Plant Sound Survey Specification

Global Common

SD-019

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1. Purpose

The purpose of this document is to provide a uniform corporate procedure to:

- Identify employees for inclusion in the Nexteer Hearing Conservation Program.
- Enable the proper selection of hearing protectors.
- Identify plant areas for investigation of feasible engineering and/or administrative controls.

The plant survey is the first step toward a complete plant Hearing Conservation and Noise Control Program.

2. Scope

This document provides a uniform method for determining work-related sound level exposure for employees of Nexteer Automotive. It establishes instrumentation requirements, uniform survey procedures, and data documentation and reporting practices to be used in the investigation and determination of employee sound level exposure.

3. General

3.1 Overview

The survey procedure documents the long-term, 8-hour, time-weighted average sound level (TWA) relative to JOB FUNCTION. The activities that are associated with a specific Job Function assignment are determined, and sound level and exposure data are measured and evaluated. An employee's NOISE EXPOSURE ASSESSMENT is the 8-hour, time-weighted average sound level (TWA) identified with the Job Function, or Representative Job Function, to which the employee is assigned as defined in Section 6.2, page 12. When an employee's Job Function assignment is changed, the employee's Noise Exposure Assessment changes to the TWA associated with the new Job Function to which the employee is assigned.

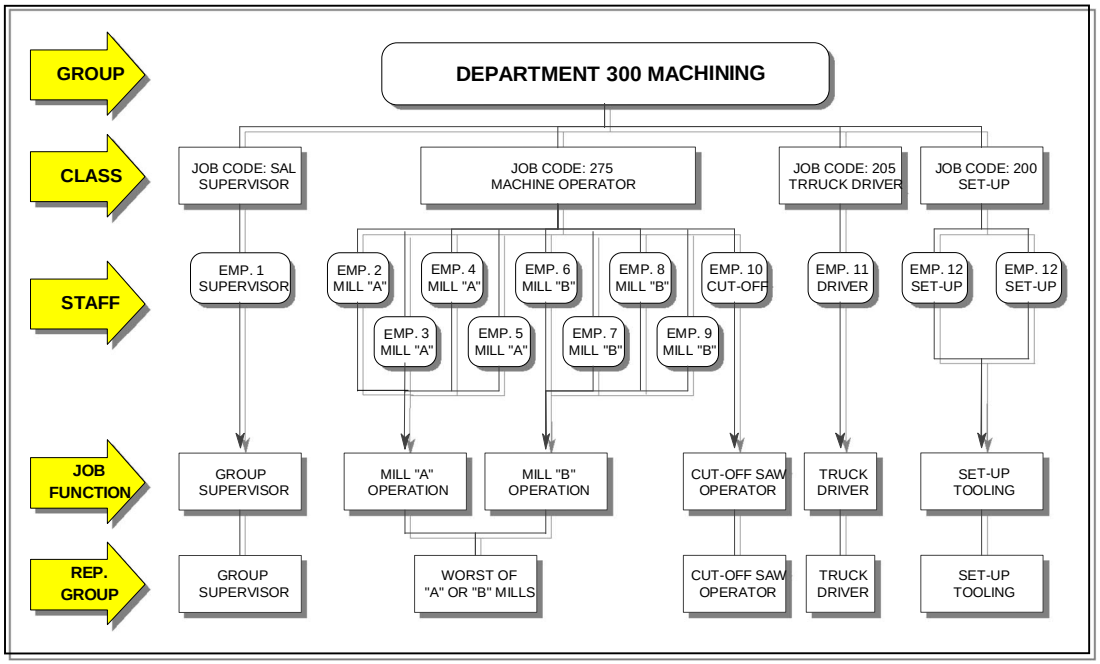

Figure 1: Facility Organizational Structure[1]

Not all exposed employees need to be monitored. The Nexteer Automotive Sound Survey procedure utilizes representative monitoring. Representative monitoring determines a Job Function sound exposure potential for a group of employees who are engaged in a similar kind of work and whose sound exposures are expected to be similar. The Job Function reasonably believed to have the highest sound exposure potential is monitored and the resulting Job Function Sound Exposure TWA is considered representative of the sound exposure potential for the group. When more than one type of work assignment exists within a Job Code group, or if sound exposure can vary significantly for the same work assignment due to physical location, shift, etc. then there will be more than one Job Function within the Job Code group.

4. Technical Requirements

4.1 References

4.1.1 A-weighted Measurements

Sound levels shall be measured in A-weighted decibels (dBA) referenced to 20 micro-Pascal.

4.1.2 Time-Weighted Average

Time-Weighted Average (TWA) sound exposure levels and sound power levels shall be expressed in A-weighted decibels and referenced to an 8-hour steady state equivalent.

4.1.3 Integrating Exchange Rate

The integrating "exchange rate" used for determining the time-weighted average of non-steady state sound levels *shall be 5 dB unless specified otherwise.*

4.1.4 Lower Limit Threshold Cutoff Sound Level

All integrated sound level measurements shall be made with an 80 dB(A) Threshold Cutoff Sound Level restriction.

4.1.5 Criterion Sound Level

All integrated steady state and cyclic sound level measurements shall be made relative to a 90 dB(A) 8-Hour Time-Weighted Average Criterion Sound Level. (TWA_8)

4.2 Measurement Instrumentation

4.2.1 Specifications

All Sound Level measurement instrumentation (Sound Level Meter, Integrating Sound Level Meter, Impact Sound Level Meter, and Dosimeter), including the microphone, used in the collection of sound level data for determining employee occupational sound exposure in accordance with this specification shall:

- Be Type 2 or better. (Except for Ultrasonic Sound Measurements)
- Be Type 1 or better when measuring the presence of ultrasonic "sound" generated by equipment and/or processes.
- Meet the performance requirements of ANSI S1.4 1983 (USA) or IEC 651 1979 and 804-1985 (Canada). [or latest revisions].
- Dosimeters shall also meet or exceed the performance requirements as specified in ANSI S1.25-1991, "SPECIFICATION FOR PERSONAL NOISE DOSIMETERS". [or latest revision]
- Integrating sound level meters shall integrate into the time-weighted average sound level measurement (TWA) all continuous, intermittent, and impulsive sound levels from 80 to 130 decibels.
- Impact Sound Level Meter must be capable of indicating the un-weighted true peak sound pressure level resulting from an impact or impulse generated sound.

4.2.2 Octave Band Filter (Mexico)

The octave band filter used to determine predominant frequency bands must comply with ANSI S1.11-1986 (R 1993), "Octave, Half-Octave, and Third Octave Band Filter Sets."

4.2.3 Acoustical Calibrator

The calibrator used to calibrate the monitoring equipment must meet ANSI S1.40-1984, "Specification for Acoustical Calibrators." (Or latest revision)

4.3 Calibration and Battery Check

4.3.1 Certified Laboratory Calibration

All sound level measuring instruments and calibrators used in conducting the survey procedure shall be calibrated and certified annually by a qualified instrumentation laboratory. ***A copy of the calibration certificate shall be kept on file with each year's Master Sound Survey Report.***

4.3.2 Field Calibration

1. Handheld Meters

Direct-reading sound level meters, integrating sound level meters, and impact-measuring sound level meters shall be field calibrated before and at the end of each day of surveying using the technique recommended by the manufacturer. ***Results of field calibration shall be recorded on the first and last JOB FUNCTION SOUND EXPOSURE PROFILE DATA COLLECTION FORM during each day of surveying.***

2. Employee Mounted Meters

Dosimeters, or other instruments used in the manner of dosimeters, shall be field calibrated before and at the end of each sound exposure evaluation. This calibration shall also include a visual check of the instrument to identify any damage to the instrument that may have occurred while the instrument was attached to the employee. ***Results of field calibration shall be recorded on the JOB FUNCTION SOUND EXPOSURE PROFILE DATA COLLECTION FORM***.

4.3.3 Battery Check

Instrument batteries shall be checked before each field calibration. It is recommended that sound level meter (current reading, integrating, and impact) batteries be checked periodically during survey usage (such as at approximately one-half (1/2) hour intervals). For instruments that do not have an internal battery check function; refer to manufacturer's recommended practice.

NOTE: If either calibration check or battery check indicates unreliable readings, all measurements taken since the last acceptable calibration and/or battery check must be repeated.

5. Sound Survey Procedure

NOTE: Pre-screening using "Center of Bay" monitoring resulting in sound levels < 80dba will not require job function analysis.

The center of Bay Survey may be used to document areas eliminated from a comprehensive survey.

Nexteer Automotive Uniform Plant Sound Survey Procedure is comprised of four (4) primary elements as shown in Table 5.

