 | ARC-AIR OPERATOR | 5129 | 101.4 | 105.3 | 4.08 | 6.28 |
| 262 | TRIM GRINDER OPER | 3419 | 96.3 | 96.3 | 3.17 | 3.17 |
| 504 | RADIAL SAW OPERATOR | 1709 | 96.3 | 96.3 | 3.17 | 3.17 |
| 326 | ARC FURNACE OPERATOR | 4274 | 96.0 | 101.9 | 3.02 | 5.18 |
| 443 | SHAKEOUT TABLE OPER | 5128 | 97.7 | 101.4 | 2.91 | 4.84 |
| 343 | MOLDMASTER OPERATOR | 5129 | 96.9 | 98.7 | 2.61 | 3.32 |
| 505 | CUT-OFF WHEEL OPER | 7691 | 96.7 | 97.6 | 2.52 | 2.96 |
| 340 | SQUEEZ/JOLT MOLDER OP | 29919 | 99.4 | 101.8 | 2.11 | 3.14 |
| 277 | PN DISC GRINDER OPER | 3419 | 94.7 | 97.8 | 1.92 | 2.93 |
| 280 | WHEEL GRINDER OPER | 9403 | 94.6 | 101.0 | 1.89 | 4.01 |
| 339 | AUTO-MOLDER OPERATOR | 3416 | 93.9 | 96.0 | 1.71 | 2.30 |
| 506 | TABOR CUT-OFF SAW OP | 1709 | 93.4 | 93.4 | 1.60 | 1.60 |
| 337 | HI PRESS. MOLDER OP | 1709 | 92.0 | 92.0 | 1.31 | 1.31 |
| 275 | PN GRINDER OPER | 70100 | 91.8 | 93.6 | 1.28 | 1.65 |
| 279 | SWING GRINDER OPER | 6837 | 91.5 | 92.0 | 1.23 | 1.33 |
| 426 | CORE SETTER | 2564 | 91.4 | 91.4 | 1.21 | 1.21 |
| 405 | SPIRALBLAST OPERATOR | 854 | 91.4 | 91.4 | 1.21 | 1.21 |
| 325 | FURNACE OPERATOR | 3419 | 91.3 | 91.3 | 1.20 | 1.20 |
| 276 | PN DRILL GRINDER OP | 854 | 91.0 | 93.6 | 1.15 | 1.64 |
| 395 | SANDSLINGER OPERATOR | 1709 | 91.0 | 94.9 | 1.14 | 1.96 |
| 421 | SHELL CORE OPERATOR | 16240 | 90.9 | 92.4 | 1.14 | 1.40 |
| 278 | PN CONE GRINDER OPER | 2564 | 90.4 | 92.6 | 1.06 | 1.44 |
| 502 | BAND SAW OPERATOR | 1709 | 90.3 | 90.3 | 1.04 | 1.04 |
| 403 | HAND BLASTER | 1709 | 90.0 | 90.0 | 1.00 | 1.00 |
| 404 | MACHINE BLASTER | 3419 | <90.0 | <90.0 | 0.99 | 0.99 |
| 281 | STAND STONE GRINDER | 19600 | <90.0 | 91.6 | 0.92 | 1.25 |
| 350 | MOLD WASH WORKER | 854 | <90.0 | <90.0 | 0.87 | 0.87 |
| 303 | ARC WELDER/A | 24790 | <90.0 | 92.8 | 0.84 | 1.48 |
| 336 | SHELLMOLDER OPERATOR | 3419 | <90.0 | 91.2 | 0.83 | 1.18 |
| 202 | FORKLIFT OPERATOR | 6836 | <90.0 | <90.0 | 0.81 | 0.97 |
| 402 | ROTOBLAST OPERATOR | 6835 | <90.0 | 92.0 | 0.79 | 1.31 |
| 327 | INDUCT. FURNACE OPER | 2563 | <90.0 | 92.8 | 0.73 | 1.48 |

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 4635

TABLE 5-24 (Cont'd) PERSONNEL NOISE EXPOSURE AND IMPACT AVERAGES

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND LEVEL MEAN | SOUND LEVEL M.C. | DAILY NOISE DOSE MEAN | DAILY NOISE DOSE M.C. |
|---|---|---|---|---|---|---|
| 440 | SHAKEOUT OPERATOR | 11967 | <90.0 | 91.0 | 0.72 | 1.14 |
| 467 | WHELLABRATOR OPER | 8546 | <90.0 | 92.4 | 0.71 | 1.40 |
| 461 | INSPECTOR | 2563 | <90.0 | <90.0 | 0.69 | 0.76 |
| 368 | MELTER/POURER | 7693 | <90.0 | 91.6 | 0.61 | 1.25 |
| 385 | MULLER OPER | 4270 | <90.0 | <90.0 | 0.54 | 0.77 |
| 367 | POURER | 18805 | <90.0 | <90.0 | 0.47 | 0.94 |
| 330 | LADLE PRE-HEATER | 5127 | <90.0 | 93.5 | 0.45 | 1.62 |
| 422 | NO-BAKE CORE OPER | 10256 | <90.0 | <90.0 | 0.43 | 0.63 |
| 427 | CORE GLUER | 854 | <90.0 | <90.0 | 0.40 | 0.49 |
| 328 | FURNACE CHARGER | 854 | <90.0 | <90.0 | 0.34 | 0.70 |
| 341 | FLOOR MOLDER | 17094 | <90.0 | <90.0 | 0.32 | 0.55 |
| 388 | SANDMULLER OPERATOR | 854 | <90.0 | <90.0 | 0.30 | 0.30 |
| 264 | SERVICEMAN | 23929 | <90.0 | <90.0 | 0.22 | 0.41 |
| 429 | OIL-BAKE COREMAKER | 1709 | <90.0 | <90.0 | 0.16 | 0.16 |
| 459 | SHIFTER | 2564 | <90.0 | <90.0 | 0.11 | 0.23 |
| 265 | LABORER | 11110 | <90.0 | <90.0 | 0.05 | 0.14 |
| 203 | WORKSAVER OPERATOR | 5129 | <90.0 | <90.0 | 0.00 | 0.23 |
| 266 | HELPER | 5129 | <90.0 | <90.0 | 0.00 | 0.14 |
| 270 | FOREMAN | 854 | <90.0 | <90.0 | 0.00 | 0.37 |
| 307 | ACETYLENE WELDER | 854 | <90.0 | <90.0 | 0.00 | 0.0 |
| 329 | CUPOLA FURNACE OPER | 1709 | <90.0 | 91.9 | 0.00 | 1.30 |
| 331 | LADLE SKIMMER | 3418 | <90.0 | <90.0 | 0.00 | 0.57 |
| 342 | PACEMAKER MOLDR OPER | 854 | <90.0 | <90.0 | 0.00 | 0.58 |
| 433 | CORE ROOM WORKER | 20517 | <90.0 | <90.0 | 0.00 | 0.13 |
| 462 | CUPOLA OPERATOR | 854 | <90.0 | 91.9 | 0.00 | 1.30 |
| 480 | OVERHEAD CRANE OPER | 6836 | <90.0 | <90.0 | 0.00 | 0.0 |
| 534 | PRESS OPERATOR | 5129 | <90.0 | <90.0 | 0.00 | 0.0 |

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9639

TABLE 5-24 PERSONNEL NOISE EXPOSURE AND IMPACT AVERAGES
(Cont'd)

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

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TOTAL NUMBER OF PERSONNEL = 453958
TOTAL NUMBER OVEREXPOSED (MEAN) = 210308
TOTAL NUMBER OVEREXPOSED (N.C.) = 286395

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ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9635

TABLE 5-25 EQUIPMENT NOISE IMPACT

EPA CRITERIA

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO.OF UNITS | MEAN LJ | M.C. LJ | NO.OF PERS. | PRIORITY INDEX | NORM. P.I. |
|---|---|---|---|---|---|---|---|
| 1160 | ARC AIR GOUGERS | 7 | 106.4 | 110.3 | 306349 | 45306.1 | 0.101 |
| 1118 | PN DISC GRINDER | 7 | 99.7 | 102.8 | 270962 | 30862.8 | 0.069 |
| 1338 | SQUEZ/JOLT MOLDER | 17 | 99.9 | 106.4 | 265810 | 29893.9 | 0.066 |
| 1120 | PN WHEEL GRINDER | 15 | 95.3 | 98.1 | 279510 | 26342.6 | 0.058 |
| 1450 | SHELL CORE | 5 | 95.0 | 96.4 | 170950 | 20382.8 | 0.045 |
| 1119 | PN CONE GRINDER | 14 | 95.4 | 97.5 | 264979 | 20237.4 | 0.045 |
| 1486 | SHAKEOUT | 6 | 91.7 | 95.0 | 132474 | 19344.3 | 0.043 |
| 1517 | STAND STONE GRIND | 10 | 91.5 | 94.0 | 209413 | 18325.1 | 0.041 |
| 1438 | INDUCT. FURNACE | 7 | 91.0 | 96.1 | 166603 | 14970.2 | 0.033 |
| 1437 | ARC FURNACE | 3 | 100.3 | 104.1 | 79463 | 13342.6 | 0.030 |
| 1117 | PN DRILL GRINDER | 8 | 92.6 | 95.2 | 241904 | 11015.9 | 0.024 |
| 1387 | SANDSLINGER | 2 | 98.0 | 98.0 | 60681 | 10614.0 | 0.024 |
| 1194 | ROTOBLAST | 5 | 92.0 | 95.4 | 67515 | 10210.9 | 0.023 |
| 1440 | FURNACE | 2 | 89.5 | 94.4 | 136747 | 9745.5 | 0.022 |
| 1452 | CORE OVEN | 1 | 82.0 | 82.0 | 37614 | 9189.3 | 0.020 |
| 1535 | VENTILATION | 2 | 82.5 | 83.2 | 289729 | 9019.7 | 0.020 |
| 1513 | WHEEL GRINDER | 2 | 97.0 | 104.1 | 20513 | 8660.8 | 0.019 |
| 1146 | PN TAMPER | 7 | 95.1 | 99.7 | 23077 | 7857.5 | 0.017 |
| 1499 | WHEELABRATOR | 5 | 90.2 | 95.8 | 112813 | 7537.4 | 0.017 |
| 1512 | SWING GRINDER | 3 | 93.7 | 94.2 | 128218 | 7241.8 | 0.016 |
| 1508 | CUT-OFF WHEEL | 2 | 100.0 | 100.0 | 190612 | 6966.0 | 0.015 |
| 1451 | NO-BAKE CORE | 2 | 95.0 | 96.4 | 31629 | 6802.8 | 0.015 |
| 1492 | SHAKEOUT TABLE | 6 | 101.0 | 104.0 | 87175 | 6512.1 | 0.014 |
| 1193 | ABRASIVE BLAST | 1 | 92.0 | 92.0 | 6838 | 6411.7 | 0.014 |
| 1503 | RADIAL SAW | 1 | 102.0 | 102.0 | 22219 | 5596.1 | 0.012 |
| 1471 | BACK/OVERHD CRANE | 1 | 90.0 | 90.0 | 10255 | 5371.7 | 0.012 |
| 1490 | SHAKEOUT CONVEYOR | 1 | 105.0 | 105.0 | 88882 | 5265.1 | 0.012 |
| 1341 | MOLDMASTER | 3 | 101.0 | 103.6 | 6838 | 5044.0 | 0.011 |
| 1446 | CRUCIBLE | 1 | 95.0 | 95.0 | 10256 | 5012.6 | 0.011 |
| 1166 | WELDING/ARC | 3 | 83.0 | 86.5 | 146171 | 4902.3 | 0.011 |

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9635

TABLE 5-25 EQUIPMENT NOISE IMPACT
(Cont'd)

EPA CRITERIA

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO.OF UNITS | MEAN LJ | M.C. LJ | NO.OF PERS. | PRIORITY INDEX | NORM. P.I. |
|---|---|---|---|---|---|---|---|
| 1507 | CUT-OFF WHEEL | 3 | 99.0 | 101.6 | 32478 | 4682.6 | 0.010 |
| 1336 | SHELL MOLDER | 3 | 93.7 | 98.2 | 87160 | 4400.4 | 0.010 |
| 1335 | AUTO-MOLDER | 2 | 95.5 | 97.6 | 133329 | 4195.6 | 0.009 |
| 1542 | COMPRESSED AIR | 8 | 94.8 | 99.4 | 121380 | 4124.1 | 0.009 |
| 1374 | MULLER | 5 | 90.8 | 93.1 | 127346 | 4042.0 | 0.009 |
| 1443 | LADLE PRE-HEAT | 5 | 90.0 | 93.8 | 192697 | 3750.9 | 0.008 |
| 1502 | BAND SAW | 1 | 94.0 | 94.0 | 18800 | 3565.9 | 0.008 |
| 1493 | BACK. ONLY CONTR. | 0 | 80.4 | 83.8 | 83756 | 3166.4 | 0.007 |
| 1494 | SHAKEOUT TABLE | 2 | 101.0 | 106.7 | 5981 | 3122.5 | 0.007 |
| 1459 | CORE SET LINE | 1 | 93.0 | 93.0 | 86320 | 3046.1 | 0.007 |
| 1482 | PN VIBRATOR | 3 | 98.7 | 101.7 | 84014 | 2675.2 | 0.006 |
| 1552 | BACK. ONLY CONTR. | 0 | 77.9 | 84.9 | 166661 | 1943.9 | 0.004 |
| 1137 | PN CHISEL | 4 | 108.8 | 112.8 | 5126 | 1782.8 | 0.004 |
| 1373 | SANDMULLER | 3 | 87.7 | 98.8 | 87152 | 1753.2 | 0.004 |
| 1509 | TABOR CUT-OFF WHL | 1 | 95.0 | 95.0 | 1709 | 1682.5 | 0.004 |
| 1442 | FURNACE | 2 | 87.0 | 90.4 | 71790 | 1665.2 | 0.004 |
| 1491 | SHAKEOUT CONVEYOR | 1 | 98.6 | 98.0 | 8834 | 1630.5 | 0.004 |
| 1375 | SAND HOPPER/VIB | 5 | 97.8 | 100.1 | 5129 | 1593.0 | 0.004 |
| 1189 | ABRASIVE BLAST | 1 | 95.0 | 95.0 | 1709 | 1580.2 | 0.004 |
| 1337 | HI-PRESS. MOLDER | 1 | 92.0 | 92.0 | 48716 | 1531.7 | 0.003 |
| 1483 | PN VIBRATOR | 1 | 105.0 | 105.0 | 1709 | 1494.5 | 0.003 |
| 1397 | EXHAUST FAN | 1 | 92.0 | 92.0 | 32401 | 1258.4 | 0.003 |
| 1544 | BACK. ONLY CONTR. | 0 | 78.1 | 84.0 | 87173 | 1082.6 | 0.002 |
| 1195 | SPIRALBLAST | 1 | 98.0 | 98.0 | 854 | 757.4 | 0.002 |
| 1802 | FORKLIFT | 3 | 85.7 | 88.2 | 21367 | 345.0 | 0.001 |
| 1175 | WELD/ACETYLENE | 1 | 88.0 | 88.0 | 1708 | 181.0 | 0.000 |
| 1340 | MOLDER-PACEMAKER | 1 | 82.0 | 82.3 | 854 | 120.8 | 0.000 |