Survey Procedure Elements
UNIFORM SOUND SURVEY PROCEDURE
• JOB FUNCTION IDENTIFICATION AND SELECTION • DATA COLLECTION • DATA PROCESSING • REPORTING AND RECORDKEEPING

Figure 2: Survey Procedure Elements

The NEXTEER AUTOMOTIVE UNIFORM PLANT SOUND SURVEY PROCEDURE FLOWCHART, shown in Figure 3, outlines the steps involved in performing each of the four primary elements. The NEXTEER AUTOMOTIVE UNIFORM PLANT SOUND SURVEY PROCEDURE LOGIC DIAGRAM is shown in APPENDIX A. The logic diagram shows the process in more detail along with the primary decision points.

For purposes of illustration, a "department structured" plant is used in the following sections.

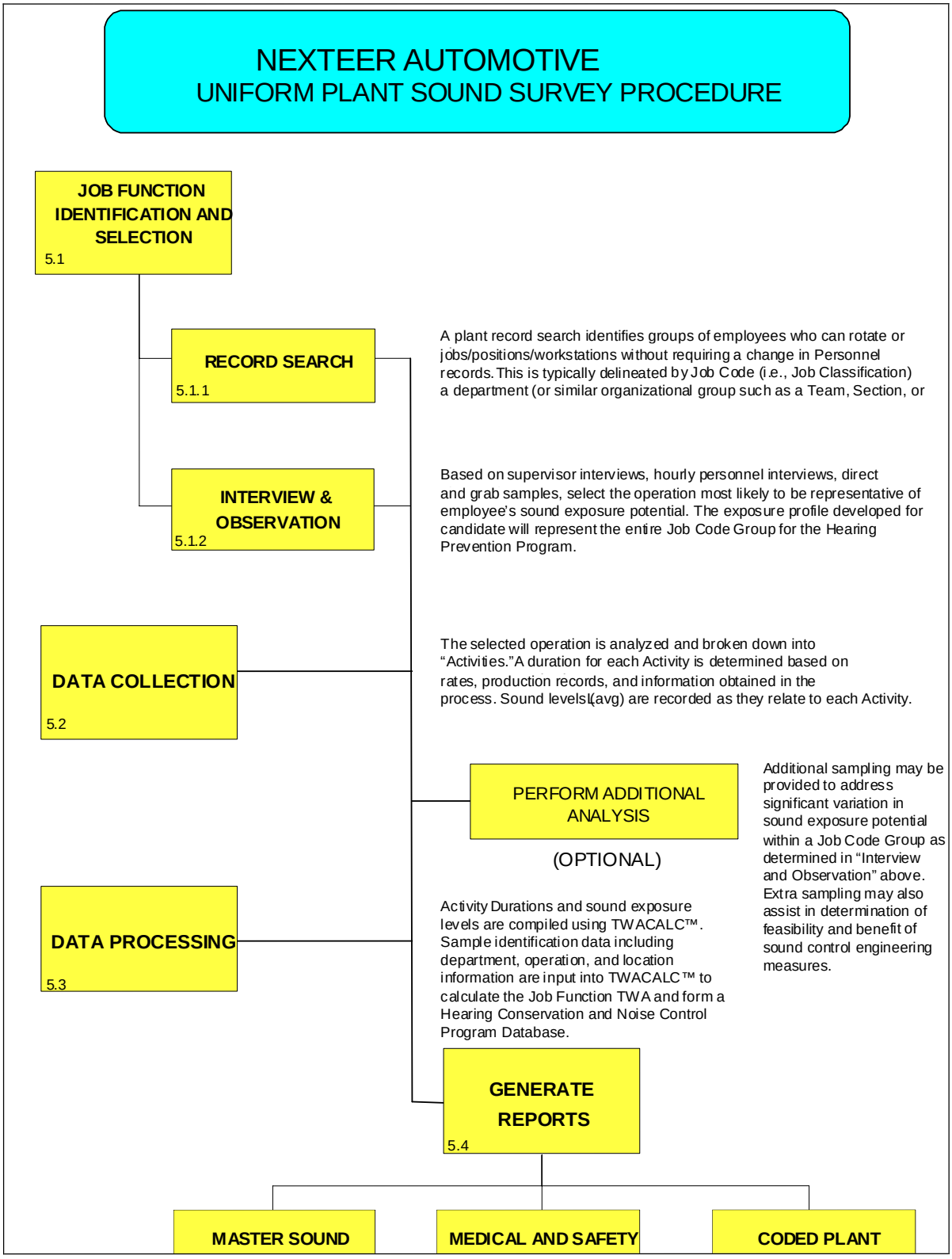

Figure 3: Nexteer Automotive Uniform Sound Survey Procedure Flowchart

5.1 Job Function Identification and Selection

The first element is sample identification and selection. The sample selection procedure involves:

- A search of plant records to identify current organizational structure
- Departmental interview and Surveyor observation

It identifies the various Job Functions (work assignments) performed by employees in each department / Job Code group.

5.1.1 Record Search

1. Initial Preparation

   Obtain the following:

   - Most recent survey results (baseline and any updates) including Job Function descriptions and Job Function Activity studies, organized by department and coded plant layouts showing monitoring results.
   - Current plant layouts, showing all fixed machinery. Layout prints should be in a large enough scale that Job Function Activity measurement positions can be identified on the print.
   - A report showing the current facility organizational structure including a summary of plant departments (or equivalent organizational group), Job Codes, Job Classification, and the number of employees per shift in a given Job Code. This information should be generated from plant employee/payroll database(s) that will account for all hourly and salaried employees.

2. Survey Information Worksheet

   Set up "SURVEY INFORMATION WORKSHEET" based on the current facility organizational structure. (Reference APPENDIX D - FORMS) This will define the minimum number of Job Functions based on at least one (1) Job Function per Job Code in each department. (Reference APPENDIX F - EXAMPLES, Figure 7 - Survey Information Worksheet-Department 200). If the survey is an update of an existing Baseline Survey, then using the previous year's reported Job Functions as a guide, note in the right column of the SURVEY INFORMATION WORKSHEET where known changes, additions, and deletions have occurred. This would also include those plant areas where engineering controls have been implemented since the last survey.

3. Job Function Identification

   For each Job Code in each department that is identified during the record search and listed on the SURVEY INFORMATION WORKSHEET, fill out the "Header" portion of the JOB FUNCTION SOUND EXPOSURE PROFILE DATA COLLECTION FORM (Refer to APPENDIX D - FORMS). This will provide the minimum of one JOB FUNCTION for each Job Code in each department (or equivalent organizational group).

   Differences in work activities within a given Job Code may require more than one Job Function per Job Code. This requirement should be determined during the department interview. (Reference Table 5.1.2 and APPENDIX F - EXAMPLES, for examples of typical organizational structure.)

5.1.2 Departmental Interview and Surveyor Observation

Locate Department supervisor or designated representative.

Confirm organization of the department (Job Code, Job Classification, and number of employees per shift in each Job Code) as recorded on the SURVEY INFORMATION WORKSHEET. If discrepancies in department organization exist between the plant information database and what is determined during the Department Interview, make necessary corrections on the SURVEY INFORMATION WORKSHEET.

NOTE: Discrepancies between recorded head-count and actual department head-count should be resolved in a uniform manner for the whole plant. One method is to adopt the recorded headcount as representative of the plant for a particular day.

Factors Determining The Number Of Job Functions In A Job Code Group

• Work assignment - significantly different tasks performed.
• Work area location with respect to major noise sources.
• Normally occurring variations that may affect sound exposure, such as:
  * processes or tooling changes.
  * operating differences between shifts.
  * different production rates.
• Work assignments where TWA levels may equal or exceed 90 dB or where L(pk) levels may exceed 120 dB.

Figure 4: Factors Determining the Number of Job Functions In A Job Code Group

Determine similarities and differences in work performed in each specific Job Code in the department. Use direct observation and interviews with the department supervisor or designated representative and selected department employees. (Refer to APPENDIX E-INTERVIEW GUIDELINES).

Using this information, define the JOB FUNCTION work assignment actives, comprising a “typical workday” and representing discrete sound exposure conditions. Record these activities on the JOB FUNCTION SOUND EXPOSURE PROFILE DATA COLLECTION FORM.

NOTE: More than one Job Function per Job Code group is required where differences in work assignment, location, work shift, etc. may cause significant differences in sound exposure within a Job Code group. Reference Figure 4.

NOTE: Where a “Team” structure exists:

- If Team members have fixed work assignments (example: don’t rotate to different work assignments within the Team group) a separate Job Function must exist for each work assignment.
- If Team members rotate to different work assignments within the Team group, only one Job Function will exist for the Team group. The differences in work assignments may still require development of separate Sound Exposure Profiles but shall be differentiated using Job Descriptions when completing the JOB FUNCTION SOUND EXPOSURE PROFILE DATA COLLECTION FORM.

5.2 Data Collection

NOTE: Prescreening using center-of-bay monitoring and resulting in sound levels less than 80 dba will not require job function analysis. Data collection for center-of-bay should consist of a minimum of 5 data points in the centerline of each bay.

5.2.1 STEP I - Job Function Selection

This step of the survey procedure selects the Job Functions to be analyzed as the basis for each Job Code Group. Selection is based on a combination of the findings during the interview processes, direct observation on the part of the surveyor, and measurements in selected hearing zone areas greater than 80 dba.

Measurements require the use of a current-reading sound level meter set to or incorporating A-weighting, Slow response, and an instrument capable of measuring the unweighted true peak sound pressure level (Lpk) as defined in Section 4 is required. The microphone of the meter must be located at a position comparable to the employee's hearing zone (as defined in APPENDIX B-TERMINOLOGY) as said employee performs his/her Job Function activities. Measurement of the Job Function activity sound level must encompass at least one complete duty cycle of the activity.

Sound level measurements will be used to determine those Job Functions where:

1. The Job Function TWA Less Than 85 dB(A) Based On Sound Levels Less Than 80 dB(A) During All Activities

   If the maximum sound level that occurs during activities performed for a specific Job Function assignment is less than 80 dB(A), the Job Function shall be considered to result in an exposure less than 85 TWA. The Sound Survey Reports shall indicate said Job Function to have an associated exposure of less than 85 TWA by reporting the Lmax measured sound level.

2. The Job Function TWA Potentially Equal To Or Greater Than 85 dB(A) Based On Sound Levels For Any Activity Equaling Or Exceeding 80 dB(A).

   If the maximum sound level that occurs during activities performed for a specific Job Function assignment is equal to or greater than 80 dB(A), the Job Function shall be considered to have the potential of resulting in an exposure equal to or greater than 85 TWA for 8 hours. A complete Job Function analysis is required.

3. The Impact Peak Sound Pressure Level >140 dB

   If an impact/impulse unweighted peak sound pressure level exceeding 140 dB occurs during activities performed for a specific Job Function assignment, a complete Job Function analysis is required.

4. The Sound Level Equal To Or Greater Than 90 dB(A) (Ontario, Canada)

   If a maximum sound level during an activity associated with a specific Job Function assignment is equal to or greater than 90 dB(A), feasible measures shall be taken to reduce the sound level below 90 dB(A).

5. The Impact / Impulse Peak Sound Pressure Levels Equal To Or Greater Than 120 dB (QUEBEC, CANADA)

   If the maximum impact/impulse unweighted peak sound pressure level equals or exceeds 120 dB the Fractional-sum of the impact noises and the Sum of Acoustic Energy (SAE) of the impact noises must be determined. (See APPENDIX F).

   For the Job Functions identified in 5.1 Job Function Identification and Selection:

   a. Determine the Job Function activities that are reasonably believed to result in the highest sound level or highest impact/impulse sound pressure level.

   b. Measure the maximum Sound level (Lmax) and the impact-impulse Peak Sound Pressure Level (Lpk) in the hearing zone area occupied by an employee while performing the Job Function activities identified in 5.2.1.1.

      - Only the activity with the highest sound level condition needs to be measured and evaluated. If the activity causing the highest sound level condition cannot be identified through interview & observation, then the maximum sound level for each Job Function activity must be determined.

- Sound in the area must be indicative of "normal" operating conditions (example: adjacent high sound producing operations are not shut down).
- High sound producing Job Function activities that occur infrequently (example: a "parts dump"), or only at certain times during a shift (i.e. "end-of-shift clean up) must be considered in the Lmax and Lpk measurements.
- Maximum transient sounds, such as a truck passing, should not be measured unless the frequency of occurrence and/or sound level magnitude is sufficient to constitute a significant portion of allowed daily exposure or if they exceed Lpk = 120 dB.

c. For the activity (or for each of the activities) addressed in section 5.2.1.2, record the maximum (Lmax), the minimum (Lmin) sound levels, the peak sound pressure level (Lpk), the microphone position, and measurement location (machine/operation/work-station number or name) on the JOB FUNCTION SOUND EXPOSURE PROFILE DATA COLLECTION FORM. Bay location (column & row) may be used to supplement machine/operation/workstation identification.

   Use the sample description field to differentiate between samples representing different conditions for the same activity. This is useful when evaluating how sound exposure varies when conditions are changed within an activity. For example: an ACTIVITY "LOAD PARTS TO FIXTURE" may have two different sample descriptions. 1 "Load to metal locator pads," or 2-"Load to rubber locator pads".

5.2.2 STEP II - Job Function Analysis

This step of the survey procedure requires a complete Job Function Analysis of the Job Functions identified in Step I as having Lmax ≥ 80 dB(A) or Lpk > 140 dB (120 or greater in Quebec).

Measurements require the use of an integrating sound level meter, or a dosimeter as defined in Section 4. In the presence of impact/impulse sound, measurements require the use of an unweighted peak reading sound level meter as defined in Section 4. The microphone of the meter or dosimeter must be located at a position comparable to the employee's hearing zone as said employee performs his/her Job Function Activities. If the dosimeter is mounted on the employee's person, refer to manufacturer's recommended location for measuring hearing zone sound levels and microphone orientation.

Sound level measurements will be used to determine those Job Functions where:

- The 8-hour, time-weighted average sound level (TWA) is less than 85 dB(A).
- The 8-hour, time-weighted average sound level (TWA) is equal to or greater than 85 dB(A).
- Impact/impulse unweighted peak sound pressure levels exceed 140 dB.
- The "Fractional-sum" of the impact noises exceeds unity. (Quebec, Canada)
- The "Sum of Acoustic Energy" (SAE) of the impact noises exceeds 160. (Quebec, Canada)

1. For each Job Function identified in 5.2.1 with an activity Lmax equal to or greater than 80 dB(A), measure and record the "short duration" period of observation and the average sound level (Lavg) for each of the Job Function's activities listed on the JOB FUNCTION SOUND EXPOSURE PROFILE DATA COLLECTION FORM[2].

   Short duration measurements to determine the Lavg for each activity must encompass a sufficient number of activity full duty cycles to obtain a steady meter reading within 0.5 dB. The minimum sufficient period of observation shall be three (3) full duty cycles of the activity.

   NOTE: Separate Activities shall exist for tasks:

   - Performed at different work locations
   - Performed at the same work location but differing in sound level by 5 dB or more
   - Representing different operating modes

2. Determine and record the time (in hours) that each activity (Activity Duration) comprises of the "Average Daily Work Shift" on the JOB FUNCTION SOUND EXPOSURE PROFILE DATA COLLECTION FORM.

3. (Quebec, Canada) For each Job Function identified in 5.2.1 that has an L(pk) equal to or greater than 120 dB measure and record the L(pk) values. If the exposure is comprised of different events that cause different impact peak levels,

measure the L(pk) value due to each different event. The number of impacts per workday occurring for each different event must also be determined and recorded as a note to the sample.

4. Impact Peak Sound Pressure Levels

   If impact/impulse sound is present during any of the activities associated with a specific Job Function assignment, measure and record the unweighted true peak of the impact/impulse sound on the JOB FUNCTION SOUND EXPOSURE PROFILE DATA COLLECTION FORM.

5.3 Data Processing

5.3.1 Overview

Information and data collected in Steps I and II of the survey procedure must be converted into a Job Function Sound Exposure Profile. This profile consists of the information recorded on the JOB FUNCTION SOUND EXPOSURE PROFILE DATA COLLECTION FORM and the determination of the Job Function TWA.

5.3.2 Computational Procedure

1. The Job Function TWA levels shall be determined by combining the fractional exposure contributions from each of the separate activities[3]. This procedure shall be based on the computational methods using the formula:

$$\%\,Dose = \left(\frac{C_1}{T_1} + \frac{C_2}{T_2} + \ldots + \frac{C_n}{T_n} \right) * 100\%$$

and

$$TWA = 90 + \frac{R}{0.3} * \log\left(\frac{\%D}{100}\right) dB(A)$$

C = Total time of exposure at a specific sound level

T = The reference duration for that level as given by Table G-16a or its 3 dB exchange rate equivalent.

%D = Percent dose

R = Exchange rate (5 or 3).

APPENDIX C - FORMULAS and APPENDIX F - EXAMPLES illustrate methods for this computational process.