ENVIRONMENTAL PROTECTION AGENCY BUN JUB NU. 9635

TABLE 5-26 EQUIPMENT NUISE CONTROL PRIORITY

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO.OF UNITS | MEAN LJ | M.C. LJ | NU.OF PERS. | PRIORITY INDEX | NORM. P.I. |
|---|---|---|---|---|---|---|---|
| 1160 | ARC AIR GOUGERS | 7 | 106.4 | 110.3 | 27351 | 27298.7 | 0.130 |
| 1120 | PN WHEEL GRINDER | 15 | 95.3 | 98.1 | 69246 | 26398.7 | 0.126 |
| 1118 | PN DISC GRINDER | 7 | 99.7 | 102.8 | 56423 | 22562.0 | 0.107 |
| 1338 | SQUEZ/JOLT MOLDER | 17 | 99.9 | 106.4 | 23081 | 21739.5 | 0.103 |
| 1119 | PN CONE GRINDER | 14 | 95.4 | 97.6 | 66661 | 19103.7 | 0.091 |
| 1117 | PN DRILL GRINDER | 8 | 92.6 | 95.2 | 62406 | 11830.0 | 0.056 |
| 1513 | WHEEL GRINDER | 2 | 97.0 | 104.1 | 9403 | 7894.9 | 0.038 |
| 1437 | ARC FURNACE | 3 | 100.3 | 104.1 | 7693 | 7693.0 | 0.037 |
| 1450 | SHELL CORE | 5 | 95.0 | 96.4 | 7693 | 7693.0 | 0.037 |
| 1512 | SHING GRINDER | 3 | 93.7 | 94.2 | 5983 | 5983.0 | 0.028 |
| 1503 | RADIAL SAW | 1 | 102.0 | 102.0 | 5128 | 5128.0 | 0.024 |
| 1508 | CUT-OFF WHEEL | 2 | 100.0 | 100.0 | 4273 | 4273.0 | 0.020 |
| 1490 | SHAKEOUT CONVEYOR | 1 | 105.0 | 105.0 | 5126 | 3659.1 | 0.017 |
| 1492 | SHAKEOUT TABLE | 6 | 101.0 | 104.0 | 3419 | 3419.0 | 0.016 |
| 1446 | CRUCIBLE | 1 | 95.0 | 95.0 | 3419 | 3419.0 | 0.016 |
| 1335 | AUTO-MOLDER | 2 | 95.5 | 97.6 | 3416 | 3418.0 | 0.016 |
| 1507 | CUT-OFF WHEEL | 3 | 99.0 | 101.6 | 3418 | 3418.0 | 0.016 |
| 1494 | SHAKEOUT TABLE | 2 | 101.0 | 106.7 | 5961 | 3315.6 | 0.016 |
| 1341 | MOLDMASTER | 3 | 101.0 | 105.6 | 5129 | 3157.9 | 0.015 |
| 1459 | CORE SET LINE | 1 | 93.0 | 93.0 | 2564 | 2564.0 | 0.012 |
| 1517 | STAND STONE GRIND | 10 | 91.5 | 94.0 | 5963 | 2023.0 | 0.010 |
| 1375 | SAND HOPPER/VIB | 5 | 97.6 | 100.1 | 5129 | 1971.1 | 0.009 |
| 1137 | PN CHISEL | 4 | 103.6 | 112.8 | 1709 | 1709.0 | 0.008 |
| 1194 | ROTOBLAST | 5 | 92.0 | 95.4 | 1709 | 1709.0 | 0.008 |
| 1486 | SHAKEOUT | 6 | 91.7 | 95.0 | 1709 | 1709.0 | 0.008 |
| 1502 | BAND SAW | 1 | 94.0 | 94.0 | 1709 | 1709.0 | 0.008 |

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9635

TABLE 5-26 (Cont'd) EQUIPMENT NOISE CONTROL PRIORITY

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO. OF UNITS | MEAN LJ | M.C. LJ | NO. OF PERS. | PRIORITY INDEX | NORM. P.I. |
|---|---|---|---|---|---|---|---|
| 1509 | TABOR CUT-OFF WHL | 1 | 95.0 | 95.0 | 1709 | 1709.0 | 0.008 |
| 1337 | HI-PRESS. MOLDER | 1 | 92.0 | 92.0 | 1709 | 1031.5 | 0.005 |
| 1195 | SPIRALBLAST | 1 | 98.0 | 98.0 | 854 | 854.0 | 0.004 |
| 1387 | SANDSLINGER | 2 | 98.0 | 98.0 | 1709 | 679.3 | 0.003 |
| 1491 | SHAKEOUT CONVEYOR | 1 | 98.0 | 98.0 | 1709 | 395.0 | 0.002 |
| 1499 | WHEELABRATOR | 5 | 90.2 | 95.8 | 854 | 225.5 | 0.001 |
| 1146 | PN TAMPER | 7 | 95.1 | 99.7 | 1709 | 132.9 | 0.001 |
| 1438 | INDUCT. FURNACE | 7 | 91.0 | 96.1 | 1709 | 106.4 | 0.001 |

TABLE 5-27
LIST OF GENERALIZED EQUIPMENT CODES

| CODE | BEGIN | END | GENERAL DESCRIPTION |
|---|---|---|---|
| 1103 | 1103 | 1124 | PNEUMATIC GRINDER |
| 1135 | 1135 | 1143 | PNEUMATIC CHISEL |
| 1144 | 1144 | 1151 | PNEUMATIC TAMPER |
| 1158 | 1158 | 1186 | WELD/BURN/GOUGING |
| 1187 | 1187 | 1199 | ABRASIVE BLASTING |
| 1333 | 1333 | 1356 | MOLDER |
| 1371 | 1371 | 1384 | MULLER |
| 1385 | 1385 | 1391 | SANDSLINGER |
| 1392 | 1392 | 1392 | HYDRAULIC PUMP |
| 1394 | 1394 | 1400 | EXHAUST FAN |
| 1434 | 1434 | 1443 | FURNACE |
| 1444 | 1444 | 1447 | CRUCIBLE |
| 1448 | 1448 | 1456 | COKE OVEN |
| 1457 | 1457 | 1459 | COKE SET LINE |
| 1460 | 1460 | 1479 | LATHE |
| 1480 | 1480 | 1483 | PNEUMATIC VIBRATOR |
| 1484 | 1484 | 1496 | SHAKEOUT/DUMPOUT |
| 1497 | 1497 | 1499 | WHEELABRATOR |
| 1500 | 1500 | 1504 | SAW/METAL |
| 1505 | 1505 | 1509 | CUT-OFF WHEEL |
| 1510 | 1510 | 1520 | ELECTRIC GRINDERS |
| 1525 | 1525 | 1527 | HAMMERING |

ENVIRONMENTAL PROTECTION AGENCY  BEN JOB NO. 9635

TABLE 5-28 EQUIPMENT NOISE IMPACT AVERAGES

EPA CRITERIA

SIC CODE = 332  AVERAGE FOR INDUSTRY  NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO.OF UNITS | MEAN LJ | M.C. LJ | NO.OF PERS. | PRIORITY INDEX | NORM. P.I. |
|---|---|---|---|---|---|---|---|
| 1103 | PNEUMATIC GRINDER | 44 | 95.5 | 96.2 | ****** | 88456.7 | 0.196 |
| 1158 | WELD/BURN/GOUGING | 11 | 96.2 | 101.9 | 454728 | 50389.3 | 0.112 |
| 1333 | MOLDER | 28 | 97.8 | 103.5 | 542729 | 45191.3 | 0.100 |
| 1434 | FURNACE | 19 | 91.6 | 96.0 | 646960 | 43480.4 | 0.097 |
| 1484 | SHAKEOUT/DUMPOUT | 16 | 97.6 | 101.1 | 405102 | 39042.9 | 0.087 |
| 1446 | CORE OVEN | 9 | 93.9 | 95.3 | 240193 | 36374.9 | 0.081 |
| 1510 | ELECTRIC GRINDERS | 15 | 92.7 | 95.6 | 358144 | 34227.6 | 0.076 |
| 1187 | ABRASIVE BLASTING | 8 | 93.1 | 96.5 | 76916 | 18960.1 | 0.042 |
| 1505 | CUT-OFF WHEEL | 6 | 96.7 | 100.8 | 224799 | 13333.2 | 0.030 |
| 1385 | SANDSLINGER | 2 | 98.0 | 96.0 | 60661 | 10614.0 | 0.024 |
| 1500 | SAW/METAL | 2 | 96.0 | 96.0 | 41019 | 9162.0 | 0.020 |
| 1144 | PNEUMATIC TAMPER | 8 | 95.4 | 99.9 | 23077 | 7857.5 | 0.017 |
| 1497 | WHEELABRATOR | 5 | 90.2 | 95.8 | 112613 | 7537.4 | 0.017 |
| 1371 | MULLER | 13 | 92.6 | 96.1 | 219657 | 7356.1 | 0.016 |
| 1460 | LATHE | 2 | 92.0 | 92.0 | 10255 | 5371.7 | 0.012 |
| 1444 | CRUCIBLE | 1 | 95.0 | 95.0 | 10256 | 5012.6 | 0.011 |
| 1480 | PNEUMATIC VIBRATOR | 4 | 100.2 | 103.3 | 66323 | 4169.8 | 0.009 |
| 1457 | CORE SET LINE | 2 | 93.5 | 93.5 | 66320 | 3046.1 | 0.007 |
| 1135 | PNEUMATIC CHISEL | 4 | 103.8 | 112.8 | 5126 | 1702.6 | 0.004 |
| 1394 | EXHAUST FAN | 2 | 92.5 | 92.5 | 32481 | 1255.4 | 0.003 |
| 1392 | HYDRAULIC PUMP | 1 | 96.0 | 96.0 | 1709 | 163.9 | 0.000 |
| 1525 | HAMMERING | 2 | 96.0 | 101.7 | 2502 | 116.0 | 0.000 |

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9635

TABLE 5-29 EQUIPMENT NOISE CONTROL PRIORITY AVERAGES

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO. OF UNITS | MEAN LJ | M.C. LJ | NO. OF PERS. | PRIORITY INDEX | NORM. P.I. |
|---|---|---|---|---|---|---|---|
| 1103 | PNEUMATIC GRINDER | 44 | 95.6 | 98.2 | 254756 | 79894.4 | 0.300 |
| 1333 | MOLDER | 28 | 97.6 | 103.6 | 33337 | 29346.9 | 0.140 |
| 1158 | WELD/BURN/GOUGING | 11 | 98.2 | 101.9 | 35900 | 27298.7 | 0.130 |
| 1510 | ELECTRIC GRINDERS | 15 | 92.7 | 95.6 | 21369 | 15900.9 | 0.076 |
| 1484 | SHAKEOUT/DUMPOUT | 16 | 97.6 | 101.1 | 17944 | 12497.6 | 0.059 |
| 1505 | CUT-OFF WHEEL | 6 | 98.7 | 100.8 | 9400 | 9400.0 | 0.045 |
| 1434 | FURNACE | 19 | 91.6 | 96.0 | 11111 | 7799.4 | 0.037 |
| 1448 | CORE OVEN | 9 | 93.9 | 95.3 | 7693 | 7693.0 | 0.037 |
| 1500 | SAW/METAL | 2 | 96.0 | 98.0 | 6837 | 6837.0 | 0.033 |
| 1444 | CRUCIBLE | 1 | 95.0 | 95.0 | 3419 | 3419.0 | 0.016 |
| 1457 | CORE SET LINE | 2 | 93.5 | 93.5 | 2564 | 2564.0 | 0.012 |
| 1187 | ABRASIVE BLASTING | 6 | 93.1 | 96.5 | 2563 | 2563.0 | 0.012 |
| 1371 | MULLER | 13 | 92.5 | 96.1 | 5129 | 1971.1 | 0.009 |
| 1135 | PNEUMATIL CHISEL | 4 | 103.8 | 112.8 | 1709 | 1709.0 | 0.008 |
| 1385 | SANDSLINGER | 2 | 98.0 | 98.0 | 1709 | 854.3 | 0.003 |
| 1497 | WHEELABRATOR | 5 | 90.2 | 95.8 | 854 | 225.5 | 0.001 |
| 1525 | HAMMERING | 2 | 96.0 | 101.7 | 854 | 190.5 | 0.001 |
| 1392 | HYDRAULIC PUMP | 1 | 96.0 | 96.0 | 1709 | 149.7 | 0.001 |
| 1144 | PNEUMATIC TAMPER | 8 | 95.4 | 99.9 | 1709 | 132.9 | 0.001 |

TABLE 5-30
INPUT NOISE REDUCTION DATA

EACH LINE SHOWS THE NOISE REDUCTION
SPECIFICATIONS FOR A RANGE OF EQUIPMENT CODES

| CODE FOR BEGINNING OF RANGE | CODE FOR END OF RANGE | NOISE REDUCTION |
|---|---|---|
| 1103 | 1124 | 10 |
| 1333 | 1356 | 10 |
| 1158 | 1186 | 10 |
| 1510 | 1520 | 5 |
| 1484 | 1496 | 8 |
| 1505 | 1509 | 0 |

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9635

TABLE 5-31 EFFECT OF EQUIPMENT NOISE CONTROL

BACKGROUND AND EQUIPMENT NOISE DATA AVERAGES (LEQ)

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO. OF SAMPLES | MEAN LEQ (DBA) BEFORE | MEAN LEQ (DBA) AFTER | NOISE RED. (DBA) |
|---|---|---|---|---|---|
| 1160 | ARC AIR GOUGERS | 7 | 106.4 | 96.4 | 10.0 |
| 1483 | PN VIBRATOR | 1 | 105.0 | 105.0 | 0.0 |
| 1490 | SHAKEOUT CONVEYOR | 1 | 105.0 | 97.0 | 8.0 |
| 1137 | PN CHISEL | 4 | 103.8 | 103.8 | 0.0 |
| 1503 | RADIAL SAW | 1 | 102.0 | 102.0 | 0.0 |
| 1341 | MOLDMASTER | 3 | 101.0 | 91.0 | 10.0 |
| 1492 | SHAKEOUT TABLE | 6 | 101.0 | 93.0 | 8.0 |
| 1494 | SHAKEOUT TABLE | 2 | 101.0 | 93.0 | 8.0 |
| 1437 | ARC FURNACE | 3 | 100.3 | 100.3 | 0.0 |
| 1508 | CUT-OFF WHEEL | 2 | 100.0 | 92.0 | 8.0 |
| 1338 | SQUEEZ/JOLT MOLDER | 17 | 99.9 | 89.9 | 10.0 |
| 1118 | PN DISC GRINDER | 7 | 99.7 | 89.7 | 10.0 |
| 1507 | CUT-OFF WHEEL | 3 | 99.0 | 91.0 | 8.0 |
| 1482 | PN VIBRATOR | 3 | 98.7 | 98.7 | 0.0 |
| 1195 | SPIRALBLAST | 1 | 98.0 | 98.0 | 0.0 |
| 1387 | SANDSLINGER | 2 | 98.0 | 98.0 | 0.0 |
| 1453 | FLEXIBLD CORE MKR | 1 | 98.0 | 98.0 | 0.0 |
| 1491 | SHAKEOUT CONVEYOR | 1 | 98.0 | 90.0 | 8.0 |
| 1375 | SAND HOPPER/VIB | 5 | 97.6 | 97.6 | 0.0 |
| 1513 | WHEEL GRINDER | 2 | 97.0 | 92.0 | 5.0 |
| 1335 | AUTO-MOLDER | 2 | 95.5 | 85.5 | 10.0 |
| 1119 | PN CONE GRINDER | 14 | 95.4 | 85.4 | 10.0 |
| 1120 | PN WHEEL GRINDER | 15 | 95.3 | 85.3 | 10.0 |
| 1146 | PN TAMPER | 7 | 95.1 | 95.1 | 0.0 |
| 1189 | ABRASIVE BLAST | 1 | 95.0 | 95.0 | 0.0 |
| 1446 | CRUCIBLE | 1 | 95.0 | 95.0 | 0.0 |
| 1450 | SHELL CORE | 5 | 95.0 | 95.0 | 0.0 |
| 1451 | NO-BAKE CORE | 2 | 95.0 | 95.0 | 0.0 |
| 1509 | TABOR CUT-OFF WHL | 1 | 95.0 | 87.0 | 8.0 |
| 1542 | COMPRESSED AIR | 6 | 94.6 | 94.6 | 0.0 |
| 1477 | HOIST | 1 | 94.0 | 94.0 | 0.0 |
| 1502 | BAND SAW | 1 | 94.0 | 94.0 | 0.0 |
| 1336 | SHELL MOLDER | 3 | 93.7 | 83.7 | 10.0 |
| 1512 | SWING GRINDER | 3 | 93.7 | 88.7 | 5.0 |
| 1396 | EXHAUST FAN | 1 | 93.0 | 93.0 | 0.0 |
| 1459 | CORE SET LINE | 1 | 93.0 | 93.0 | 0.0 |
| 1117 | PN DRILL GRINDER | 6 | 92.6 | 82.6 | 10.0 |
| 1193 | ABRASIVE BLAST | 1 | 92.0 | 92.0 | 0.0 |

TABLE 5-31 EFFECT OF EQUIPMENT NOISE CONTROL
(Cont'd)

BACKGROUND AND EQUIPMENT NOISE DATA AVERAGES (LEQ)

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO. OF SAMPLES | MEAN LEQ (DBA) BEFORE | AFTER | NOISE RED. (DBA) |
|---|---|---|---|---|---|
| 1194 | RUTOBLAST | 5 | 92.0 | 92.0 | 0.0 |
| 1337 | HI-PRESS. MOLDER | 1 | 92.0 | 82.0 | 10.0 |
| 1397 | EXHAUST FAN | 1 | 92.0 | 92.0 | 0.0 |
| 1486 | SHAKEOUT | 6 | 91.7 | 83.7 | 8.0 |
| 1517 | STAND STONE GRIND | 10 | 91.5 | 86.5 | 5.0 |
| 1339 | MOLDER | 1 | 91.0 | 81.0 | 10.0 |
| 1438 | INDUCT. FURNACE | 7 | 91.0 | 91.0 | 0.0 |
| 1374 | MULLER | 5 | 90.6 | 90.6 | 0.0 |
| 1499 | WHEELABRATOR | 5 | 90.2 | 90.2 | 0.0 |
| 1443 | LADLE PRE-HEAT | 5 | 90.0 | 90.0 | 0.0 |
| 1445 | BACK/CRUCIBLE | 1 | 90.0 | 90.0 | 0.0 |
| 1471 | BACK/OVERHD CRANE | 1 | 90.0 | 90.0 | 0.0 |
| 1440 | FURNACE | 2 | 89.5 | 89.5 | 0.0 |
| 1485 | BACK/SHAKEOUT | 10 | 89.3 | 89.1 | 0.2 |
| 1104 | BACK/PN GRINDER | 3 | 89.0 | 84.5 | 4.5 |
| 1506 | BACK/CUTOFF WHEEL | 6 | 88.2 | 81.6 | 6.6 |
| 1458 | BACK/CORE SET LIN | 1 | 88.0 | 88.0 | 0.0 |
| 1501 | BACK/SAW/METAL | 2 | 88.0 | 88.0 | 0.0 |
| 1511 | BACK/ELEC GRINDER | 3 | 88.0 | 82.8 | 5.2 |
| 1159 | BACK/WLD/BRN/GOUG | 4 | 87.8 | 81.5 | 6.2 |
| 1373 | SANDMULLER | 3 | 87.7 | 87.7 | 0.0 |
| 1386 | BACK/SANDSLINGER | 3 | 87.3 | 87.3 | 0.0 |
| 1395 | BACK/EXHAUST FAN | 1 | 87.0 | 85.6 | 1.4 |
| 1442 | FURNACE | 2 | 87.0 | 87.0 | 0.0 |
| 1175 | WELD/ACETYLENE | 1 | 86.0 | 76.0 | 10.0 |
| 1802 | FORKLIFT | 3 | 85.7 | 85.7 | 0.0 |
| 1498 | BACK/WHEELABRATOR | 2 | 85.5 | 85.5 | 0.0 |
| 1136 | BACK/PN CHISEL | 2 | 85.0 | 83.4 | 1.6 |
| 1188 | BACK/ABRASV BLAST | 1 | 85.0 | 84.1 | 0.9 |
| 1526 | BACK/HAMMER | 1 | 85.0 | 82.2 | 2.8 |
| 1334 | BACK/MOLDERS | 4 | 84.8 | 77.3 | 7.5 |
| 1372 | BACK/MULLER | 3 | 84.3 | 84.3 | 0.0 |
| 1543 | BACK/COMPRSD AIR | 6 | 83.8 | 83.5 | 0.3 |
| 1435 | BACK/FURNACE | 19 | 83.5 | 83.5 | 0.0 |
| 1536 | BACK/VENTILATION | 9 | 83.3 | 82.7 | 0.6 |
| 1102 | BACK/FIN/GRINDERS | 3 | 83.0 | 74.6 | 8.4 |
| 1145 | BACK/PN TAMPER | 2 | 83.0 | 83.0 | 0.0 |
| 1166 | WELDING/ARC | 3 | 83.0 | 73.0 | 10.0 |

TABLE 5-31 EFFECT OF EQUIPMENT NOISE CONTROL
(Cont'd)

BACKGROUND AND EQUIPMENT NOISE DATA AVERAGES (LEQ)

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO. OF SAMPLES | MEAN LEQ (DBA) BEFORE | AFTER | NOISE RED. (DBA) |
|---|---|---|---|---|---|
| 1535 | VENTILATION | 2 | 82.5 | 82.5 | 0.0 |
| 1449 | BACK/CORE EQUIP | 3 | 82.3 | 82.3 | 0.0 |
| 1340 | MOLDER-PACEMAKER | 1 | 82.0 | 72.0 | 10.0 |
| 1452 | CORE OVEN | 4 | 82.0 | 82.0 | 0.0 |
| 1493 | BACK. ONLY CONTR. | 0 | 80.4 | 73.7 | 6.7 |
| 1551 | BACK/EXHAUST FAN | 3 | 79.7 | 79.2 | 0.5 |
| 1481 | BACK/PN VIBRATOR | 1 | 78.0 | 76.6 | 1.4 |
| 1552 | BACK. ONLY CONTR. | 0 | 77.9 | 78.0 | -0.1 |
| 1544 | BACK. ONLY CONTR. | 0 | 76.1 | 75.7 | 0.3 |

ENVIRONMENTAL PROTECTION AGENCY SBN JOB NO. 9635

TABLE 5-32 EFFECT OF EQUIPMENT NOISE CONTROL

EQUIPMENT NOISE DATA AVERAGES (LEQ) GENERALIZED

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO. OF SAMPLES | MEAN LEQ (DBA) BEFORE | AFTER | NOISE RED. (DBA) |
|---|---|---|---|---|---|
| 1135 | PNEUMATIC CHISEL | 4 | 103.8 | 103.8 | 0.0 |
| 1480 | PNEUMATIC VIBRATOR | 4 | 100.2 | 100.2 | 0.0 |
| 1505 | CUT-OFF WHEEL | 6 | 98.7 | 90.7 | 8.0 |
| 1158 | WELD/BURN/GOUGING | 11 | 98.2 | 88.2 | 10.0 |
| 1500 | SAW/METAL | 2 | 98.0 | 98.0 | 0.0 |
| 1385 | SANDSLINGER | 2 | 98.0 | 98.0 | 0.0 |
| 1333 | MOLDER | 26 | 97.8 | 87.8 | 10.0 |
| 1484 | SHAKEOUT/DUMPOUT | 16 | 97.0 | 89.0 | 8.0 |
| 1525 | HAMMERING | 2 | 96.0 | 96.0 | 0.0 |
| 1392 | HYDRAULIC PUMP | 1 | 96.0 | 96.0 | 0.0 |
| 1103 | PNEUMATIC GRINDER | 44 | 95.6 | 85.6 | 10.0 |
| 1144 | PNEUMATIC TAMPER | 6 | 95.4 | 95.4 | 0.0 |
| 1444 | CRUCIBLE | 1 | 95.0 | 95.0 | 0.0 |
| 1446 | CURE OVEN | 9 | 93.9 | 93.9 | 0.0 |
| 1457 | CURE SET LINE | 2 | 93.5 | 93.5 | 0.0 |
| 1187 | ABRASIVE BLASTING | 3 | 93.1 | 93.1 | 0.0 |
| 1510 | ELECTRIC GRINDERS | 15 | 92.7 | 87.7 | 5.0 |
| 1371 | MULLER | 13 | 92.6 | 92.6 | 0.0 |
| 1394 | EXHAUST FAN | 2 | 92.5 | 92.5 | 0.0 |
| 1460 | LATHE | 2 | 92.0 | 92.0 | 0.0 |
| 1434 | FURNACE | 17 | 91.6 | 91.6 | 0.0 |
| 1497 | WHEELABRATOR | 5 | 90.2 | 90.2 | 0.0 |

TABLE 5-33
EFFECT OF NOISE CONTROL ON PERSONNEL EXPOSURE AVERAGES

EPA CRITERIA

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO.OF PERS. | --- LEVEL WEIGHTED POPULATION --- BEFORE MEAN | BEFORE M.C. | AFTER MEAN | AFTER M.C. | CHANGE MEAN | CHANGE M.C. |
|---|---|---|---|---|---|---|---|---|
| 275 | PN GRINDER OPER | 70100 | 626773 | 708070 | 152382 | 215659 | 474391 | 552411 |
| 340 | SQUEZ/JOLT MOLDER OP | 29919 | 348776 | 569463 | 129040 | 256260 | 219736 | 313203 |
| 303 | ARC WELDER/A | 24790 | 235939 | 318564 | 70030 | 119127 | 165909 | 199437 |
| 310 | ARC AIR GOUGER | 10255 | 225570 | 287184 | 99629 | 141467 | 125941 | 145717 |
| 421 | SHELL CORE OPERATOR | 16240 | 127559 | 147676 | 124861 | 147014 | 2698 | 662 |
| 281 | STAND STONE GRINDER | 19660 | 121862 | 156074 | 56821 | 76535 | 65041 | 79539 |
| 367 | POURER | 18805 | 110720 | 146650 | 91893 | 128713 | 18827 | 17937 |
| 302 | ARC-AIR OPERATOR | 5129 | 103976 | 133500 | 44362 | 63672 | 59614 | 69828 |
| 505 | CUT-OFF WHEEL OPER | 7691 | 101020 | 111418 | 44003 | 50641 | 57017 | 60777 |
| 280 | WHEEL GRINDER OPER | 9403 | 97905 | 170481 | 53880 | 112451 | 44025 | 58030 |
| 341 | FLOOR MOLDER | 17094 | 80723 | 117619 | 77344 | 115025 | 3379 | 2594 |
| 443 | SHAKEOUT TABLE OPER | 5128 | 73921 | 99111 | 33613 | 50578 | 40308 | 48533 |
| 264 | SERVICEMAN | 23929 | 73735 | 101293 | 55698 | 85261 | 18037 | 16032 |
| 440 | SHAKEOUT OPERATOR | 11967 | 69730 | 97466 | 25701 | 29602 | 44029 | 67866 |
| 343 | MOLDMASTER OPERATOR | 5129 | 68540 | 80649 | 46263 | 57164 | 22257 | 23485 |
| 326 | ARC FURNACE OPERATOR | 4274 | 61252 | 62457 | 61251 | 62456 | 1 | 1 |
| 279 | SWING GRINDER OPER | 6837 | 53331 | 56629 | 27312 | 29700 | 26019 | 26929 |
| 282 | TRIM GRINDER OPER | 3419 | 52984 | 52984 | 52984 | 52984 | 0 | 0 |
| 467 | WHEELABRATOR OPER | 8546 | 49576 | 75573 | 36512 | 61277 | 13064 | 14296 |
| 422 | NO-BAKE CORE OPER | 10256 | 43628 | 56315 | 42711 | 54705 | 917 | 1610 |
| 202 | FORKLIFT OPERATOR | 6836 | 43528 | 50158 | 19089 | 21648 | 24439 | 28510 |
| 277 | PN DISC GRINDER OPER | 3419 | 41319 | 52940 | 13358 | 19640 | 27961 | 33300 |
| 402 | ROTOBLAST OPERATOR | 6835 | 40567 | 58592 | 39195 | 57520 | 1392 | 1072 |
| 368 | MELTER/POURER | 7693 | 40091 | 67882 | 38043 | 66933 | 2048 | 949 |
| 433 | CORE ROOM WORKER | 20517 | 37857 | 70401 | 29534 | 68829 | 8323 | 1572 |
| 318 | GAS BURNER | 1709 | 37371 | 47643 | 16375 | 23380 | 20996 | 24263 |
| 319 | POWDER BURNER | 1709 | 37371 | 47643 | 16375 | 23380 | 20996 | 24263 |
| 450 | DUMPOUT/SHAKEOUT OP | 1709 | 35764 | 35764 | 18746 | 18746 | 17038 | 17038 |
| 339 | AUTO-MOLDER OPERATOR | 3418 | 32899 | 40276 | 8541 | 12196 | 24358 | 28080 |
| 480 | OVERHEAD CRANE OPER | 6836 | 30725 | 30725 | 29436 | 29436 | 1289 | 1289 |
| 325 | FURNACE OPERATOR | 3419 | 29435 | 29435 | 28633 | 28633 | 802 | 802 |
| 265 | LABORER | 11110 | 28010 | 40395 | 21998 | 43720 | 6012 | -3325 |
| 330 | LADLE PRE-HEATER | 5127 | 27510 | 53090 | 26622 | 55022 | 888 | -1932 |
| 504 | RADIAL SAW OPERATOR | 1709 | 26492 | 26492 | 26492 | 26492 | 0 | 0 |
| 338 | SHELLMOLDER OPERATOR | 3419 | 23941 | 30246 | 5133 | 7860 | 18808 | 22386 |
| 404 | MACHINE BLASTER | 3419 | 21968 | 21968 | 21834 | 21834 | 134 | 134 |
| 278 | PN CONE GRINDER OPER | 2564 | 21083 | 25829 | 5537 | 5537 | 15546 | 20292 |
| 266 | HELPER | 5129 | 20278 | 22591 | 18636 | 36912 | 1642 | -14321 |

TABLE 5-33 (Cont'd)
EFFECT OF NOISE CONTROL ON PERSONNEL EXPOSURE AVERAGES

EPA CRITERIA

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO.OF PERS. | --- LEVEL WEIGHTED POPULATION --- BEFORE MEAN | BEFORE M.C. | AFTER MEAN | AFTER M.C. | CHANGE MEAN | CHANGE M.C. |
|---|---|---|---|---|---|---|---|---|
| 385 | MULLER OPER | 4270 | 19674 | 25585 | 18634 | 24860 | 1040 | 725 |
| 426 | CORE SETTER | 2564 | 19571 | 19571 | 18839 | 18839 | 732 | 732 |
| 395 | SANDSLINGER OPERATOR | 1709 | 17346 | 25045 | 11554 | 11554 | 5794 | 13491 |
| 506 | TABOR CUT-OFF SAW OP | 1709 | 15591 | 15591 | 5259 | 5259 | 10332 | 10332 |
| 327 | INDUCT. FURNACE OPER | 2563 | 14753 | 24494 | 13141 | 23724 | 1612 | 770 |
| 461 | INSPECTOR | 2563 | 14674 | 15576 | 6764 | 7157 | 7910 | 8419 |
| 337 | HI PRESS. MOLDER OP | 1709 | 14114 | 14114 | 6874 | 6874 | 7240 | 7240 |
| 459 | SHIFTER | 2564 | 13523 | 15845 | 7467 | 11207 | 6056 | 4638 |
| 502 | BAND SAW OPERATOR | 1709 | 13021 | 13021 | 13021 | 13021 | 0 | 0 |
| 403 | HAND BLASTER | 1709 | 12837 | 12837 | 12620 | 12620 | 217 | 217 |
| 203 | WORKSAVER OPERATOR | 5129 | 12319 | 16532 | 3075 | 3075 | 9244 | 13457 |
| 331 | LADLE SKIMMER | 3416 | 10640 | 17275 | 6540 | 11093 | 4100 | 6182 |
| 534 | PRESS OPERATOR | 5129 | 8207 | 10367 | 0 | 444 | 8207 | 9443 |
| 405 | SPINALBLAST OPERATOR | 854 | 8182 | 8182 | 7908 | 7908 | 274 | 274 |
| 429 | OIL-BAKE COREMAKER | 1709 | 7897 | 7897 | 7834 | 7834 | 63 | 63 |
| 329 | CUPOLA FURNACE OPER | 1709 | 7666 | 13921 | 7664 | 13920 | 2 | 1 |
| 350 | MOLD WASH WORKER | 854 | 6527 | 6527 | 2399 | 2399 | 4128 | 4128 |
| 276 | PN DRILL GRINDER OP | 854 | 6060 | 7976 | 1216 | 2023 | 4844 | 5953 |
| 388 | SANDMULLER OPERATOR | 854 | 5155 | 5155 | 3449 | 3449 | 1706 | 1706 |
| 328 | FURNACE CHARGER | 854 | 4766 | 6654 | 3962 | 6168 | 806 | 486 |
| 462 | CUPOLA OPERATOR | 854 | 4497 | 7263 | 3815 | 6952 | 642 | 311 |
| 427 | CORE GLUER | 854 | 4432 | 5115 | 3777 | 4575 | 655 | 540 |
| 270 | FOREMAN | 854 | 3026 | 4425 | 2326 | 3966 | 702 | 459 |
| 307 | ACETYLENE WELDER | 854 | 2674 | 3326 | 946 | 1338 | 1928 | 1990 |
| 342 | PACEMAKER MOLDR OPER | 854 | 2634 | 4356 | 830 | 1501 | 2804 | 2857 |