2. (Quebec, Canada) Determine the “Fractional Sum” and the “Sum of Acoustic Energy” (SAE) of the impact noises per APPENDIX F - Canadian Procedures Sections F.3 to F.4.

5.3.3 Database Software

NOTE: Other data base programs approved by Global Industrial Hygienist may be used.

1. NEXTEER TWACALC™ or Equivalent

   The NEXTEER TWACALC™ Version 2.0 (or most recent) computer program shall be used to establish a database of the information recorded on the JOB FUNCTION SOUND EXPOSURE PROFILE DATA COLLECTION FORM, determine the Job Function TWA, and print the following required reports.

   Required reports are:

   - Master Sound Survey Report

5.3.4 Update of Hearing Conservation Database

Each plant must maintain on file an unaltered plant sound survey database that documents the plant's sound exposure environment at the time of the annual survey or survey update.

When conducting an update survey, a copy of the previous year's database shall be made, and the copy edited to incorporate the new monitoring data. This will result in a new database reflecting current plant status. This will involve combining data for new or revised Job Functions with those that remained unchanged from previous surveys. Any data related to Job Functions that have been eliminated or otherwise superseded by information collected during the most recent survey shall be eliminated so that the new database reflects only the current year's Job Functions.

5.4 Recording and Reporting Data

5.4.1 Overview

The final step of the survey procedure is to condense the information obtained during the survey into a Master Sound Survey and a Coded Plant Layout that may be used by the plant, division, and corporate staff groups requiring information about employee sound exposure potential.

5.4.2 Reports

1. Master Sound Survey Report

A Master Sound Survey Report shall be developed and contain:

Introduction and Purpose:

- A description of project methodology, including a precise statement that the sampling strategy complies with the NEXTEER AUTOMOTIVE Survey Procedure organizational based representative monitoring.

Executive Summary:

An executive summary for the plant consisting of:

- A table showing number of employees required to be in the plant Hearing Conservation Program in each action level category (<85, 85 and over dB(A) 8-hour TWA)by shift in tabular form.
- A graphic (pie chart, bar chart, stacked bar chart, etc.) showing the total percentage (%) of plant employees in each action level category (<85, 85 and over dB(A) 8-hour TWA)
- A Trend Chart showing the percent (%) of employees in each action level category for current year and for the four (4) previous years.

Color Coded Plant Layouts:

- One (1) Color Coded Plant Layout for the Primary Production shift length and conditions per requirements specified in Section 5.4.2.3
- One (1) copy of each additional Color-Coded Plant Layout as required by the plant to depict non-Primary Production shift conditions that result in a change in employee Job Function Exposure Category (Example: TWA8 <85 dB(A), 85 and over dB(A).

Summary of Survey Results by Department:

- A table of survey results by department showing the total number of employees in the department, and the number of employees in each action level category (<85, 85 and over dB(A) 8-hour TWA) per shift for the Primary Production shift length and conditions. Special shift lengths and/or conditions shall be noted separately. (See Figure 13)

Survey Procedures:

- Summarizes the methodology and instrumentation used in conducting the specific survey.

Calibration Records:

- A copy of the calibration certificates for all sound measurement instruments used to conduct the survey.

Special Reports:

- Quebec, Canada -- A list of Job Functions for which the impact noise "Fractional Sum" exceeds unity, or the "Sum of Acoustic Energy" (SAE) exceeds 160. (Quebec, Canada)
- Ontario, Canada - A list of Job Functions for which the measured sound level exceeds 90 dB(A).
- The number of man-hours that were required to complete the survey (submitted as a supplement to the survey report).

2. Medical and Safety Report

   NOTE: Replaced with Master Sound Survey Report

3. Color Coded Plant Layouts

   Coded plant layouts are to be generated for purposes of identifying hearing protection boundaries and satisfying the posting requirements for employee notification of sound survey results

   - A minimum of one (1) Color-Coded Plant Layout **SHALL** be posted in each Department. A "You Are Here" sticker will be placed on the Color-Coded Plant Layout identifying the location of the posting in the Department.
   - Rules for applying monitoring results to establishing program boundaries must be consistent and consider employee sound exposure potential as indicated by Job Function TWA, not workstation sound levels.
   - Boundaries must recognize the effects of employee mobility between Job Functions within Job Code Groups, and effective administration of any Hearing Conservation Program requirements.

   The coding scheme shall follow the color codes provided herein and be easily discerned with a legend defining the coding scheme as follows:

RED	Areas/departments where Job Function sound exposure profiles indicate potential for employee sound exposure to exceed 90 dB(A) TWA_8.
WHITE	Areas/departments where Job Function sound exposure profiles indicate potential for employee sound exposure to be less than 85 dB(A) TWA_8.
CROSSHATCH	Areas/departments where Job Function sound exposure profiles exceed 90 dB(A) TWA_8 only when specific equipment is used, and that use is intermittent or variable.
GRAY	Areas/departments under construction or for other reasons not operative.

   Layouts may show additional information such as:

   - Location of infrequently used equipment, which may provide sound exposure, levels above the color-coded area in which they are located.

4. Additional Reports

   Any additional reports requested by the plant will be submitted as a document separate from the required "Master Sound Survey Report".

5.4.3 Record Retention

The Master Sound Survey Report shall be retained on file at each plant consistent with the practice for retaining medical records.

5.4.4 Data Diskettes

Each baseline and update survey shall be recorded in the NEXTEER AUTOMOTIVE database format on diskette and maintained permanently along with a paper copy of the required reports. Each plant is responsible for maintaining archival data disks of each baseline and update survey.

5.4.5 NEXTEER AUTOMOTIVE Sound Status Report

The NEXTEER AUTOMOTIVE SOUND STATUS REPORT is to be completed and submitted to the NEXTEER AUTOMOTIVE Global Industrial Hygienist on or before April 1 of each year. This report reflects the current status of the plant in terms of employee exposures, and the plant's hearing conservation and noise control program's progress and expenditures in the past year (calendar year).

Copies of the NEXTEER AUTOMOTIVE SOUND STATUS REPORT may be required by respective Divisional Staff.

5.4.6 Corporate Partner

Outside contractors are required to submit the "Master Sound Survey Report" within 30 working days following the completion of plant data collection unless otherwise agreed upon between contractor and the plant. Reports must follow the requirements set forth in Section 5.4.2. The plant/division requesting the survey will specify the number of copies of each report required if more than the minimum number specified in Section 5.4.2 (See also, SL3.0-1999 Section 1.8) are required.

If employee assignment is requested by the plant:

- The contractor shall provide for security and confidentiality of such information.
- The contractor shall assign employee sound exposure assessments in accordance with the NEXTEER AUTOMOTIVE requirements in Section 6.2.
- The contractor is responsible for the accuracy of assignment of employee sound exposure levels for the time period in which the survey data were collected.

6. Employee Sound Exposure Assignments

6.1 Survey Environment

Plants are to be surveyed based on the current work environment conditions and practices.

6.2 Assignment of Employee 'Noise Exposure Assessment' and Number of Employees Working 85 and Over TWA_8 Based ON Job Function Assignment

6.2.1 Employees Regularly Exposed

Employees assigned to, or regularly rotated into, a Job function that has an associated 8-hour time-weighted average sound level exposure (TWA_8) 85 and over dB(A):

1. This TWA8 shall be recorded on the employee's audiogram as the " Noise Exposure Assessment."
2. The employee shall be included in the headcount with a TWA8 85 and over dB(A).
3. The employee shall be included in the plant Hearing Conservation Program.

6.2.2 Employees Infrequently Exposed

Employees, whose regular Job assignment has a TWA8 <85 dB(A), but infrequently works a Job Function with associated TWA8 85 and over dB(A) due to an unusual circumstance - such as absenteeism:

1. The TWA8 associated with the employee's regular Job Function shall be recorded on the employee's annual audiogram as the employee's "Noise Exposure Assessment."
2. The employee SHALL NOT be in the headcount of employees with TWA8 85 and over dB(A).
3. The employee SHALL be included in the plant Hearing Conservation Program.

NOTE: Section 6.2.1 or 6.2.2 requirements apply when an employee's regular Job Function TWA8 exposure is increased due to overtime work assignment. (Ref. TWA8 vs. Shift Length Table)

6.3 Obtaining Employee Names & Linking Names To Job Function Exposure

6.3.1 VIP and PRISM Databases

Employee names can be obtained from the plant VIP (hourly) and PRISM (salaried) **or SAP** databases. These systems will list employees by Shift, Department, Job Code and Job Classification.

NOTE: Listing(s) from the VIP, PRISM or SAP database(s) are **CONFIDENTIAL**! They are to be used only in the scope of this program.