ENVIRONMENTAL PROTECTION AGENCY  BBN JOB NO. 4635

TABLE 5-34
EFFECT OF NOISE CONTROL ON PERSONNEL EXPOSURE AVERAGES

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 332  AVERAGE FOR INDUSTRY  NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO.OF PERS. | DAILY NOISE DOSE — BEFORE MEAN | BEFORE M.C. | AFTER MEAN | AFTER M.C. | CHANGE MEAN | CHANGE M.C. |
|---|---|---|---|---|---|---|---|---|
| 310 | ARC AIR GOUGER | 10255 | 6.24 | 11.09 | 1.63 | 2.76 | 4.92 | 8.33 |
| 450 | DUMPOUT/SHAKEOUT OP | 1709 | 6.52 | 6.52 | 2.15 | 2.15 | 4.37 | 4.37 |
| 318 | GAS BURNER | 1709 | 6.34 | 10.77 | 1.58 | 2.69 | 4.75 | 8.08 |
| 319 | POWDER BURNER | 1709 | 6.34 | 10.77 | 1.58 | 2.69 | 4.75 | 8.08 |
| 302 | ARC-AIR OPERATOR | 5129 | 4.08 | 8.28 | 1.22 | 2.07 | 3.86 | 6.21 |
| 282 | TRIM GRINDER OPER | 3419 | 3.17 | 3.17 | 3.17 | 3.17 | 0.0 | 0.0 |
| 504 | RADIAL SAW OPERATOR | 1709 | 3.17 | 3.17 | 3.17 | 3.17 | 0.0 | 0.0 |
| 326 | ARC FURNACE OPERATOR | 4274 | 3.02 | 5.18 | 3.02 | 5.18 | 0.0 | 0.0 |
| 443 | SHAKEOUT TABLE OPER | 5128 | 2.91 | 4.64 | 0.96 | 1.60 | 1.95 | 3.24 |
| 343 | MOLDMASTER OPERATOR | 5129 | 2.01 | 3.32 | 1.41 | 1.82 | 1.21 | 1.50 |
| 505 | CUT-OFF WHEEL OPER | 7691 | 2.52 | 2.96 | 0.83 | 0.96 | 1.69 | 1.99 |
| 340 | SQUEZ/JOLT MOLDER OP | 29919 | 2.11 | 5.14 | 0.04 | 1.31 | 2.07 | 3.83 |
| 277 | PN DISC GRINDER OPER | 3419 | 1.92 | 2.93 | 0.00 | 0.73 | 1.92 | 2.20 |
| 280 | WHEEL GRINDER OPER | 9403 | 1.09 | 4.81 | 0.82 | 2.17 | 1.08 | 2.44 |
| 339 | AUTO-MOLDER OPERATOR | 3418 | 1.71 | 2.30 | 0.00 | 0.0 | 1.71 | 2.30 |
| 506 | TABOR CUT-OFF SAW OP | 1709 | 1.60 | 1.60 | 0.00 | 0.0 | 1.60 | 1.60 |
| 337 | HI PRESS. MOLDER OP | 1709 | 1.31 | 1.31 | 0.22 | 0.22 | 1.09 | 1.09 |
| 275 | PN GRINDER OPER | 70100 | 1.28 | 1.65 | 0.00 | 0.17 | 1.28 | 1.48 |
| 279 | SWING GRINDER OPER | 6837 | 1.23 | 1.33 | 0.00 | 0.0 | 1.23 | 1.33 |
| 426 | CORE SETTER | 2564 | 1.21 | 1.21 | 1.21 | 1.21 | 0.0 | 0.0 |
| 405 | SPIRALBLAST OPERATOR | 854 | 1.21 | 1.21 | 1.21 | 1.21 | 0.0 | 0.0 |
| 325 | FURNACE OPERATOR | 3419 | 1.20 | 1.20 | 1.20 | 1.20 | 0.0 | 0.0 |
| 276 | PN DRILL GRINDER OP | 854 | 1.15 | 1.64 | 0.00 | 0.0 | 1.15 | 1.64 |
| 395 | SANDSLINGER OPERATOR | 1709 | 1.14 | 1.96 | 0.68 | 0.68 | 0.46 | 1.28 |
| 421 | SHELL CORE OPERATOR | 16240 | 1.14 | 1.40 | 1.14 | 1.41 | 0.0 | -0.02 |
| 278 | PN CONE GRINDER OPER | 2564 | 1.06 | 1.44 | 0.00 | 0.0 | 1.06 | 1.44 |
| 502 | BAND SAW OPERATOR | 1709 | 1.04 | 1.04 | 1.04 | 1.04 | 0.0 | 0.0 |
| 403 | HAND BLASTER | 1709 | 1.00 | 1.00 | 1.00 | 1.00 | 0.0 | 0.0 |
| 404 | MACHINE BLASTER | 3419 | 0.99 | 0.99 | 0.99 | 0.99 | 0.0 | 0.0 |
| 281 | STAND STONE GRINDER | 19660 | 0.92 | 1.25 | 0.00 | 0.0 | 0.92 | 1.25 |
| 350 | MOLD WASH WORKER | 854 | 0.87 | 0.87 | 0.00 | 0.0 | 0.87 | 0.87 |
| 303 | ARC WELDER/A | 24790 | 0.84 | 1.48 | 0.21 | 0.36 | 0.63 | 1.12 |
| 338 | SHELLMOLDER OPERATOR | 3419 | 0.83 | 1.16 | 0.00 | 0.0 | 0.83 | 1.16 |
| 202 | FORKLIFT OPERATOR | 6836 | 0.81 | 0.97 | 0.24 | 0.25 | 0.57 | 0.72 |

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9035

TABLE 5-34 (Cont'd)
EFFECT OF NOISE CONTROL ON PERSONNEL EXPOSURE AVERAGES

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO.OF PERS. | DAILY NOISE DOSE BEFORE MEAN | BEFORE M.C. | AFTER MEAN | AFTER M.C. | CHANGE MEAN | CHANGE M.C. |
|---|---|---|---|---|---|---|---|---|
| 402 | ROTOBLAST OPERATOR | 6835 | 0.79 | 1.31 | 0.79 | 1.31 | 0.0 | 0.0 |
| 327 | INDUCT. FURNACE OPER | 2563 | 0.73 | 1.48 | 0.73 | 1.48 | 0.0 | 0.0 |
| 440 | SHAKEOUT OPERATOR | 11467 | 0.72 | 1.14 | 0.00 | 0.0 | 0.72 | 1.14 |
| 467 | WHEELABRATOR OPER | 8546 | 0.71 | 1.40 | 0.59 | 1.15 | 0.12 | 0.25 |
| 461 | INSPECTOR | 2563 | 0.69 | 0.76 | 0.33 | 0.33 | 0.36 | 0.43 |
| 368 | MELTER/POURER | 7693 | 0.61 | 1.25 | 0.61 | 1.25 | 0.0 | 0.0 |
| 385 | MULLER OPER | 4270 | 0.54 | 0.77 | 0.54 | 0.77 | 0.0 | 0.0 |
| 367 | POURER | 16805 | 0.47 | 0.94 | 0.47 | 0.78 | 0.0 | 0.16 |
| 330 | LADLE PRE-HEATER | 5127 | 0.45 | 1.52 | 0.45 | 1.58 | 0.0 | 0.05 |
| 422 | NO-BAKE CORE OPER | 10256 | 0.43 | 0.63 | 0.43 | 0.63 | 0.0 | 0.01 |
| 427 | CORE GLUER | 854 | 0.40 | 0.49 | 0.40 | 0.49 | 0.0 | 0.0 |
| 328 | FURNACE CHARGER | 854 | 0.34 | 0.70 | 0.34 | 0.70 | 0.0 | 0.0 |
| 341 | FLOOR MOLDER | 17094 | 0.32 | 0.55 | 0.32 | 0.55 | 0.0 | 0.0 |
| 388 | SANDMULLER OPERATOR | 854 | 0.30 | 0.30 | 0.00 | 0.0 | 0.30 | 0.30 |
| 264 | SERVICEMAN | 23929 | 0.22 | 0.41 | 0.22 | 0.36 | 0.0 | 0.05 |
| 429 | OIL-BAKE COREMAKER | 1709 | 0.16 | 0.16 | 0.16 | 0.16 | 0.0 | 0.0 |
| 459 | SHIFTER | 2564 | 0.11 | 0.23 | 0.11 | 0.23 | 0.0 | 0.0 |
| 265 | LABORER | 11110 | 0.05 | 0.14 | 0.05 | 0.28 | 0.0 | -0.15 |
| 203 | WORKSAVER OPERATOR | 5129 | 0.00 | 0.23 | 0.00 | 0.0 | 0.0 | 0.23 |
| 266 | HELPER | 5129 | 0.00 | 0.14 | 0.00 | 1.25 | 0.0 | -1.10 |
| 270 | FOREMAN | 854 | 0.00 | 0.37 | 0.00 | 0.37 | 0.0 | 0.0 |
| 307 | ACETYLENE WELDER | 854 | 0.00 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 |
| 329 | CUPULA FURNACE OPER | 1709 | 0.00 | 1.30 | 0.00 | 1.30 | 0.0 | 0.0 |
| 331 | LADLE SKIMMER | 3418 | 0.00 | 0.57 | 0.00 | 0.21 | 0.0 | 0.36 |
| 342 | PACEMAKER MOLDR OPER | 854 | 0.00 | 0.58 | 0.00 | 0.0 | 0.0 | 0.58 |
| 433 | CORE ROOM WORKER | 20517 | 0.00 | 0.13 | 0.00 | 0.14 | 0.0 | -0.01 |
| 462 | CUPULA OPERATOR | 854 | 0.00 | 1.30 | 0.00 | 1.30 | 0.0 | 0.0 |
| 480 | OVERHEAD CRANE OPER | 6836 | 0.00 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 |
| 534 | PRESS OPERATOR | 5129 | 0.00 | 0.0 | 0.00 | 0.0 | 0.0 | 0.0 |

ENVIRONMENTAL PROTECTION AGENCY BEN JOB NO. 9635

EPA CRITERIA

TABLE 5-35

EFFECT OF NOISE CONTROL ON PERSONNEL EXPOSURE AVERAGES

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND LEVEL BEFORE MEAN | BEFORE M.C. | AFTER MEAN | AFTER M.C. | CHANGE MEAN | CHANGE M.C. |
|---|---|---|---|---|---|---|---|---|
| 310 | ARC AIR GOUGER | 10255 | 104.6 | 108.5 | 94.7 | 98.5 | 10.0 | 10.0 |
| 318 | GAS BURNER | 1709 | 104.6 | 108.4 | 94.6 | 98.4 | 10.0 | 10.0 |
| 319 | POWDER BURNER | 1709 | 104.6 | 108.4 | 94.6 | 98.4 | 10.0 | 10.0 |
| 450 | DUMPOUT/SHAKEOUT OP | 1709 | 103.9 | 103.9 | 95.9 | 95.9 | 8.0 | 8.0 |
| 302 | ARC-AIR OPERATOR | 5129 | 103.5 | 107.3 | 93.6 | 97.3 | 9.9 | 9.9 |
| 282 | TRIM GRINDER OPER | 3419 | 99.9 | 99.9 | 99.9 | 99.9 | 0.0 | 0.0 |
| 504 | RADIAL SAW OPERATOR | 1709 | 99.9 | 99.9 | 99.9 | 99.9 | 0.0 | 0.0 |
| 443 | SHAKEOUT TABLE OPER | 5128 | 99.0 | 102.8 | 91.2 | 94.9 | 7.8 | 7.9 |
| 326 | ARC FURNACE OPERATOR | 4274 | 98.9 | 102.8 | 98.9 | 102.8 | 0.0 | 0.0 |
| 343 | MOLDMASTER OPERATOR | 5129 | 98.1 | 100.1 | 94.0 | 96.1 | 4.1 | 4.0 |
| 505 | CUT-OFF WHEEL OPER | 7691 | 97.9 | 99.1 | 90.1 | 91.2 | 7.8 | 7.8 |
| 277 | PN DISC GRINDER OPER | 3419 | 97.0 | 99.9 | 87.5 | 90.2 | 9.5 | [illegible] |
| 340 | SQUEZ/JOLT MOLDER OP | 24919 | 96.3 | 102.3 | 86.1 | 93.3 | 8.3 | 8.9 |
| 280 | WHEEL GRINDER OPER | 9403 | 95.4 | 101.9 | 90.1 | 96.8 | 5.3 | 5.1 |
| 395 | SANDSLINGER OPERATOR | 1709 | 95.1 | 99.2 | 91.4 | 91.4 | 3.7 | 7.8 |
| 339 | AUTO-MOLDER OPERATOR | 3418 | 94.6 | 96.7 | 85.0 | 86.9 | 9.6 | 9.8 |
| 405 | SPIRALBLAST OPERATOR | 854 | 94.5 | 94.5 | 94.2 | 94.2 | 0.3 | 0.3 |
| 506 | TABOR CUT-OFF SAW OP | 1709 | 94.1 | 94.1 | 86.1 | 86.1 | 8.0 | 8.0 |
| 275 | PN GRINDER OPER | 70100 | 93.9 | 95.9 | 84.3 | 86.1 | 9.6 | 9.8 |
| 303 | ARC WELDER/A | 24790 | 93.6 | 96.6 | 84.5 | 87.9 | 9.1 | 8.7 |
| 325 | FURNACE OPERATOR | 3419 | 93.6 | 93.6 | 93.3 | 93.3 | 0.3 | 0.3 |
| 337 | HI PRESS. MOLDER OP | 1709 | 93.2 | 93.2 | 87.7 | 87.7 | 5.5 | 5.5 |
| 278 | PN CONE GRINDER OPER | 2564 | 93.1 | 95.1 | 84.3 | 84.3 | 8.8 | 10.8 |
| 279 | SWING GRINDER OPER | 6837 | 92.7 | 93.2 | 87.6 | 88.2 | 5.0 | 5.0 |
| 421 | SHELL CURE OPERATOR | 16240 | 92.6 | 94.0 | 92.4 | 94.0 | 0.2 | 0.0 |
| 350 | MOLD WASH WORKER | 854 | 92.5 | 92.5 | 85.6 | 85.6 | 6.9 | 6.9 |
| 426 | CORE SETTER | 2564 | 92.5 | 92.5 | 92.1 | 92.1 | 0.3 | 0.3 |
| 502 | BAND SAW OPERATOR | 1709 | 92.5 | 92.5 | 92.5 | 92.5 | 0.0 | 0.0 |
| 403 | HAND BLASTER | 1709 | 92.3 | 92.3 | 92.2 | 92.2 | 0.1 | 0.1 |
| 276 | PN DRILL GRINDER OP | 854 | 91.8 | 94.3 | 82.5 | 84.7 | 9.3 | 9.6 |
| 338 | SHELLMOLDER OPERATOR | 3419 | 91.7 | 93.8 | 82.7 | 84.5 | 9.0 | 9.3 |
| 404 | MACHINE BLASTER | 3419 | 91.0 | 91.0 | 91.0 | 91.0 | 0.0 | 0.0 |
| 281 | STAND STONE GRINDER | 19660 | 90.7 | 92.8 | 85.7 | 87.5 | 5.0 | 5.4 |
| 388 | SANDMULLER OPERATOR | 854 | 90.5 | 90.5 | 87.7 | 87.7 | 2.8 | 2.8 |
| 402 | ROTOBLAST OPERATOR | 6835 | 90.4 | 93.5 | 90.1 | 93.3 | 0.3 | 0.2 |
| 440 | SHAKEOUT OPERATOR | 11967 | 90.3 | 93.0 | 84.3 | 84.9 | 6.0 | 8.1 |
| 327 | INDUCT. FURNACE OPER | 2563 | 90.2 | 94.5 | 84.3 | 94.2 | 0.9 | [illegible] |
| 467 | WHELLABRATOR OPER | 8546 | 90.0 | 93.6 | 87.8 | 91.3 | 2.2 | 2.3 |

ENVIRONMENTAL PROTECTION AGENCY SBA JOB NO. 9635

EPA CRITERIA

TABLE 5-35 (Cont'd)