1. READ the PRISM, VIP or SAP data bases to obtain a listing of employees by Shift, Department, Job Code, and Job Classification. This READ will be a total plant read-out unless the Employee Name Query is restricted for those Shifts, Departments & Job Codes (Boundary Conditions) for which the Sound Survey results indicate Job Functions with associated TWA8 exposures equal to or greater than 85 dB(A).

   NOTE: PRISM, VIP or SAP identification of employees only goes down to the Job Code level.

2. In a given Department if the Sound Survey results shows that only one (1) Job Function is associated with a given Job Code, then all employees in the department, identified with said Job Code, shall be assigned the Job Function Sound Exposure as their Noise Exposure Assessment.
3. In a given Department if the Sound Survey results show two (2) or more dissimilar Job Functions for a given Job Code, further definition of individual employees is required before assignment of the employee's Noise Exposure Assessment. It will be necessary to link the employee's name assignments associated with the dissimilar Job Functions at the plant production floor level with the Department/Area Supervisor.

   NOTE: Reference "Employee Sound Exposure Assignment from Nexteer Automotive Sound Survey" flow map on Figure 5.

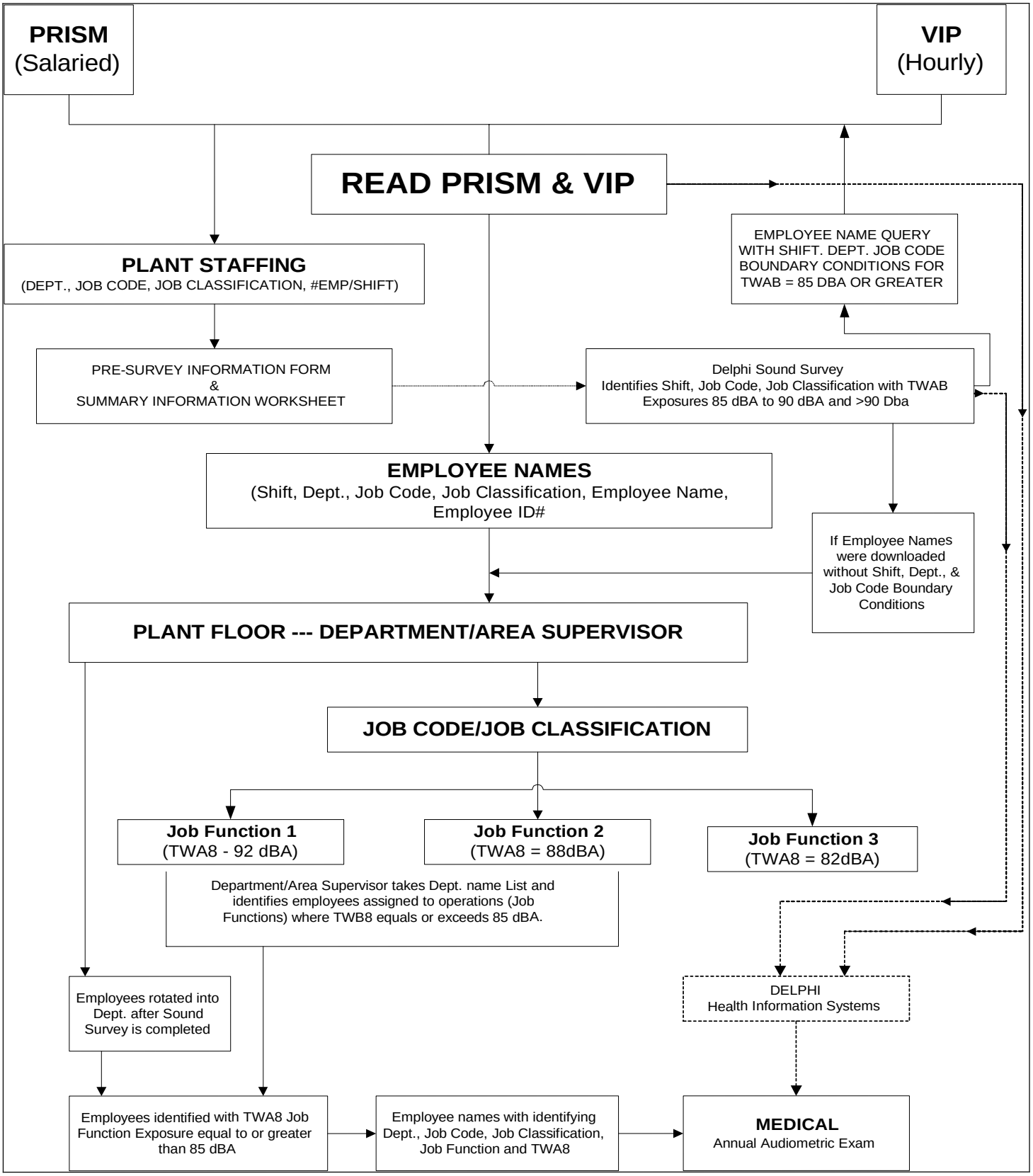

Figure 5: Employee Sound Exposure Assignment from NEXTEER AUTOMOTIVE Sound Survey

Annex List

A. Sound Survey Logic Diagram

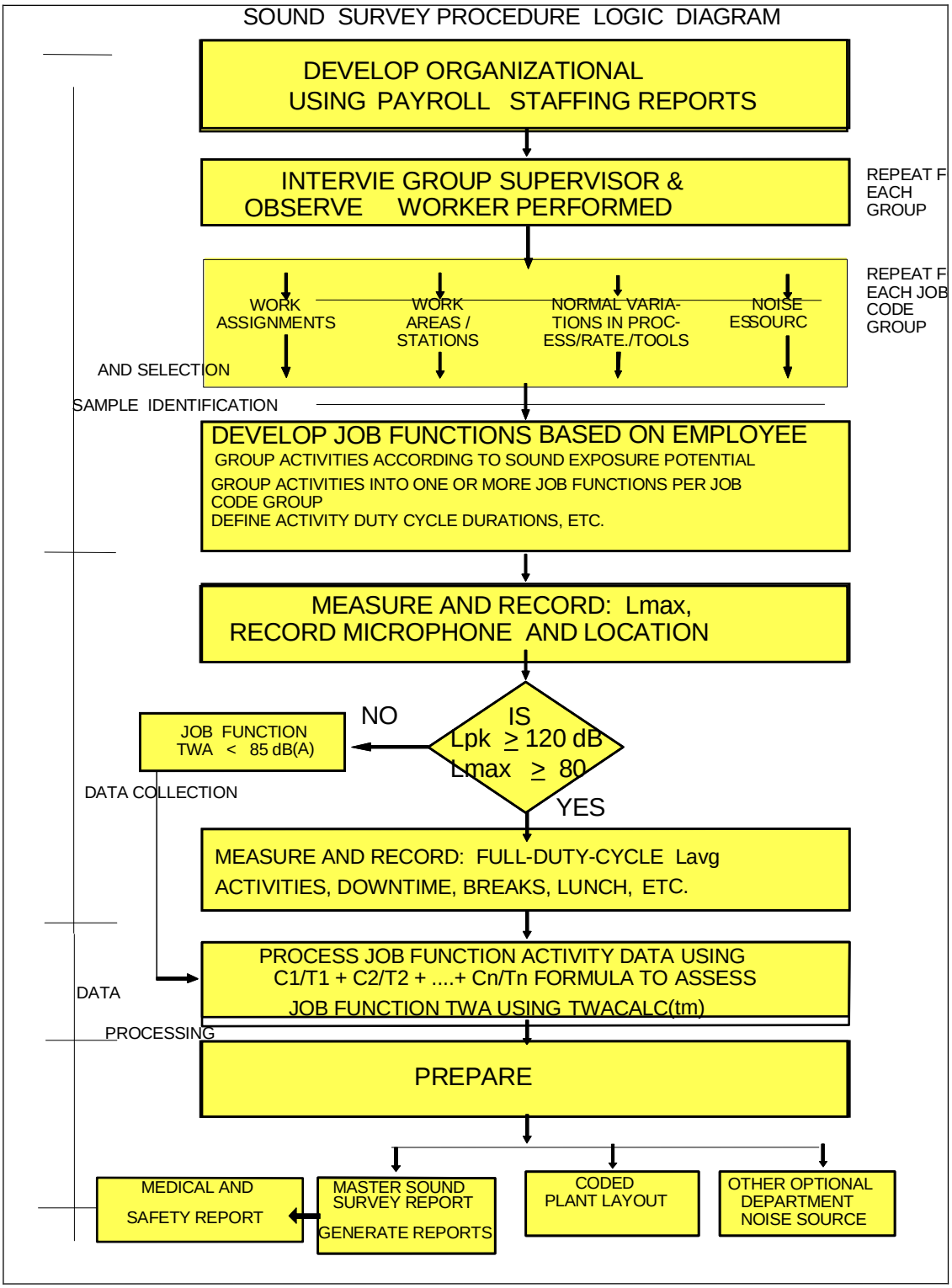

Figure 6: Uniform Sound Survey Procedure Logic Diagram

B. Terminology

Activity: A reasonable sub-element of an employee's workday. Each activity is comprised of a set of fundamental tasks that can be recognized and have specific beginning and ending points. For the purpose of developing Job Function sound exposure profiles activities should be developed that represent different sound exposure conditions experienced by an employee during the performance of a typical workday assignment.