EFFECT OF NOISE CONTROL ON PERSONNEL EXPOSURE AVERAGES

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO. OF PERS. | SOUND LEVEL BEFORE MEAN | BEFORE M.C. | AFTER MEAN | AFTER M.C. | CHANGE MEAN | CHANGE M.C. |
|---|---|---|---|---|---|---|---|---|
| 328 | FURNACE CHARGER | 854 | 89.9 | 92.6 | 88.6 | 92.0 | 1.3 | 0.7 |
| 367 | POURER | 18805 | 89.9 | 92.2 | 88.1 | 90.7 | 1.8 | 1.5 |
| 459 | SHIFTER | 2564 | 89.5 | 90.7 | 85.8 | 88.2 | 3.7 | 2.5 |
| 462 | CUPOLA OPERATOR | 854 | 89.4 | 93.4 | 88.4 | 93.0 | 1.1 | 0.4 |
| 368 | MELTER/POURER | 7693 | 89.4 | 93.8 | 89.1 | 93.7 | 0.4 | 0.1 |
| 427 | CORE GLUER | 854 | 89.4 | 90.5 | 88.3 | 89.6 | 1.1 | 0.8 |
| 429 | OIL-BAKE COREMAKER | 1709 | 88.6 | 88.6 | 88.5 | 88.5 | 0.1 | 0.1 |
| 329 | CUPOLA FURNACE OPER | 1709 | 88.4 | 93.0 | 88.4 | 93.0 | 0.0 | 0.0 |
| 480 | OVERHEAD CRANE OPER | 8836 | 88.4 | 88.4 | 88.0 | 88.0 | 0.3 | 0.3 |
| 385 | MULLER OPER | 4270 | 88.3 | 90.2 | 88.0 | 90.0 | 0.3 | 0.2 |
| 330 | LADLE PRE-HEATER | 5127 | 88.3 | 93.3 | 87.9 | 93.9 | 0.4 | 0.0 |
| 341 | FLOUR MULLER | 17094 | 88.3 | 91.2 | 88.0 | 91.0 | 0.3 | 0.2 |
| 461 | INSPECTOR | 2563 | 88.2 | 89.0 | 81.2 | 83.0 | 7.0 | 6.1 |
| 202 | FORKLIFT OPERATOR | 8836 | 87.8 | 90.1 | 83.2 | 85.0 | 4.6 | 5.1 |
| 266 | HELPER | 5129 | 87.6 | 88.3 | 87.1 | 92.0 | 0.5 | 0.0 |
| 422 | NO-BAKE CORE OPER | 10256 | 87.3 | 89.2 | 87.1 | 89.0 | 0.2 | 0.3 |
| 270 | FOREMAN | 854 | 86.9 | 89.4 | 85.4 | 88.6 | 1.5 | 0.8 |
| 307 | ACETYLENE WELDER | 854 | 86.0 | 37.5 | 81.7 | 82.9 | 4.4 | 4.6 |
| 342 | PACEMAKER MOLDR OPER | 854 | 86.5 | 89.3 | 81.2 | 83.4 | 5.3 | 5.9 |
| 331 | LADLE SKIMMER | 3418 | 86.1 | 89.2 | 83.7 | 86.2 | 2.4 | 2.9 |
| 264 | SERVICEMAN | 23929 | 85.6 | 87.6 | 83.6 | 86.2 | 2.0 | 1.4 |
| 203 | WORKSAVER OPERATOR | 5129 | 84.8 | 86.4 | 79.9 | 79.9 | 4.9 | 6.5 |
| 433 | CORE ROOM WORKER | 20517 | 83.4 | 86.7 | 82.6 | 86.5 | 0.8 | 0.1 |
| 534 | PRESS OPERATOR | 5129 | 83.0 | 84.0 | <75.0 | 76.9 | 8.0 | 7.1 |
| 265 | LABORER | 11110 | 82.6 | 84.5 | 81.6 | 84.8 | 1.0 | 0.0 |

ENVIRONMENTAL PROTECTION AGENCY BSN JOB NO. 9635

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

TABLE 5-36
EFFECT OF NOISE CONTROL ON PERSONNEL EXPOSURE AVERAGES

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO.OF PERS. | SOUND LEVEL BEFORE MEAN | BEFORE M.C. | AFTER MEAN | AFTER M.C. | CHANGE MEAN | CHANGE M.C. |
|---|---|---|---|---|---|---|---|---|
| 310 | ARC AIR GOUGER | 10255 | 103.5 | 107.4 | 93.5 | 97.3 | 10.0 | 10.0 |
| 450 | DUMPOUT/SHAKEOUT OP | 1709 | 103.5 | 103.5 | 95.5 | 95.5 | 8.0 | 8.0 |
| 318 | GAS BURNER | 1709 | 103.3 | 107.1 | 93.3 | 97.1 | 10.0 | 10.0 |
| 319 | POWDER BURNER | 1709 | 103.3 | 107.1 | 93.3 | 97.1 | 10.0 | 10.0 |
| 302 | ARC-AIR OPERATOR | 5129 | 101.4 | 105.3 | 91.4 | 95.3 | 10.0 | 10.0 |
| 262 | TRIM GRINDER OPER | 3419 | 98.3 | 98.3 | 98.3 | 98.3 | 0.0 | 0.0 |
| 504 | RADIAL SAW OPERATOR | 1709 | 98.3 | 98.3 | 98.3 | 98.3 | 0.0 | 0.0 |
| 326 | ARC FURNACE OPERATOR | 4274 | 98.0 | 101.9 | 98.0 | 101.9 | 0.0 | 0.0 |
| 443 | SHAKEOUT TABLE OPER | 5128 | 97.7 | 101.4 | <90.0 | 93.4 | 7.7 | 8.0 |
| 343 | MOLDMASTER OPERATOR | 5129 | 98.9 | 98.7 | 92.5 | 94.3 | 4.5 | [illegible] |
| 505 | CUT-OFF WHEEL OPER | 7091 | 98.7 | 97.6 | <90.0 | <90.0 | 8.7 | 7.6 |
| 340 | SQUEZ/JOLT MOLDER OP | 29919 | 95.4 | 101.8 | <90.0 | 91.9 | 5.4 | 9.9 |
| 277 | PN DISC GRINDER OPER | 3419 | 94.7 | 97.6 | <90.0 | <90.0 | 4.7 | 7.6 |
| 280 | WHEEL GRINDER OPER | 9403 | 94.6 | 101.0 | <90.0 | 95.6 | 4.6 | 5.4 |
| 339 | AUTO-MOLDER OPERATOR | 3418 | 93.9 | 96.0 | <90.0 | <90.0 | 3.9 | 6.0 |
| 506 | TABOR CUT-OFF SAW OP | 1709 | 93.4 | 93.4 | <90.0 | <90.0 | 3.4 | 3.4 |
| 337 | HI PRESS. MOLDER OP | 1709 | 92.0 | 92.0 | <90.0 | <90.0 | 2.0 | 2.0 |
| 275 | PN GRINDER OPER | 70100 | 91.8 | 93.6 | <90.0 | <90.0 | 1.8 | 3.6 |
| 279 | SWING GRINDER OPER | 6837 | 91.5 | 92.0 | <90.0 | <90.0 | 1.5 | 2.0 |
| 426 | CORE SETTER | 2564 | 91.4 | 91.4 | 91.4 | 91.4 | 0.0 | 0.0 |
| 405 | SPIRALBLAST OPERATOR | 854 | 91.4 | 91.4 | 91.4 | 91.4 | 0.0 | 0.0 |
| 325 | FURNACE OPERATOR | 3419 | 91.3 | 91.3 | 91.3 | 91.3 | 0.0 | 0.0 |
| 276 | PN DRILL GRINDER OP | 854 | 91.0 | 93.6 | <90.0 | <90.0 | 1.0 | 3.6 |
| 395 | SANDSLINGER OPERATOR | 1709 | 91.0 | 94.9 | <90.0 | <90.0 | 1.0 | 4.9 |
| 421 | SHELL CORE OPERATOR | 16240 | 90.9 | 92.4 | 90.9 | 92.5 | 0.0 | 0.0 |
| 278 | PN CONE GRINDER OPER | 2564 | 90.4 | 92.6 | <90.0 | <90.0 | 0.4 | 2.6 |
| 502 | BAND SAW OPERATOR | 1709 | 90.3 | 90.3 | 90.3 | 90.3 | 0.0 | 0.0 |
| 403 | HAND BLASTER | 1709 | 90.0 | 90.0 | 90.0 | 90.0 | 0.0 | 0.0 |
| 404 | MACHINE BLASTER | 3419 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 281 | STAND STONE GRINDER | 19660 | <90.0 | 91.6 | <90.0 | 0.0 | 0.0 | 1.6 |
| 350 | MOLD WASH WORKER | 854 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 303 | ARC WELDER/A | 24790 | <90.0 | 92.6 | <90.0 | 82.6 | 0.0 | 2.6 |
| 338 | SHELLMOLDER OPERATOR | 3419 | <90.0 | 91.2 | <90.0 | 0.0 | 0.0 | 1.2 |
| 202 | FORKLIFT OPERATOR | 6836 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |

ENVIRONMENTAL PROTECTION AGENCY 88N JOB NO. 9635

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

TABLE 5-36 (Cont'd)

EFFECT OF NOISE CONTROL ON PERSONNEL EXPOSURE AVERAGES

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| JOB CODE | JOB DESCRIPTION | NO.OF PERS. | SOUND LEVEL BEFORE MEAN | BEFORE M.C. | AFTER MEAN | AFTER M.C. | CHANGE MEAN | CHANGE M.C. |
|---|---|---|---|---|---|---|---|---|
| 402 | ROTOBLAST OPERATOR | 6835 | <90.0 | 92.0 | <90.0 | 92.0 | 0.0 | 0.0 |
| 327 | INDUCT. FURNACE OPER | 2563 | <90.0 | 92.8 | <90.0 | 92.8 | 0.0 | 0.0 |
| 440 | SHAKEOUT OPERATOR | 11967 | <90.0 | 91.0 | <90.0 | 0.0 | 0.0 | 1.0 |
| 467 | WHELLABRATOR OPER | 6546 | <90.0 | 92.4 | <90.0 | 91.0 | 0.0 | 1.4 |
| 461 | INSPECTOR | 2563 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 368 | MELTER/POURER | 7693 | <90.0 | 91.6 | <90.0 | 91.6 | 0.0 | 0.0 |
| 385 | MULLER OPER | 4270 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 367 | POURER | 18805 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 330 | LADLE PRE-HEATER | 5127 | <90.0 | 93.5 | <90.0 | 93.3 | 0.0 | 0.2 |
| 422 | NO-BAKE CORE OPER | 10256 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 427 | CORE GLUER | 854 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 328 | FURNACE CHARGER | 854 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 341 | FLOOR MOLDER | 17094 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 368 | SANDMULLER OPERATOR | 854 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 264 | SERVICEMAN | 23929 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 429 | OIL-BAKE COREMAKER | 1709 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 459 | SHIFTER | 2564 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 265 | LABORER | 11110 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 203 | WORKSAVER OPERATOR | 5129 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 266 | HELPER | 5129 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 270 | FOREMAN | 854 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 307 | ACETYLENE WELDER | 854 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 329 | CUPOLA FURNACE OPER | 1709 | <90.0 | 91.9 | <90.0 | 91.9 | 0.0 | 0.0 |
| 331 | LADLE SKIMMER | 3418 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 342 | PACEMAKER MOLDR OPER | 854 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 433 | CORE ROOM WORKER | 20517 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 462 | CUPOLA OPERATOR | 854 | <90.0 | 91.9 | <90.0 | 91.9 | 0.0 | 0.0 |
| 480 | OVERHEAD CRANE OPER | 6836 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |
| 534 | PRESS OPERATOR | 5129 | <90.0 | <90.0 | <90.0 | <90.0 | 0.0 | 0.0 |

ENVIRONMENTAL PROTECTION AGENCY  BBN JOB NO. 4639

TABLE 5-37

EFFECT OF NOISE CONTROL ON PERSONNEL EXPOSURE

EPA CRITERIA

SIC CODE = 332  AVERAGE FOR INDUSTRY  NJ DATES SPECIFIED

| | BEFORE CHANGE | AFTER CHANGE |
|---|---|---|
| TOTAL NO. OF PERSONNEL | 453958 | 453958 |
| TOTAL NO OF PERS. WITH LEQ>75 (MEAN) | 450538 | 445408 |
| TOTAL NO OF PERS. WITH LEQ>75 (M.C.) | 452248 | 452248 |
| TOTAL NO OF PERS. WITH LEQ>90 (MEAN) | 240659 | 108573 |
| TOTAL NO OF PERS. WITH LEQ>90 (M.C.) | 337690 | 206033 |
| LEVEL WEIGHTED POPULATION (MEAN) | 3553913.0 | 1679816.0 |
| LEVEL WEIGHTED POPULATION (M.C.) | 4607670.0 | 2704767.0 |

TABLE 5-38

EFFECT OF NOISE CONTROL ON PERSONNEL EXPOSURE

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| | BEFORE CHANGE | AFTER CHANGE |
|---|---|---|
| TOTAL NUMBER OF PERSONNEL = | 453956 | 453956 |
| TOTAL NUMBER OVEREXPOSED (MEAN) = | 210306 | 69247 |
| TOTAL NUMBER OVEREXPOSED (W.C.) = | 266395 | 147044 |

ENVIRONMENTAL PROTECTION AGENCY BBN JOB NO. 9635

TABLE 5-39 EQUIPMENT NOISE IMPACT AVERAGES

EPA CRITERIA

AFTER NOISE CONTROL ON SELECTED EQUIPMENT

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO.OF UNITS | MEAN LJ | M.C. LJ | NO.OF PERS. | PRIORITY INDEX | NORM. P.I. |
|---|---|---|---|---|---|---|---|
| 1103 | PNEUMATIC GRINDER | 44 | 85.6 | 88.2 | ****** | 72409.6 | 0.163 |
| 1434 | FURNACE | 19 | 91.6 | 96.0 | 646980 | 55596.7 | 0.125 |
| 1158 | WELD/BURN/GOUGING | 11 | 88.2 | 91.9 | 444470 | 42998.5 | 0.097 |
| 1448 | CORE OVEN | 9 | 93.9 | 95.3 | 240193 | 38354.7 | 0.086 |
| 1510 | ELECTRIC GRINDERS | 15 | 87.7 | 90.6 | 347886 | 34288.7 | 0.077 |
| 1333 | MOLDER | 28 | 87.8 | 93.6 | 542729 | 32074.6 | 0.072 |
| 1187 | ABRASIVE BLASTING | 8 | 93.1 | 96.5 | 76916 | 23657.2 | 0.053 |
| 1484 | SHAKEOUT/DUMPOUT | 16 | 89.6 | 93.0 | 405102 | 22656.0 | 0.051 |
| 1385 | SANDSLINGER | 2 | 96.0 | 96.0 | 60681 | 12615.1 | 0.028 |
| 1505 | CUT-OFF WHEEL | 6 | 90.7 | 92.8 | 219670 | 12204.5 | 0.027 |
| 1371 | MULLER | 13 | 92.6 | 96.1 | 219657 | 12187.6 | 0.027 |
| 1500 | SAW/METAL | 2 | 96.0 | 96.0 | 41019 | 10420.7 | 0.023 |
| 1497 | WHEELABRATOR | 5 | 90.2 | 95.6 | 112613 | 9127.4 | 0.020 |
| 1144 | PNEUMATIC TAMPER | 8 | 95.4 | 99.9 | 23077 | 9033.1 | 0.020 |
| 1460 | LATHE | 2 | 92.0 | 92.0 | 10255 | 5747.1 | 0.013 |
| 1444 | CRUCIBLE | 1 | 95.0 | 95.0 | 10256 | 5693.0 | 0.013 |
| 1480 | PNEUMATIC VIBRATOR | 4 | 100.2 | 103.3 | 86323 | 5084.9 | 0.011 |
| 1394 | EXHAUST FAN | 2 | 92.5 | 92.5 | 32401 | 3509.5 | 0.008 |
| 1457 | CORE SET LINE | 2 | 93.5 | 93.5 | 86320 | 3051.4 | 0.007 |
| 1135 | PNEUMATIC CHISEL | 4 | 103.6 | 112.8 | 5126 | 2034.0 | 0.005 |
| 1392 | HYDRAULIC PUMP | 1 | 96.0 | 96.0 | 1709 | 580.2 | 0.001 |
| 1525 | HAMMERING | 2 | 96.0 | 101.7 | 2562 | 512.6 | 0.001 |

ENVIRONMENTAL PROTECTION AGENCY  BBN JOB NO.  9635

TABLE 5-40 EQUIPMENT NOISE CONTROL PRIORITY AVERAGES

AFTER NOISE CONTROL ON SELECTED EQUIPMENT

THRESHOLD LEVEL = 90.0 DBA
8-HR PERMISSIBLE LEVEL = 90.0 DBA
EXCHANGE RATE = 5 DBA

SIC CODE = 332 AVERAGE FOR INDUSTRY NO DATES SPECIFIED

| EQUIP. CODE | EQUIPMENT DESCRIPTION | NO.OF UNITS | MEAN L1 | M.L. L1 | NO.OF PERS. | PRIORITY INDEX | NORM. P.I. |
|---|---|---|---|---|---|---|---|
| 1156 | WELD/BURN/GOUGING | 11 | 88.2 | 91.9 | 18802 | 18802.0 | 0.272 |
| 1448 | CORE OVEN | 9 | 93.9 | 95.3 | 7693 | 7693.0 | 0.111 |
| 1434 | FURNACE | 19 | 91.5 | 96.0 | 7693 | 7693.0 | 0.111 |
| 1500 | SAW/METAL | 2 | 98.0 | 98.0 | 6837 | 6837.0 | 0.099 |
| 1484 | SHAKEOUT/DUMPOUT | 16 | 89.6 | 93.0 | 8545 | 5537.0 | 0.080 |
| 1510 | ELECTRIC GRINDERS | 15 | 87.7 | 90.5 | 8838 | 5129.0 | 0.074 |
| 1371 | MULLER | 13 | 92.6 | 98.1 | 5129 | 3662.2 | 0.053 |
| 1444 | CRUCIBLE | 1 | 95.0 | 95.0 | 3419 | 3419.0 | 0.049 |
| 1457 | CORE SET LINE | 2 | 93.5 | 93.5 | 2564 | 2564.0 | 0.037 |
| 1187 | ABRASIVE BLASTING | 8 | 93.1 | 96.5 | 2563 | 2563.0 | 0.037 |
| 1505 | CUT-OFF WHEEL | 5 | 90.7 | 92.8 | 1709 | 1709.0 | 0.025 |
| 1135 | PNEUMATIC CHISEL | 4 | 103.8 | 112.8 | 1709 | 1709.0 | 0.025 |
| 1333 | MOLDER | 28 | 87.8 | 93.6 | 5129 | 1460.8 | 0.021 |
| 1497 | WHEELABRATOR | 5 | 90.2 | 95.8 | 854 | 445.0 | 0.006 |

# Section 6
# EXPECTED ERRORS IN PERSONNEL NOISE EXPOSURE AND IMPACT PREDICTIONS

## 6.1 Introduction

The important industry averaged parameters predicted by the BBN computer program are as follows:

1. Total Level Weighted Population (LWP) for the industry and for each plant

2. Total Population with an 8-hour $L_{eq}(8)>75$ dBA, where $L_{eq}(8)$ is calculated using the EPA formulation discussed in Section 5

3. Total Population with an 8-hour $L_{eq}(8)$ >90 dBA, where $L_{eq}(8)$ is calculated using the OSHA formulation

4. Total population with an 8-hour $L_{eq}(8)$ >90 dBA, where $L_{eq}(8)$ is calculated using the OSHA formulation outlined in Section 5

5. Total LWP for individual personnel categories (EPA criteria)

6. Daily Noise Dose (DND) for individual personnel categories (OSHA criteria)

7. Equipment impact normalized priority index (NPI) for individual equipment classifications (EPA criteria)

8. Equipment impact normalized priority index (NPI) for individual equipment classifications (OSHA criteria).

The first six parameters are predicted in terms of a mean and worst case. The mean value predictions are based on data collected in the field and the worst case predictions are calculated from the mean, using as a basis the variance in the field data, as outlined in Section 5.

The issue of interest here is the expected error in the parameter estimates for an entire industry based upon the sample measurements used for the parameter calculations. Specifically, it is desired to establish (a) confidence limits about the parameter estimates which define the accuracy of the predicted industry averages, (b) tolerance (prediction) limits about the parameter estimates which define the range of parameter values to be expected for individual plants not included in the sample, and, (c) verification of the validity of the worst case estimates for the first six parameters. To accomplish such error evaluations, it is necessary to assume that the sample plants used to calculate the parameter estimates for the industry represent a random selection of typical plants within that industry.

The theoretical basis used to derive the results presented in the following sections is outlined in Appendix A.

## 6.2 Applications to Sawmill Industry Data

The sample of the sawmill industry noise exposure levels produced data for n = 9 mills which are believed to be representative of the industry.

### 6.2.1 Total LWP Values for Sawmill Industry (Parameter 1)

The computer analysis described earlier in this report gives Level Weighted Population (LWP) results in terms of a mean and worst case estimate. The mean is the actual value calculated

from the measured data and the worst case is an estimate, based on the variance of the data, of the highest likely value.

The LWP values for the nine sample mills and the overall sample values are summarized in Table 6-1. Substsituting appropriate results from this table into Eq.(A-4) yields the 90% confidence intervals for the predicted LWP value for the entire industry. The interpretation of these confidence intervals is straightforward. Given the mean predicted LWP value of 1,078,540, for the industry based upon measurements in n = 9 randomly selected plants, it can be said with 90% confidence that the true LWP value for the industry is between 891,465 and 1,265,540, or within about $\pm$ 17% of the predicted value. The worst case LWP prediction is 1,625,903. which as expected is larger than the upper value of the 90% confidence interval for the mean and indicates that it is indeed a worst case prediction which is unlikely to be exceeded.

To look at the plants on an individual basis, it is necessary to normalize the total LWP for a given plant by dividing the plant population.

Tolerance (prediction) intervals for the normalized LWP values of individual plants within the industry, computed using the nonparametric relationship of Eq.(A-5), are given in Table 6-2. From these results, it can be stated with 90% confidence that at least 63% of all plants will have a normalized LWP value between 3.824 and 7.938. These same limits apply to at least 75% of all plants with 70% confidence, and at least 82% of all plants with 50% confidence. The worst case estimate of 7.017 is close to the upper 90% confidence limit and thus is a reasonable estimate of the highest likely value for the normalized LWP for the entire industry. As stated in Section 3 the worst case results for the individual plant analyses should be ignored.

Table 6-1 Level Weighted Population Exposure Data for the Sawmill Industry

| Plant Number | Number of Personnel ($m_i$) | LWP($y_i$) | | Normalized LWP($x_i$) | |
|---|---|---|---|---|---|
| | | Mean | Worst Case | Mean | Worst Case |
| 1 | 201 | 768.6 | | 3.824 | |
| 2 | 119 | 561.5 | | 4.718 | |
| 3 | 95 | 667.7 | | 7.028 | |
| 4 | 43 | 205.6 | | 4.781 | |
| 5 | 43 | 227.9 | | 5.300 | |
| 6 | 88 | 407.5 | | 4.631 | |
| 7 | 179 | 780.8 | | 4.362 | |
| 8 | 78 | 619.2 | | 7.938 | |
| 9 | 58 | 226.9 | | 3.912 | |
| All 9 | 904 | 4208.0 | 6343.6 | 4.655 | 7.017 |
| s | - | - | - | 1.302 | |
| Industry | 231700 | 1078540 | 1625903 | 4.655 | 7.017 |

Table 6-2. Prediction Limits for Normalized Mean LWP Values of Individual Sawmills

| Confidence Coefficient | Portion of Mills Within Interval | Predicted Normalized LWP Value | Predicted Worst Case Value | Interv.Limits Lower | Interv.Limits Upper |
|---|---|---|---|---|---|
| 0.90 | 0.63 | 4.655 | 7.017 | 3.824 | 7.938 |
| 0.70 | 0.75 | | | | |
| 0.50 | 0.82 | | | | |

### 6.2.2 FOP Values for Sawmill Industry (Parameters 2,3,and 4)

The fraction of personnel (FOP) exposed to an 8 hours $L_{eq}$ > 75 dBA and $L_{eq}(8)$ > 90 dBA for each of the nine sample plants, and the overall FOP for all 9 sample plants are summarized in Table 6-3. Substituting appropriate results from this table into Eq. (A-8) gives the 90% confidence intervals shown in Table 6-4 for the predictions. From these results, it can be said with 90% confidence that the true fraction of personnel in the industry with an exposure of $L_{eq}(8)$ > 75 dBA is 0.88 to 0.93. The worst case prediction of 0.917 is slightly less than the upper 90% confidence limit but is a reasonable estimate of the highest likely value. The intervals for $L_{eq}$ > 90 dBA (EPA criteria) are 0.19 to 0.36. The intervals for $L_{eq}(8)$ > 90 dBA (OSHA criteria) are 0.17 to 0.33. The worst case prediction of 0.399 is again a good estimate of the upper limit which is unlikely to be exceeded.

Table 6-3 Number of Critically Exposed Personnel Data for Sawmill Industry

| Plant Number | Number of Personnel ($m_i$) | Portion Exposed To $L_{eq}(8)>75$ dBA | | Portion Exposed To $L_{eq}(8)>90$ dBA (EPA criterion) | | Portion Exposed To $L_{eq}(8)>90$ dBA (OSHA criterion) | |
|---|---|---|---|---|---|---|---|
| | | Mean | Worst Case | Mean | Worst Case | Mean | Worst Case |
| 1 | 201 | 0.876 | | 0.264 | | 0.184 | |
| 2 | 119 | 0.941 | | 0.445 | | 0.336 | |
| 3 | 95 | 0.937 | | 0.516 | | 0.474 | |
| 4 | 43 | 0.837 | | 0.581 | | 0.419 | |
| 5 | 43 | 0.977 | | 0.372 | | 0.349 | |
| 6 | 88 | 0.920 | | 0.341 | | 0.341 | |
| 7 | 179 | 0.866 | | 0.112 | | 0.101 | |
| 8 | 78 | 0.897 | | 0.385 | | 0.385 | |
| 9 | 58 | 0.845 | | 0.345 | | 0.276 | |
| All 9 | 904 | 0.900 | 0.917 | 0.275 | 0.576 | 0.249 | 0.399 |
| s | - | 0.0376 | - | - | - | 0.123 | - |
| Industry | 231700 | 0.900 | 0.917 | 0.279 | 0.576 | 0.249 | 0.399 |

Table 6-4 90% Confidence Limits for Sawmill Industry FOP Values

| Case | Mean FOP Value | Predicted Worst Case Value | 90% Interval Limits | |
|---|---|---|---|---|
| | | | Lower | Upper |
| $L_{eq}(8) > 75$ dBA | 0.900 | 0.917 | 0.88 | 0.93 |
| $L_{eq}(8) > 90$ dBA EPA Criteria | 0.279 | 0.576 | 0.19 | 0.36 |
| $L_{eq}(8) > 90$ dBA OSHA Criteria | 0.249 | 0.399 | 0.17 | 0.33 |

As expected, the FOP with $L_{eq}(8) > 90$ dBA is greater when EPA criteria are used as noise levels between 75 dBA and 90 dBA are included in the $L_{eq}(8)$ calculation whereas these levels excluded in the OSHA calculation. The worst case prediction of 0.576 is well above the upper 90% confidence limit, indicating that it is indeed an upper level estimate which is unlikely to be exceeded. The intervals discussed in the preceding text can be converted to actual numbers of personnel by multiplying the fractional portions by 231,700 - the estimated number of personnel in the industry.

Tolerance (prediction) limits on the FOP values for individual plants in the industry are detailed in Table 6-5. As before, the limits can be assumed to include various different portions of all sawmills with the noted confidence coefficient. For example, it can be stated with 90% confidence that at least 63% of the mills in the industry will have FOP values between 0.84 and 0.98 for exposures of $L_{eq}(8) > 75$ dBA, and between 0.11 and 0.58 for exposures of $L_{eq}(8) > 90$ dBA.

### 6.2.3 Level Weighted Population Values for Individual Personnel Categories

The level weighted population (LWP) values for various personnel categories in the entire industry are summarized in Table 6-6. Only the most important 21 personnel categories are included. The estimated category population for the entire industry (Column 2) was derived from the category population for the nine plants sampled and the ratio of total industry population to total population in the nine sample plants. These estimates could be improved at a later date by sending out questionnaires to a large percentage of plants in the industry, as discussed later in this report.

Table 6-5 Prediction Limits for FOP Values of Individual Sawmills

| Case | Confidence Coefficient | Portion of Plants Within Interval | Predicted Mean FOP Value | Interval Limits for mean values | |
|---|---|---|---|---|---|
| | | | | Smallest value in Sample | Largest value in Sample |
| $L_{eq}(8)$ >75 dBA mean | 0.90<br>0.70<br>0.50 | 0.63<br>0.75<br>0.82 | 0.900 | 0.84 | 0.98 |
| $L_{eq}(8)$ >90 dBA EPA Criterion | 0.90<br>0.70<br>0.50 | 0.63<br>0.75<br>0.82 | 0.279 | 0.11 | 0.58 |
| $L_{eq}(8)$ >90 dBA OSHA Criterion | 0.90<br>0.70<br>0.50 | 0.63<br>0.75<br>0.82 | 0.249 | 0.10 | 0.47 |

Table 6-6 90% Confidence Limits for Sawmill Industry
LWP Values (EPA Criteria)

| Job Code | Est. Categ. Population | Job Description | LWP (Indust. Average) | | Worst Case Prediction | Sample Standard Deviation (Norm. LWP) | LWP Confidence Limits (90%) | |
|---|---|---|---|---|---|---|---|---|
| | | | Prediction | Normalized | | | Lower | Upper |
| 173 | 13837 | Grader/Planer Mill | 92323 | 6.672 | 121382 | 3.106 | 66044 | 118569 |
| 211 | 14095 | Millwright/General | 86567 | 6.142 | 111593 | 3.335 | 57832 | 115283 |
| 168 | 3329 | Planer Set-Up Man | 79853 | 23.987 | 100769 | 11.820 | 55731 | 103815 |
| 167 | 7175 | Planer Operator | 78610 | 10.956 | 111853 | 5.932 | 52600 | 104604 |
| 176 | 23321 | Dry Chain Puller | 62407 | 2.676 | 100916 | 1.416 | 42211 | 82556 |
| 228 | 10506 | Electricians | 59679 | 5.680 | 75452 | 3.203 | 39124 | 80224 |
| 148 | 9479 | Trimmer Operator | 49056 | 5.175 | 93561 | 3.991 | 25906 | 72145 |
| 151 | 7430 | Green Chain Puller | 43544 | 5.861 | 61372 | 3.137 | 29274 | 57761 |
| 202 | 14607 | Forklift Operator | 41980 | 2.874 | 75054 | 1.646 | 27286 | 56675 |
| 134 | 6407 | Edger Operator | 36306 | 5.666 | 86772 | 4.480 | 18766 | 53838 |
| 137 | 2304 | Chipper Operator | 33812 | 14.675 | 45672 | 7.361 | 23402 | 44129 |
| 212 | 3843 | Millwright/Sawmill | 28839 | 7.504 | 31331 | 3.375 | 20910 | 36758 |
| 101 | 3328 | Sawmill Supervisor | 23122 | 6.947 | 25305 | 3.578 | 15821 | 30371 |
| 154 | 7174 | Stacker - Green | 20841 | 2.905 | 50104 | 1.014 | 16371 | 25267 |
| 127 | 1793 | Tail Sawyer | 20058 | 11.189 | 32880 | 5.412 | 14123 | 25982 |
| 213 | 1792 | Millwright/Planer | 20005 | 11.164 | 25783 | 5.958 | 13449 | 26495 |
| 140 | 3075 | Resaw Operator | 18887 | 6.142 | 23680 | 3.736 | 11860 | 25901 |
| 144 | 1792 | Lumber Diverter | 17226 | 9.612 | 21006 | 3.842 | 12988 | 21400 |
| 261 | 2560 | Clean-Up Man/Regular | 16617 | 6.491 | 20817 | 4.249 | 9948 | 23240 |
| 138 | 1536 | Hog Operator | 15862 | 10.327 | 20126 | 5.199 | 10973 | 20733 |
| 104 | 2561 | Planer Supervisor | 15828 | 6.180 | 18367 | 3.484 | 10359 | 21264 |

The statistical results shown in Table 6-6 were derived on the assumption that the values in column 2 of the table are good estimates of the true values.

Table 6-6 shows that the predicted worst case values are generally close to the upper 90% confidence limit, indicating that they are reasonable estimates of the highest likely values. (Compare columns 5 and 7 in the table). From Table 6-6, it can be seen that although the Grader/Planer Mill category has the highest predicted LWP value for the entire industry, the sampling errors are such that six other personnel categories could feasibly have a higher LWP value for the industry as a whole. This follows because the upper bounds on the LWP values for six other personnel categories are higher than the lower bound for the Grader/Planer Mill category.

### 6.2.4 Daily Noise Dose

The OSHA criteria involve a Daily Noise Dose (DND) calculation for the various labor categories which is directly related to the eight hour equivalent noise level exposure ($L_{eq}(8)$). Specifically,

$$DND = 10^{[(L_{eq}(8)-90)/16.65)]} \qquad (6\text{-}1)$$

Hence, the variability of the DND data is directly related to the variability of the $L_{eq}(8)$ calculations.