Different sound exposure conditions exist when:

- tasks are performed at different work locations,
- tasks are performed at the same location but differ in sound level by 5 dB or more, or
- different operating modes exist, such as, load/unload, parts dump, rough cut/finish cut, weld/index, etc.

Activity duration: The duration of an Activity Duty Cycle multiplied by the number of times the activity occurs per workday.

Activity duty cycle: The length of time required for all of the tasks comprising an activity to occur at least once and in proportion to their occurrence relative to other tasks associated with the Activity.

Average daily work shift: If an employee frequently works longer than 8 hours, however the longer work shift is not a regularly scheduled occurrence, the average hours worked per day, based on a week, month, etc. time period (holidays and vacation excluded), may be used to determine the Average Daily Work Shift. The TWA for the Average Daily Work Shift must be converted to an equivalent 8-hour TWA to evaluate Job Function Exposure.

Average sound level (L_{avg}): The time-weighted average sound level derived from an integrating sound level meter set to use either a 5 or 3 dB doubling rate. Denoted by L_{avg}.

Center of bay: A screening survey that measures 5 data points per bay and where 5 data points are less than 80 dba or less the area within the bay is not required to be included in the job function analysis.

Criterion duration: The duration in hours used as a basis for measurement or for the calculation of sound exposure. Most common is an 8-hour workday criterion used in the USA, Canada and Mexico.

NOTE: The use of different criterion duration, e.g., a 40-hour workweek would be determined by applicable legislation.

Criterion sound level: That constant sound level which, if it continues for the criterion duration, will provide 100% of an employee's allowable sound exposure. (Under current governmental regulations the Criterion Level for exposure is an eight (8) hour Time Weighted Average Sound Level of 90 dB(A), or equivalently, a noise dose of 100%).

Employee mobility: Flexibility in assigning any given employee to a given Job Function within the employee's Job Code and Department or other organizational group.

Employee noise exposure assessment: An employee's Noise Exposure Assessment is the 8-hour, time-weighted average (TWA) sound level identified with the Job Function to which the employee is assigned.

Group: Employees who work in similar acoustical environments and are expected to have similar sound exposure.

Hearing conservation program: An effective Hearing Conservation Program provides a safe and healthy workplace sound environment. Requires Hearing Protection available, Annual Audiograms, and Annual Employee Training for employees with an 8-hour Time Weighted Sound Level Exposure equal to or exceeding the Action Level. (Hearing protection must be made available to all employees and worn by those employees with a Standard Threshold Shift.) Refer to the "NEXTEER AUTOMOTIVE PROGRAM FOR OCCUPATIONAL HEARING CONSERVATION AND NOISE CONTROL," NEXTEER AUTOMOTIVE Specification SL3.0-1999 (or most recent revision).

Hearing Zone: A location at a specific workstation where the measured sound levels are indicative of the exposure received by an employee occupying said workstation during performance of the assigned Job Function. For workstation exposures that involve a dominant source, care must be taken that the "line-of-sight" between the measuring instrument microphone and the sound source is not obstructed by the employee's body or other shielding objects. For measurements very close to a sound source the microphone location and orientation shall be precisely stated in the survey report. The preferred microphone location shall be the position of the head of the worker while performing the activity under consideration without the person present. When the worker has to be present, the microphone should be located, where practicable, approximately 0.1 meter (4 inches) from the entrance of the external canal of the ear receiving the higher value A-weighted sound level.

Impact unweighted peak sound pressure levels: An unweighted peak sound pressure level measurement must be used to determine compliance when impact/impulse sound is present at an employee work location(s). This requires an instrument with unweighted peak measuring capabilities. (Peak measurement is NOT a maximum reading from a meter set on "Fast" response, or a selected L(max) reading.)

Instrumentation:

- Current Reading Sound Level Meter

A Sound Level Meter (Analog Or Digital) That Indicates The Presently Existing Sound Level At The Measurement Location. For Purposes Of The Nexteer Automotive Survey, The Sound Level Meter, Including Microphone, Shall Meet Or Exceed The Performance Requirements For Type 2 Sound Level Meters As Specified In Ansi S1.4-1983 "Specification For Sound Level Meters" Incorporate A-Weighting, Slow Response.

- Impact / Impulse Sound Level Meter

A sound level meter (analog or digital) that indicates the unweighted true peak sound pressure level resulting from an impact or impulse generated sound. For purposes of the NEXTEER AUTOMOTIVE Survey, the impact sound level meter, including microphone, must have unweighted true peak measuring capability as specified in ANSI S1.4-1983 or IEC Publications 651-1979 and 804-1985 (Canada) (latest revision).

- Dosimeter

A dosimeter indicates the amount of exposure that has taken place during the time period that the dosimeter has operated. Instrument display consists of the amount of accumulated exposure expressed in % (such as 75%) or as a decimal equivalent of % (such as 0.75 or 750). 100% (1.0 or 1000) represents the criterion amount of exposure that has been established as the maximum allowable exposure for a given workday. The criterion level for exposure is an 8-hour, time-weighted average sound level of 90 dB(A) or equivalently a noise dose of 100% (1.0).

For purposes of the NEXTEER AUTOMOTIVE Survey, the dosimeter, including microphone, shall meet or exceed the performance requirements as specified in ANSI S1.4-1983 and S1.25-1978 "SPECIFICATION FOR PERSONAL NOISE DOSIMETERS" or IEC Publication 651-1979 and 804-1985 "INTEGRATING - AVERAGING SOUND LEVEL METERS" (Canada) (latest revisions). The dosimeter shall incorporate A-weighting, SLOW response, and integrate into the sound exposure measurement all continuous, intermittent and impulsive sound levels from 80 to 130 decibels utilizing the sound level/exposure time provisions of 5 dB exchange rate.

- Integrating Sound Level Meter

A sound level meter that indicates the time-average sound level that is equivalent to the actual time-varying sound level. Some integrating sound level meters will continually update the average sound level indicated as more time-varying sound level data is measured and "processed." Other integrating sound level meters will indicate the average sound level after a selected integrating time period has elapsed.

When an integrating sound level meter is used to determine exposure, it must be understood that the time-weighted average sound level (TWA) indicated by the meter represents a "rate of exposure" and not an "amount of exposure." To equate the TWA obtained from the meter to an amount of exposure, a time period such as 8 hours must also be considered. For purposes of the NEXTEER AUTOMOTIVE Survey, the integrating sound level meter, including microphone, must meet or exceed the performance requirements for Type 2 sound level meters as specified in ANSI S1.4-1983 "SPECIFICATION FOR SOUND LEVEL METERS" or IEC Publication 651-1979 and

804-1985 (Canada) (latest revision). The integrating sound level meter shall be set to or incorporate A-weighting, SLOW response, and integrate into the time-weighted average sound level measurement (TWA) all continuous, intermittent and impulsive sound levels from 80 to 130 decibels utilizing the sound level/exposure time provisions of 5 dB exchange rate.

- Octave Band Filter (Quebec, Canada)

The octave band filter used to determine predominant frequency bands must comply with ANSI S1.11-1966 (R1976), "Octave, Half-Octave, and Third Octave Band Filter Sets."

Job activity: A list of the actual activities carried out in the course of an average normal day by an employee in the performance of his/her Job Function. This listing also indicates the average time devoted to a specific activity each day. A simple breakdown is shown in the following example:

Activity 1	Machine Down—Setup	0.60 hours
Activity 2	Machine Up—Loading parts	1.75 hours
Activity 3	Machine Up—Unload parts	4.25 hours
Activity 4	Tool Crib—Visit	0.40 hours
Activity 5	Breaks	0.50 hours
Activity 6	Lunch	0.50 hours

Job classification: A general classification related to skills and as used by Employee Relations/Payroll, etc. (Mechanic, Electrician, Machine Repair, Machine Operator, Quality Operator, Team member, etc.).