The DND values for various personnel categories in the 9-plant sample are summarized in Table 6-7. Only the most important 15 categories are included. The table shows that the variance is similar to the LWP values and that for an industry average any one of 5 personnel categories could conceivably be the most important. The table also shows that the worst case predictons are generally good estimates of the likely upper limit of the

Table 6.7 90% Confidence Limits for Sawmill Industry DND Values Using OSHA Criteria

| Code | Description | Daily Noise Dose | Sample Standard Deviation | DND Worst Case Prediction | Confidence Limits | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| 168 | Planer Set-up Man | 7.45 | 6.77 | 12.29 | 3.29 | 11.64 |
| 137 | Chipper Operator | 3.00 | 1.61 | 4.94 | 2.00 | 4.00 |
| 128 | Quadsaw Tail Sawyer | 2.64 | 0.893 | 2.64 | 2.09 | 3.19 |
| 127 | Tail Sawyer | 2.46 | 1.30 | 5.71 | 1.65 | 3.27 |
| 167 | Planer Operator | 2.02 | 2.16 | 3.38 | 0.68 | 3.36 |
| 144 | Lumber Diverter | 1.79 | 0.756 | 2.38 | 1.32 | 2.26 |
| 185 | Ripsaw Operator | 1.74 | 0.589 | 1.74 | 1.37 | 2.10 |
| 138 | Hog Operator | 1.71 | 0.860 | 2.46 | 1.17 | 2.23 |
| 213 | Millwright/Planer | 1.44 | 0.599 | 2.28 | 1.07 | 1.81 |
| 133 | Slab Board Puller | 1.41 | 0.477 | 1.56 | 1.11 | 1.71 |
| 186 | Ripsaw Offbearer | 1.32 | 0.447 | 1.32 | 1.04 | 1.69 |
| 212 | Millwright/Sawmill | 1.17 | 0.574 | 1.28 | 0.81 | 1.53 |
| 173 | Grader/Planer Mill | 1.15 | 0.797 | 1.56 | 0.66 | 1.64 |
| 245 | Oiler | 1.15 | 0.586 | 1.36 | 0.79 | 1.51 |
| 191 | Specialty Resaw Offb. | 1.11 | 0.782 | 2.39 | 0.62 | 1.60 |

industry average DND values for each personnel category (compare columns 5 and 7 in the table).

### 6.2.5 NPI Values for Sawmill Industry

The normalized priority index (NPI) values (calculated using EPA criteria) for various types of equipment in the nine sample mills, and the standard deviations of the NPI values for individual plants are summarized in Table 6-8. The data cover all types of machines which had an NPI value in excess of 1% (NPI > 0.01). 90% confidence limits on the true NPI value for each type of equipment calculated using Eq. (A-16) are also shown in this table.

From Table 6-8, it can be seen that although the Planers have the highest predicted NPI value, the sampling errors are such that four other types of equipment could feasibly have a higher NPI value for the industry as a whole, namely, Kiln Chains, Headrigs, Dry Chains, and Green Chains. This follows because the upper bounds on the NPI values for these four equipment types are higher than the lower bound on the NPI value for the Planers. Of course, the probability that this might be true is very small. However, for the equipment types with predicted NPI values of less than, say 5%, their order of importance could easily be quite different than indicated by the predicted NPI values because the confidence intervals strongly overlap.

Similar NPI results calculated using OSHA criteria are summarized in Table 6-9. Comparing the results in this table with those in Table 6-8, it it clear that the variability in the NPI values using EPA and OSHA criteria is similar; i.e., the statistical stability of the OSHA results is no better than for the EPA results. This matter is pursued further in Section 6.4.

Table 6-8 90% Confidence Limits for Sawmill Industry
NPI Values - EPA Criteria

| Equip. Code | Equipment Description | Normal Priority Index | Sample Standard Deviation | Confidence Limits Lower | Upper |
|---|---|---|---|---|---|
| 1699 | Planer | 0.167 | 0.080 | 0.118 | 0.216 |
| 1688 | Kiln Chain | 0.131 | 0.072 | 0.087 | 0.175 |
| 1620 | Headrig | 0.109 | 0.088 | 0.055 | 0.163 |
| 1739 | Dry Chain | 0.086 | 0.053 | 0.053 | 0.119 |
| 1800 | Forklift | 0.079 | 0.028 | 0.062 | 0.096 |
| 1664 | Trimmer | 0.073 | 0.029 | 0.055 | 0.091 |
| 1629 | Edger | 0.069 | 0.039 | 0.045 | 0.093 |
| 1679 | Green Chain | 0.066 | 0.101 | 0.004 | 0.128 |
| 1644 | Resaw/Large | 0.029 | 0.028 | 0.012 | 0.046 |
| 1810 | Lumber Carrier | 0.025 | 0.023 | 0.011 | 0.039 |
| 1792 | Powerhouse | 0.022 | 0.027 | 0.005 | 0.039 |
| 1600 | Debarker | 0.020 | 0.023 | 0.006 | 0.034 |
| 1819 | Quadsaw | 0.016 | 0.040 | 0 | 0.041 |
| 1828 | Gang Saw | 0.016 | 0.036 | 0 | 0.038 |
| 1759 | Resaw/Specialty | 0.016 | 0.028 | 0 | 0.033 |
| 1779 | Chipper | 0.015 | 0.010 | 0.009 | 0.021 |
| 1776 | Conveyor/Gen. | 0.013 | 0.018 | 0.002 | 0.024 |

Table 6-9 90% Confidence Limits for Sawmill Industry
NPI Values using OSHA Criteria

| Equip. Code | Equipment Description | Normal Priority Index | Sample Standard Deviation | Confidence Limits | |
|---|---|---|---|---|---|
| | | | | Lower | Upper |
| 1699 | Planer | 0.396 | 0.260 | 0.236 | 0.556 |
| 1629 | Edger | 0.119 | 0.091 | 0.063 | 0.175 |
| 1620 | Headrig | 0.104 | 0.066 | 0.063 | 0.145 |
| 1644 | Resaw/Large | 0.084 | 0.075 | 0.038 | 0.130 |
| 1679 | Green Chain | 0.082 | 0.171 | 0 | 0.187 |
| 1664 | Trimmer | 0.054 | 0.071 | 0.010 | 0.098 |
| 1779 | Chipper | 0.045 | 0.040 | 0.020 | 0.070 |
| 1828 | Gang Saw | 0.025 | 0.051 | 0 | 0.056 |
| 1819 | Quadsaw | 0.025 | 0.055 | 0 | 0.059 |
| 1785 | Hog | 0.023 | 0.028 | 0.006 | 0.040 |
| 1759 | Resaw/Specialty | 0.022 | 0.041 | 0 | 0.047 |

## 6.3 Applications to Foundry Industry Data

The sample of the foundry industry noise exposure levels produced data for n = 7 foundries which are believed to be representative of the industry.

### 6.3.1 Total LWP Values for Foundry Industry (Parameter 1)

The level weighted population (LWP) values for the seven sample foundries are summarized in Table 6-10. Using the results of Table 6-10 and given the mean predicted LWP value of 3,553,913 for the industry based upon measurements in n = 7 randomly selected plants, it can be stated with 90% confidence that the true LWP value for the industry is between 3,175,040 and 3,933,140 or within $\pm$ 11% of the predicted value. The worst case LWP prediction is 4,687,870 which is larger than the upper value of the 90% confidence interval for the mean and is a good indication of the upper limit which is unlikely to be exceeded.

Tolerance (prediction) intervals for the normalized LWP values of individual foundries within the industry, computed using the nonparametric relationship of Eq. (A-5), are presented in Table 6-11. For the sample size of n = 7, the stated limits apply to at least 55% of the foundries with 90% confidence, at least 69% with 70% confidence, and at least 77% with 50% confidence.

### 6.3.2 FOP Values for Foundry Industry (Parameters 2, 3 and 4)

The fraction of personnel (FOP) exposed to $L_{eq}(8) > 75$ dBA and $L_{eq}(8) > 90$ dBA for each of the seven sample foundries, and the overall FOP value for all seven sample foundries are summarized in Table 6-12. The 90% confidence intervals computed from Eq (A-8) are shown in Table 6-13. From these results, it is seen that the fractional portion of personnel in the foundry

Table 6-10 Level Weighted Population Exposure Data for the Foundry Industry

| Plant Number | Number of Personnel ($m_i$) | LWP($y_i$) | | Normalized LWP($x_i$) | |
|---|---|---|---|---|---|
| | | Mean | Worst Case | Mean | Worst Case |
| 1 | 44 | 419.0 | | 9.523 | |
| 2 | 48 | 399.5 | | 8.323 | |
| 3 | 70 | 524.7 | | 7.496 | |
| 4 | 46 | 380.6 | | 8.274 | |
| 5 | 248 | 1988.5 | | 8.025 | |
| 6 | 23 | 75.0 | | 3.261 | |
| 7 | 52 | 361.0 | | 6.942 | |
| All 7 | 531 | 4160.6 | 5483.5 | 7.835 | 10.326 |
| s | - | - | - | 1.137 | |
| Industry | 453958 | 3556913 | 4687870 | 7.835 | 10.326 |

Table 6-11 Prediction Limits for Normalized LWP Values of Individual Foundries

| Case | Confidence | Portion of Foundries Within Interval | Predicted Normalized LWP Value | Interval Limits Lower | Interval Limits Upper |
|---|---|---|---|---|---|
| Mean | 0.90 | 0.55 | 7.835 | 3.260 | 9.522 |
| | 0.70 | 0.69 | | | |
| | 0.50 | 0.77 | | | |

Table 6-12 Number of Critical Personnel Data for Foundry Industry

| Foundry Number | Number of Personnel ($m_i$) | Portion Exposed To $L_{eq}(8)>75$ dBA | | Portion Exposed To $L_{eq}(8)>90$ dBA (EPA criteria) | | Portion Exposed To $L_{eq}(8)>90$ dBA (OSHA criteria) | |
|---|---|---|---|---|---|---|---|
| | | Mean | Worst Case | Mean | Worst Case | Mean | Worst Case |
| 1 | 44 | 1.000 | | 0.977 | | 0.886 | |
| 2 | 48 | 1.000 | | 0.854 | | 0.542 | |
| 3 | 70 | 1.000 | | 0.671 | | 0.457 | |
| 4 | 46 | 1.000 | | 0.652 | | 0.630 | |
| 5 | 248 | 0.992 | | 0.605 | | 0.532 | |
| 6 | 23 | 0.957 | | 0.130 | | 0.130 | |
| 7 | 52 | 1.000 | | 0.519 | | 0.346 | |
| All 7 | 531 | 0.992 | 0.996 | 0.640 | 0.744 | 0.463 | 0.631 |
| s | - | 0.00888 | | 0.164 | | 0.150 | |
| Industry | 453958 | 0.992 | 0.996 | 0.640 | 0.744 | 0.463 | 0.631 |

Table 6-13. 90% Confidence Limits for Foundry Industry FOP Values

| Case | Predicted FOP Value | Interval Limits | | Worst Case Value |
|---|---|---|---|---|
| | | Lower | Upper | |
| $L_{eq}(8)>75$ dBA, Mean | 0.992 | 0.985 | 0.999 | 0.996 |
| $L_{eq}(8)>90$ dBA (EPA criteria) | 0.640 | 0.520 | 0.760 | 0.744 |
| $L_{eq}(8)>90$ dBA (OSHA criteria) | 0.463 | 0.353 | 0.573 | 0.631 |

industry that will be exposed to $L_{eq}(8) > 75$ dBA is at least 98%. For an exposure of $L_{eq}(8) > 90$ dBA, the fractional portion is 52 to 76% for EPA criteria, and 35 to 57% for OSHA criteria. Again, the worst case prediction is seen to be a good estimate of the likely upper limit to the values.

Tolerance (prediction) limits on the FOP values for the individual industries are shown in Table 6-14. As before, the limits can be assumed to include various different portions of all foundries with the noted confidence coefficient. For example, using the mean data, it can be said with 90% confidence that at least 55% of the individual foundries in the industry will have FOP values between 0.96 and 1.00 for exposures of $L_{eq}(8) > 75$ dB, and between 0.13 and 0.98 for exposures of $L_{eq}(8) > 90$ dBA.

Table 6-14 Prediction Limits for FOP Values of Individual Foundries

| Case | Confidence Coefficient | Portion of Foundries Within Interval | Predicted Mean FOP Value | Interval Limits for Mean Values | |
|---|---|---|---|---|---|
| | | | | Smallest Value in Sample | Largest Value in Sample |
| $L_{eq}(8)>75$ dBA, Mean | 0.90 | 0.55 | 0.992 | 0.96 | 1.00 |
| | 0.70 | 0.69 | | | |
| | 0.50 | 0.77 | | | |
| $L_{eq}(8)>90$ dBA (EPA criteria) | 0.90 | 0.55 | 0.640 | 0.13 | 0.98 |
| | 0.70 | 0.69 | | | |
| | 0.50 | 0.77 | | | |
| $L_{eq}(8)>90$ dBA (OSHA criteria) | 0.90 | 0.55 | 0.463 | 0.13 | 0.89 |
| | 0.70 | 0.69 | | | |
| | 0.50 | 0.77 | | | |

### 6.3.3 Level Weighted Population Values for Individual Personnel Categories

The LWP values for the most important 19 personnel categories in the foundry industry are summarized in Table 6-15. The category with the largest predicted LWP is pneumatic grinder operator. Only the squeeze jolt-molder category could feasibly have a higher LWP due to sampling errors. Again the worst case prediction values are close to the upper limit of the 90% confidence interval for most categories, indicating that the worst case is a good prediction of the likely upper limit for the LWP values in each category.

### 6.3.4 Daily Noise Dose

The DND values for various personnel categories in the seven plant sample are summarized in Table 6-16. Again the variance in these values is similar to the variance in LWP values.

### 6.3.5 NPI Values for Foundry Industry

The normalized priority index (NPI) values for various types of equipment in the seven sample foundries, and the standard deviations of the NPI values for the individual foundries computed using Eq. (A-15) are summarized in Table 6-17. As before, the data cover all types of equipment which had an NPI value in excess of 1% (NPI > 0.01). 90% confidence limits on the True NPI value for each type of equipment calculated using Eq.(A-16) are also shown in this table.

Similar NPI results calculated using OSHA criteria are summarized in Table 6-18. Again it is clear that the variability in NPI values using OSHA criteria and EPA criteria is similar. This matter is pursued further in the next section.

Table 6.15 90% Confidence Limits for Foundry Industry LWP Values (EPA Criteria)

| Job Code | Est. Categ. Population | Job Description | LWP-Industry Average | | Worst Case Prediction | Sample Standard Deviation for Normalized LWP | LWP Confidence Limits (90%) | |
|---|---|---|---|---|---|---|---|---|
| | | | Industry Average | Normalized | | | Lower | Upper |
| 275 | 70100 | PN Grinder Operator | 626773 | 8.941 | 768070 | 3.733 | 439527 | 814281 |
| 340 | 29919 | Squz/Jolt Molder Op. | 348776 | 11.657 | 569463 | 4.412 | 254102 | 443130 |
| 303 | 24790 | Arc Welder/A | 235939 | 9.518 | 318564 | 5.464 | 139047 | 333004 |
| 310 | 10255 | Arc Air Gouger | 225570 | 21.996 | 287184 | 11.653 | 139960 | 311095 |
| 421 | 16240 | Shell Core Operator | 127559 | 7.855 | 147676 | 2.254 | 89905 | 153368 |
| 281 | 19660 | Stand Stone Grinder | 121862 | 6.198 | 156074 | 2.254 | 89905 | 153368 |
| 367 | 18895 | Pourer | 110720 | 5.888 | 146650 | 4.507 | 50059 | 171426 |
| 302 | 5129 | Arc Air Operator | 103976 | 20.272 | 133500 | 4.911 | 85916 | 121983 |
| 505 | 7691 | Cut Off Wheel Operator | 103976 | 13.134 | 111418 | 5.741 | 78717 | 132808 |
| 280 | 9403 | Wheel Grinder Operator | 97905 | 10.412 | 170481 | 4.091 | 70504 | 125586 |
| 341 | 17094 | Floor Molder | 80723 | 4.722 | 117619 | 4.150 | 30000 | 131573 |
| 443 | 5128 | Shakeout Table Operator | 73921 | 14.415 | 99111 | 7.419 | 46737 | 101216 |
| 264 | 23929 | Serviceman | 73735 | 3.081 | 101293 | 1.641 | 45393 | 101626 |
| 440 | 11967 | Shakeout Operator | 69730 | 5.827 | 97488 | 1.999 | 52774 | 87024 |
| 343 | 5129 | Moldmaster Operator | 68540 | 13.363 | 80649 | 6.667 | 44058 | 93030 |
| 326 | 4274 | Arc Furnace Operator | 61252 | 14.331 | 82457 | 6.865 | 40270 | 82283 |
| 279 | 6837 | Swing Grinder Operator | 53331 | 7.800 | 56629 | 3.465 | 36134 | 70059 |
| 282 | 3419 | Trim Grinder Operator | 52984 | 15.497 | 52984 | 4.378 | 42385 | 63822 |
| 467 | 8546 | Wheelabrator Operator | 49576 | 5.801 | 75573 | 3.908 | 25553 | 73376 |

Table 6.16 90% Confidence Limits for Foundry Industry DND Values Using OSHA Criteria

| Code | Job Description | Daily Noise Dose | Sample Standard Deviation | DND Worst Case Prediction | Confidence Limits | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| 310 | Arc Air Gouger | 6.54 | 3.80 | 11.09 | 3.75 | 9.33 |
| 450 | Dumpout/Shakeout Operator | 6.52 | 1.69 | 6.52 | 5.28 | 7.76 |
| 318 | Gas Burner | 6.34 | 3.80 | 10.77 | 3.55 | 9.13 |
| 302 | Arc-Air Operator | 4.88 | 0.894 | 8.28 | 4.22 | 5.54 |
| 282 | Trim Grinder Operator | 3.17 | 0.912 | 3.17 | 2.50 | 3.84 |
| 504 | Radial Saw Operator | 3.17 | 0.910 | 3.17 | 2.50 | 3.84 |
| 326 | Arc Furnace Operator | 3.02 | 1.54 | 5.18 | 1.89 | 4.15 |
| 443 | Shakeout Table Operator | 2.91 | 1.68 | 4.84 | 1.68 | 4.14 |
| 343 | Moldmaster Operator | 2.61 | 1.30 | 3.32 | 1.66 | 3.56 |
| 505 | Cut-off Wheel Operator | 2.52 | 1.28 | 2.96 | 1.58 | 3.46 |
| 340 | Squez/Jolt Molder Operator | 2.11 | 0.750 | 5.14 | 1.56 | 2.66 |
| 277 | Pn. Disc Grinder Operator | 1.92 | 0.514 | 2.93 | 1.54 | 2.30 |
| 280 | Wheel Grinder Operator | 1.89 | 0.755 | 4.61 | 1.34 | 2.44 |
| 339 | Auto-Molder Operator | 1.71 | 0.677 | 2.30 | 1.21 | 2.21 |

Table 6-17 90% Confidence Limits for Foundry Industry
NPI Values - EPA Criteria

| Code | Job Description | Normal Priority Index | Sample Standard Deviation | Confidence Limits | |
|---|---|---|---|---|---|
| | | | | Lower | Upper |
| 1103 | Pneumatic Grinder | 0.196 | 0.108 | 0.117 | 0.275 |
| 1158 | Weld/Burn/Gouging | 0.112 | 0.094 | 0.043 | 0.181 |
| 1333 | Molder | 0.100 | 0.097 | 0.029 | 0.171 |
| 1434 | Furnace | 0.097 | 0.070 | 0.046 | 0.148 |
| 1484 | Shakeout/Dumpout | 0.087 | 0.038 | 0.059 | 0.115 |
| 1448 | Core Oven | 0.081 | 0.113 | 0.015 | 0.179 |
| 1510 | Electric Grinder | 0.076 | 0.032 | 0.053 | 0.099 |
| 1187 | Abrasive Blasting | 0.042 | 0.033 | 0.018 | 0.066 |
| 1505 | Cut-off Wheel | 0.030 | 0.018 | 0.017 | 0.043 |
| 1385 | Sandslinger | 0.024 | 0.022 | 0.008 | 0.040 |
| 1500 | Saw/Metal | 0.020 | 0.065 | 0 | 0.067 |
| 1144 | Pneumatic Tamper | 0.017 | 0.020 | 0.002 | 0.032 |
| 1497 | Wheelabrator | 0.017 | 0.011 | 0.009 | 0.025 |
| 1371 | Muller | 0.016 | 0.014 | 0.006 | 0.026 |
| 1460 | Lathe | 0.012 | 0.012 | 0.003 | 0.021 |
| 1444 | Crucible | 0.011 | 0.036 | 0 | 0.037 |

Table 6.18 90% Confidence Limits for Foundry Industry NPI Values Using OSHA Criteria

| Code | Job Description | Normal Priority Index | Sample Standard Deviation | Confidence Limits | |
|---|---|---|---|---|---|
| | | | | Lower | Upper |
| 1103 | Pneumatic Grinder | 0.380 | 0.237 | 0.206 | 0.554 |
| 1333 | Molder | 0.140 | 0.128 | 0.046 | 0.234 |
| 1158 | Weld/Burn/Gouging | 0.130 | 0.112 | 0.048 | 0.212 |
| 1510 | Electric Grinders | 0.076 | 0.112 | 0.048 | 0.212 |
| 1484 | Shakeout/Dumpout | 0.059 | 0.067 | 0.010 | 0.108 |
| 1505 | Cut-off Wheel | 0.045 | 0.046 | 0.011 | 0.079 |
| 1434 | Furnace | 0.037 | 0.070 | 0 | 0088 |
| 1448 | Core Oven | 0.037 | 0.090 | 0 | 0.103 |
| 1500 | Saw/Metal | 0.033 | 0.088 | 0 | 0.098 |
| 1444 | Crucible | 0.016 | 0.044 | 0 | 0.048 |
| 1457 | Core Set Line | 0.012 | 0.033 | 0 | 0.036 |
| 1187 | Abrasive Blasting | 0.012 | 0.014 | 0.002 | 0.022 |
| 1371 | Muller | 0.009 | 0.010 | 0.002 | 0.016 |
| 1135 | Pneumatic Chisel | 0.008 | 0.007 | 0.002 | 0.014 |
| 1385 | Sandslinger | 0.003 | 0.003 | 0.001 | 0.005 |

From Table 6-17, it can be seen that the Pneumatic Grinder has the highest average NPI value, but any one of the next five equipment items in the order (through Core Ovens) could actually be more important since the upper bound on their confidence intervals is higher than the lower bound for the Pneumatic Grinder. Similarly, the last eight equipment items could in reality have a significantly different order of importance since their confidence limits strongly overlap.

In summary, for this sample of seven foundries, the normalized priority index calculation appears to provide only a coarse estimate of the importance of various machines to the noise exposure of workers.

## 6.4 Sample Size Requirements

In this section we determine the number of plants which need to be sampled from each of the sawmill and foundry industries in order to obtain good estimates of values for Level Weighted Population, Daily Noise Dose and Equipment Normalized Priority Index.

The total Level Weighted Population (LWP) data for the entire industry (parameter 1) are reasonably stable even for the sample sizes of 9 and 7 plants involved in the sawmill and foundry industry studies. The Normalized Priority Index (NPI) Daily Noise Dose (DND) results, and LWP results for individual personnel categories however, are rather unstable due to the large standard deviation in the values from one plant to the next. One way of assessing this standard deviation is in terms of a "coefficient of variation" $\varepsilon$ given by

$$\varepsilon = s/x \qquad (6\text{-}2)$$

where s = standard deviation of the sample values from one plant to the next.

x = mean value for all plants in the sample.

The average coefficients of variation for the LWP, NPI and DND values for the sawmill and foundry industries are summarized in Table 6-19. Note that the coefficient of variation for the total industry LWP as well as the individual personnel category LWP is shown. As expected the variation for the total industry LWP is less than the variation for individual personnel categories.

**Table 6-19 Average Coefficients of Variation for NPI and DND Values for Sawmill and Foundry Industries**

| Industry | No. of Plants | Average Coefficient of Variation | | | | |
|---|---|---|---|---|---|---|
| | | EPA-NPI | EPA-LWP | EPA-Tot.LWP | OSHA-NPI | OSHA-DND |
| Sawmill | 9 | 1.22 | 0.55 | 0.28 | 1.49 | 0.58 |
| Foundry | 7 | 1.46 | 0.51 | 0.15 | 1.66 | 0.44 |

The values in this table represent an energy average; i.e.,

$$\varepsilon_{av} = \left[\frac{1}{n} \sum_{i=1}^{n} \varepsilon_i^2\right]^{\frac{1}{2}} \qquad (3)$$

It is seen from Table 6-19 that the variability of the NPI values for both industries using either the EPA or OSHA criteria are similar. The average 90% confidence limits here can be approximated by

$$90\%\ C.L. = x(1 \pm 1.7\ \varepsilon/\sqrt{n}) \qquad (4)$$

where the 1.7 factor represents the approximate value of the Student "t" variable for a relatively large sample size (n>15).

From the preceding expression the sample size required to obtain a given accuracy with 90% confidence can be estimated. Sample size estimates for an accuracy of ±50% and ±20% are given in Tables 6-20 and 6-21 below. The tables indicate how many plants need to be sampled in a particular industry to result in the indicated accuracy (±20%, ±50%) for estimates of the quantities shown.

**Table 6-20 Minimum Number of Plants to be Sampled for ±50% error with 90% Confidence**

| Industry | EPA-NPI | EPA-LWP | EPA-Tot LWP | OSHA-NPI | OSHA-DND |
|---|---|---|---|---|---|
| Sawmill | 18 | 6 | <5 | 26 | 6 |
| Foundry | 25 | 5 | <5 | 32 | <5 |

Table 6-21 Minimum Number of Plants to be Sampled for ±20% error with 90% Confidence

| Industry | EPA-NPI | EPA-LWP | EPA-Tot LWP | OSHA-NPI | OSHA-DND |
|---|---|---|---|---|---|
| Sawmill | 100 | 22 | 7 | 150 | 25 |
| Foundry | 150 | 20 | <5 | 190 | 15 |

The preceding tables show that sufficient plants were sampled in the survey reported here to give a good estimate of the total Level Weighted Population (LWP) for each industry. The tables also show that relatively few plants need to be sampled in each industry in order to rank the importance of a given industry in terms of overall personnel noise exposure. However, the error in the estimates for the industry averaged LWP and Daily Noise Dose (DND) for individual personnel categories, is probably on the order of ±50%. For ±20% accuracy in these quantities (with 90% confidence), approximately 25 plants would have to be sampled in each industry. For a ±20% accuracy in the industry averaged Normalized Priority Index (NPI) values for various equipment classifications, the results show that between 100 and 190 plants would need to be sampled.

However, as mentioned earlier, the results obtained with the limited sample size used herein are useful in that they indicate which classifications of equipment are the most important contributors to the LWP and DND values in each industry, although the ordering shown may change slightly if a larger plant sample were used.

# Section 7
# RECOMMENDATIONS FOR FUTURE WORK

This section contains details of the work which we consider is necessary to complete the project which we have begun here. Each recommendation is discussed in detail below.

## 7.1 Determination of Minimum Noise Reduction Requirements

This work involves the use of an iterative procedure to determine the Minimum Equipment noise reductions necessary to achieve compliance with a given criteria, be it EPA or OSHA. The method involves the following steps:

(a) reduce the noise level of the equipment with the highest priority index by 1 dB (or less if more accuracy is desired);

(b) Recalculate the personnel exposure impact and the equipment priority indices;

(c) Repeat the above two steps until all personnel are in compliance with the criteria.

Complications in this procedure which need to be considered are as follows:

(a) Suitable consideration of background noise levels and the calculation of the effect on a given background level of noise reduction for one or more equipment types contributing to it;

(b) Allowance for the exclusion from the iteration process of equipment types for which noise control is considered not practical or not feasible;

(c) Use of an "ease of treatment" index to further weight the iterative procedure towards equipment types which are easier to treat.

## 7.2 Economic Evaluation

This work involves the determination of the cost to industry, of compliance with a given personnel noise exposure criteria (EPA or OSHA). The cost determination is closely linked with the determination of the minimum noise reduction requirements as discussed in the previous section. In addition the following information would be required.

(a) Estimation of the number of each type of equipment in the particular industry. This could be obtained using a questionaire sent to a large proportion of plants involved in the industry;

(b) Estimation of the noise control cost in dollars per dB for each equipment type. These estimates would be derived from BBN's experience in this type of work;

(c) Inclusion of an escalation index to allow both the number of items of equipment and the cost of noise control to be increased with time, based on the increase in CPI and the economic growth experienced in the particular industry.

## 7.3 Establishment of a Data Bank

This involves collection of noise level and personnel work assignment data from a selection of plants in all industries which are considered important from a noise exposure viewpoint. The data may be collected over an extended period of time but the data bank can be established early in the work and

periodically updated as new data become available. The eventual aim is to allow the evaluation of the exposure problems and approximate costs of compliance in any industry of interest. It is intended that the data bank will exist either on disk file or magnetic tape at the Washington Computer Center. These details are discussed more fully in Section 3 of Appendix B.

## 7.4 Computer Program Improvements

These improvements, which are designed to extend the usefulness of the program and minimize the complexity in using it, are discussed in detail in Section 3 of Appendix B. The more important extensions to the program are listed below:

(a) Calculation of the effect of the specification of maximum equipment noise levels on certain given equipment types. This will allow the effect of noise control legislation which specifies maximum permitted noise levels, to be evaluated more easily than is possible with the existing program;

(b) Improvement in the accuracy of the extrapolation of results from the entire industry from average results from a small sample of plants. This involves determining the approximate industry population in each personnel category which will require a questionaire to be sent to the majority of plants in a particular industry. The inclusion of more plants in the data sample will also improve the accuracy but collecting the data is a slow process;

(c) Inclusion of the capability of looking at the effect of a four day week or variations thereof on personnel exposure impact.

(d) Finally, it is proposed that the computer program be stored on disc file at the Washington Computer Center and linked with a data bank so that information and data analyses for any given industry can be made available on an interactive basis with the user located at some remote low speed terminal.

## Section 8
## CONCLUSIONS

Conclusions may be summarized as follows:

1. The computer model which has been developed is a useful tool for estimating personnel noise exposure impacts and equipment contributions to these impacts for individual plants and extrapolating the average results for a randomly selected sample of plants to an entire industry. There are two separate parts to the analysis and results section of the computer program. One produces results in the EPA format (LWP, etc.) and the other produces results in the OSHA formate (DND, etc.). The OSHA part accepts any criteria regarding threshold level, allowable 8-hour level and exchange rate which the user submits. This allows comparison of results obtained using the EPA criterion with any other criterion. The effect of given noise reductions for specified equipment types may also be calculated, either for individual plant results or for the entire industry. This capability is useful for evaluating the effect of any proposed legislation concerning equipment noise levels.

2. The computer model has been used to rank order individual equipment types and general equipment classifications in terms of their effect on the overexposure problem in two industries -- the Sawmill Industry and the Foundry Industry.

3. Personnel categories have also been rank ordered in terms of their importance to the overall noise exposure impact for both the Sawmill and Foundry Industries. The personnel category rank ordering and the equipment rank ordering were calculated using both EPA and OSHA criteria.

4. Results for both personnel exposure impact and equipment noise impact differ depending on whether the EPA criterion

or the OSHA criterion are used in the analysis. In fact the rank ordering of personnel categories in terms of exposure impact and equipment types in terms of their contribution to the exposure impact differes considerably for the two analyses. Reasons for the differences are the different threshold levels (90 dBA for OSHA and 75 dBA for EPA) and the energy exchange in terms of dBA per halving of the exposure time (5 dBA for OSHA and 3 dBA for EPA).

5. The statistical analysis in Section 6 showed that ±20% accuracy for the estimate of the total Level Weighted Population (LWP) is obtained with a sample size of five plants for each industry. The analysis also showed that the LWP and Daily Noise Dose (DND) values extrapolated to the entire industry for each personnel category were estimated with an accuracy of approximately ±50% with the sample size of nine plants for the Sawmill Industry and seven plants for the Foundry Industry. In order to obtain an accuracy of ±20% for these quantities on an industry basis at least 25 plants in each industry would have to be sampled. The computer program uses the variance in the input data to calculate a worst case situation for the LWP and DND values for each category and for the total population when results are extrapolated to the entire industry. The statistical analysis of Section 6 indicates that the worst case values are good estimates of the upper bound for these values.

6. The statistical analysis demonstrated that the accuracy of the Equipment Normalized Priority Index (NPI) values is less than ±50% for the sample size chosen. The NPI values indicate the importance of various equipment types on the exposure of personnel in a given industry. It is shown in Section 6 that at least 30 plants need to be sampled in each industry to obtain an accuracy of ±50% for the NPI value for

each equipment classification and that between 100 and 190 plants need to be sampled for an accuracy of ±20%.

7. The results obtained with the limited sample size used herein are useful in that they indicate which equipment classifications contribute most to personnel exposure in each industry studied (NPI rank ordering) and which personnel categories are most affected by noise overexposure (LWP and DND ordering). The rank ordering may change slightly if more plants are used in the sample, but the changes are not expected to be significant.

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