Job code: A number or alphanumeric designation (e.g. NEXTEER AUTOMOTIVE codes) used to identify each Job Classification.

Job code group: That group of employees with the same Job Code who work in a department or equivalent organizational group who can work any of the jobs that are expected to be performed by that department.

Job description: Describes the job conditions used as the representative sample for the associated Job Function sample. It is the "plant floor" description of the work performed. For example: a paint booth painter's Job Description might be: Color Booth 2, station 4; or a press operator's Job Description might be: Tend blankers #23, #26, and #32, plus set-up work.

Job function: A more specific job classification title that relates to a set of Job Activities (work tasks) routinely performed by an employee with a certain Job Classification. It is used to distinguish between different types of jobs with different sound exposure profiles within the same job classification (e.g. paint booth painter, paint booth cleaner, press operator-blanker, press operator-transfer, etc.). A completely developed Job Function is a combination of the title and the list of activities and associated sound exposure information necessary to fully describe the sound exposure profile for a typical full shift including non-productive periods. It includes a detailed description of the work performed routinely by an employee. Day-to-day or week-to-week variations that habitually occur would be included in the analysis of the Job Function.

Job function TWA: The 8-hour, time-weighted average sound level (TWA) indicative of the sound exposure that is incurred by an employee during the routine performance of the Job Function during a NORMAL work day, without regard to any attenuation provided by the use of personal protective equipment.

Maximum sound level ($L_{(MAX)}$): The maximum A-weighted slow response sound level measured during a given measurement duration.

Measurement Duration: The time required for a single measurement to be performed to represent an employee's sound exposure during a single activity or over a shift. The measurement duration shall be sufficiently long for the resulting sound exposure level to be representative of the activities performed by the employee (i.e. all significant variations of sound levels during activities at the working place are covered). The duration shall be either three full duty cycle of the workday's activities, or subdivided into part-time intervals within which the exposure to sound is of the same type, (Example: corresponding to the different activities at the working place or in its environment). Measurements must be taken over three or more repetitions of the duty cycle, as required to obtain a steady meter reading within 0.5 dB. See also "Sufficient Period of Observation".

Noise reduction rating (NRR): A hearing protection rating method developed by the US Environmental Protection Agency (EPA). By EPA regulation the NRR must be shown on the hearing protector package. Various methods are presented in the OSHA standard for using the NRR to assess adequacy of the attenuation of a given protector for an employee's noise environment.

Normal workday: The activities and tasks that an employee might be expected to perform on any given day, which is a composite average of the employee's total Job Function—including daily, weekly, or monthly variations that occur, whether scheduled or unscheduled (e.g. habitual).

Peak sound pressure level (L_{pk}): The logarithmic ratio of the peak sound pressure to a reference sound pressure of 20 micro pascals. L_{pk} is obtained by use of a sound level meter having unweighted true peak measuring capability as required in section of this specification.

Sufficient period of observation: The time spent over which a measurement is conducted that is sufficiently long to assure that all sounds that do occur during the performance of the Activity are included in the sample in proper proportion to the other sounds that also occur during the Activity. The minimum sufficient period of observation is one complete Activity Duty Cycle for the sound events that occur during the Activity. However, the measurement duration should include several complete Activity Duty Cycles to account for the expected variability in sound events that can and usually do occur between one duty cycle and the next. The fewer complete Activity Duty Cycles included in the measurement duration the lower the reliability of the measurement results. As a general rule three or more full Activity Duty Cycles should be included in each measurement duration if the sound events are reasonably repeatable. If the sound events are not uniform (such as, hammering, grinding, manually operated air blow-offs, etc.) then more Activity Duty Cycles should be included in the measurement duration.

Representative monitoring: May be used to determine the Noise Exposure Assessment for a group of employees within a department, who are engaged in similar kinds of Job Function activities and whose sound exposures are expected to be similar. The Job Function which is reasonably believed to have the highest sound exposure is monitored and the resulting Job Function Exposure is assigned as the Noise Exposure Assessment for each employee in the group.

Representative monitoring can be used for similar work occurring on 1st, 2nd and 3rd shifts, and for similar work occurring within a given shift.

Sound level: The current sound level as read from an approved sound level meter (analog or digital) set to or incorporating "A" weighting, SLOW response.

In most industrial environments, the sound level reading will continually vary. If variations in the sound level reading are within approximately ±2 dB (ignoring larger transient excursions), an average sound level reading may be estimated by taking the mean level reading around which the measurement appears to vary most of the time.

Standard threshold shift: A change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear. [Allowance may be made for aging (presbycusis) to a change in hearing level.]

Time-weighted average sound level (TWA): The average sound level for a criterion duration based on measured sound levels from 80 dB(A) to L(upper limit) dB(A) (Continuous, intermittent and impulsive) utilizing the sound level/exposure time provision of either 3 or 5 dB exchange rate as specified in applicable Occupational Noise Exposure Standard.

Where an employee workday is regularly or frequently longer than 8 hours, the time-weighted average sound level must be converted to an 8-hour equivalent [TWA].

L(upper limit) is defined by applicable U.S. or Canadian Standard. Currently L(upper limit) equals 130 dB(A) (U.S.), 140 dB(A) (Ontario, Canada), and is undefined in Quebec, Canada.

Work activities: Activities shall be representative of normal work patterns. The measurements shall be carried out in such a way as to disturb these activities as little as possible.

Workstation(s): Usually associated with, but not necessarily limited to, a location relative to a machine or process that is occupied by an employee during the performance of the Job Function assignment. In many cases there may be more than one workstation associated with a specific Job Function and the resulting exposure.

C. Formulas

Computational Methods Used to Process Sound Exposure Data

This appendix presents the formulas and relationships used by the NEXTEER CORPORATION Sound Survey Procedure to compute the Job Function's TWA, Dose, Minimum NRR, Predominant Frequency Bands, Fractional Sum, and Sum of Acoustic Energy (SAE).

C.1 Computing Job Function Sound Exposure Profile TWA Values

Table C.1 shows the Job Function activity information in row/column format. The data describing each activity are arranged by column. The information required to perform these calculations may be collected using the JOB FUNCTION DATA COLLECTION FORM provided in APPENDIX D-FORMS. This procedure presumes that the activity Lavg values are collected with an instrument that can directly read out the L_{avg} over the sampling period-of-observation. It is also assumed that the instrument accounts for the required exchange rate (5 dB for OSHA monitoring) and any cut-off thresholds (80 dB for OSHA monitoring) in determining L_{avg}. Conversion formulas are presented to assist in preparing data collected from dosimeters into the format required for this procedure.

EXCHANGE RATE = 3 OR 5					
ACT.#	SAMPLE	ACTIVITY	ACTIVITY DURATION (HRS.)	L_{avg} DURING ACTIVITY	ACTIVITY DOSE (%)
1	SAM_1	ACT_1	C_1	L_1	D_1
2	SAM_2	ACT_2	C_2	L_2	D_2
3	SAM_3	ACT_3	C_3	L_3	D_3
4	SAM_4	ACT_4	C_4	L_4	D_4
5	SAM_5	ACT_5	C_5	L_5	D_5
6	SAM_6	ACT_6	C_6	L_6	D_6
7	SAM_7	ACT_7	C_7	L_7	D_7
8	SAM_8	ACT_8	C_8	L_8	D_8
9	SAM_9	ACT_9	C_9	L_9	D_9
10	SAM_{10}	ACT_{10}	C_{10}	L_{10}	D_{10}
11	SAM_{11}	ACT_{11}	C_{11}	L_{11}	D_{11}
12	SAM_{12}	ACT_{12}	C_{12}	L_{12}	D_{12}
13	SAM_{13}	ACT_{13}	C_{13}	L_{13}	D_{13}
14	SAM_{14}	ACT_{14}	C_{14}	L_{14}	D_{14}
15	SAM_{15}	ACT_{15}	C_{15}	L_{15}	D_{15}
ACCUMULATED DURATION			C_n		
JOB FUNCTION 8-HOUR TIME-WEIGHTED-AVERAGE				TWA	
ACCUMULATED FRACTIONAL DOSE VALUES					D_n
MINIMUM NOISE REDUCTION RATING (NRR)					

Table C.1: Relationships Between Job Function Activity Sound Exposure Variables

The ACTIVITY # column is used to provide a field sub-script for the data values in the rest of each activity's fields. The actual data are represented by variable names, such as L_1 for the field describing the measured Lavg for activity 1 (ACT1).

C.1.1 Traditional Computational Method

To determine the % Noise Dose associated with each activity for a Job Function the following formulas are applied.

Activity Dose (D_i) = $[C_i/T_i] * 100\%$

Job Function Dose (D_o) = $100[C_1/T_1 + C_2/T_2 + ... + C_{15}/T_{15}]\%$

Or (D_o) = $D_1 + D_2 + ... + D_{15}$ %

Where: $C_{1...15}$ = Exposure time associated with given $L_{avg1...15}$ as determined from Job Function Activity Study

And $T_{1...15}$ = Allowable time of exposure for given Lavg1...15 obtained from Table G16a of 29-CFR 1910.95 DOL Occupational Noise Exposure Standard as amended and effective April 7, 1983.

To convert %Dose to its equivalent eight (8) hour time weighted average (TWA) sound level the following formula is applied when the exchange rate is 5.

TWA = $90 + 16.61 * \text{Log}_{10} [D_n/100]$ dB(A)

This method is illustrated in Example 1, APPENDIX F-EXAMPLES, page 43.

The Minimum NRR may be calculated to any level of protection ($L_{protect}$) by means of the following relationships.

$L_{protect}$ = TWA - (NRR-7)

Thus:

$L_{protect}$ = TWA - $L_{protect}$ + 7

$L_{protect}$ = 85 dB(A) TWA (See Note Below)

Therefore:

If TWA $\geq$ 85 Then NRR = TWA - 85 + 7 = TWA -78

If TWA < 85 Then NRR = 0

NOTE: This calculation uses 85 dB(A) TWA as the ear canal protection goal, as required by NEXTEER AUTOMOTIVE, rather than 90 dB(A) TWA as required by OSHA. OSHA requires protection to 85 dB(A)TWA for any person with a Standard Threshold Shift (STS).

C.1.2 Using A Dosimeter to Determine Job Function (L_i) Sound Exposure TWA Values

Dosimeters measure and store in memory the amount of noise dose accumulated during the "ON-TIME" of the dosimeter. The readout from the dosimeter will be a % Dose accumulated or some decimal equivalent representative of the % Dose accumulated during the "ON-TIME" monitoring. If the time period of dosimeter monitoring is less than the activity duration the % Dose measured must be extrapolated to the full activity % Dose Di. Note that in all cases the time period of dosimeter monitoring must encompass at least three full duty cycles of the activity per Section 5.2.2.1.

Extrapolation can be done by the following equation:

$$D_i\left(\%Dose\ For\ Activity\right) = \%Dose(Measured) * \left(\frac{C_i}{t_i}\right)$$

Where: C_i = Activity Duration (hours)

ti = time period of dosimeter monitoring(hours)

The Di (%Dose Activity) can then be converted to the activity Lavg sound level (Li) by use of the following equation when using a 5 dB exchange rate:

$$L_i = 90 + 16.61 * \log\left[\frac{D_i * \frac{8}{C_i}}{100}\right] dB(A)$$

Where: L_i = equivalent time-weighted average sound level L_{avg}

D_i = %Dose Activity

C_i = Activity Duration (hours)

If a dosimeter is used for only a segment of a Job Function which cannot be obtained by use of an Integrating Sound Level Meter (ISLM) as permitted in footnote 2, page 8, the value(s) of Li associated with the activity(s) should be computed and used along with the Li values obtained for the other activities by means of an ISLM.

If a dosimeter was used to collect all sound level data and the information was not intended for use in the NEXTEER AUTOMOTIVE TWACALC™ database, the Job Function TWA may be calculated as follows:

$$Job\ Function\ Dose\ (Dn) = \left[\left(D_1 * \frac{C_1}{t_1}\right) + \left(D_2 * \frac{C_2}{t_2}\right) + \cdots \left(D_i * \frac{C_i}{t_i}\right)\right]\%$$

And

$$Job\ Function\ TWA = 90\ + 16.61 * log\left[\frac{D_n}{100}\right] dB(A)$$

For other methods of using a dosimeter to determine the activity Li values when the work shift is represented by more than one activity refer to the instrument manufacturers' instructions.

C.2 Additional Canadian Procedures

C.2.1 Method of Measuring Predominant Frequency Bands, Determination of "dB(A) Corrected Continuous Level (Quebec, Canada)

(The following method of determining "dB(A) Corrected Continuous Level" was taken from Section 47 and Schedule "F," O.C. 3845-80, 17 December 1980, Environment Quality Act.)

If the sound during an Activity is "dominated" by a tonal noise producing a "Predominant Frequency Band," then the "dB(A) Corrected Continuous Level" must be computed per Section 47 and Schedule "F," O.C. 3845-80, 17 December 1980--ENVIRONMENT QUALITY ACT.

A "Predominant Frequency Band" is defined as:

"predominant frequency band": a frequency band whose level passes through a maximum that exceeds the arithmetic average of the levels of the preceding and following octave bands by 4 dB or more, and for the bands at the upper and lower limits of the sound spectrum, whose level exceeds that of the contiguous octave band by 5 dB;

Since the lowest octave band and highest octave band in the Schedule "F" procedure are 31.5 Hz and 16,000 Hz, respectively, these two bands would correspond to the "upper and lower limits of the sound spectrum" as per the "Predominant Frequency Band" definition.

NOTE: To evaluate a situation which may qualify for "Predominant Frequency Band" analysis requires a sound level meter incorporating or with attached octave band filter.

The condition for the existence of a "Predominant Frequency Band" is present in certain equipment (such as electric motors, fans, hydraulic pumps, etc.) and processes (such as metal removal with a milling cutter or reamer). During their sound generating operation, a tonal sound is produced—often characterized as a "whine" or a "hum." The sound from these types of equipment or processes is generally "steady state," at least for some finite period of time (hopefully long enough to allow a sound level measurement).

This procedure consists of the following steps:

1. Using the analysis of each octave band from 31.5 Hz to 16 kHz, determine if one of the bands corresponds to the notion of predominant frequency band.
2. Add 5 dB to the measured level of each band corresponding to the notion of predominant frequency band.
3. Modify the resulting sound spectrum as shown in Table IX.
4. Add the corrected levels for each octave of the spectrum by following the method for adding decibels.
5. The result thus obtained is expressed in corrected dB(A).

CORRECTION FACTORS FOR PREDOMINANT FREQUENCY BAND CALCULATIONS	
Octave Band Center Frequency (Hz)	Correction Factor
31.5	-39.4
63	-26.2
125	-16.1
250	-8.6
500	-3.2
1000	0.0
2000	+1.2
4000	+1.0
8000	-1.1
16000	-6.6

Table C.2.1: Correction Factors for Predominant Frequency Band Calculations

An example of this procedure is presented in APPENDIX F-EXAMPLES, Section F.2.

C.2.2 Determining Fractional Sum Due to Impact Sound, (Quebec, Canada)

If the Fractional Sum of the impact noises exceeds unity, a Hearing Conservation Program and mandatory full shift ear protection are required until feasible engineering controls are implemented.

$$FRACTIONAL\ SUM = \sum_{i=1}^{m} \frac{C_i}{N_i} = \frac{C_1}{N_1} + \frac{C_2}{N_2} + \cdots + \frac{C_m}{N_m}$$

C = Total number of impacts with a specific peak level.

N = Total number of impacts permitted in accordance with the table presented in Section 48, O.C. 3845-80, 17 December 1980, Environment Quality Act (table presented in following).

Sound Level in dBLin as Peak Value	Permitted Number of Impacts (per 8 Hrs)
120	10,000
121	7,943
122	6,310
123	5,012
124	3,981
125	3,162
126	2,512
127	1,995
128	1,585
129	1,259
130	1,000
131	794
132	631
133	501
134	398
135	316
136	251
137	200
138	158
139	126
140	100
>140	0

Table C.2.2: Permitted Number Of Impacts For Fractional Sum Calculations

An example of this procedure is included in APPENDIX F-EXAMPLES, Section F.3.

C.2.3 Method For Determining Sum Of Acoustic Energy (SAE), (Quebec, Canada)

If the Sum Of Acoustic Energy from impact noises exceeds 160, a Hearing Conservation Program and mandatory full shift ear protection are required until feasible engineering controls are implemented.

SAE = L_{eq} + 10 * log(N)

Where:

$$L_{eq} = 10 * \log\left(\frac{1}{N}\sum_{n=1}^{N} 10^{\frac{L_n}{10}}\right) dB$$

L_n = Impact peak sound pressure level in dB Leq + 10 * log(N)

N = Total number of impact sounds to which a worker is exposed per day.

L_{eq} = Equivalent level of impact sounds.

Substituting the equation for Leq into the equation for SAE yields:

$$SAE = 10 * \log\left(\sum_{n=1}^{N} 10^{\frac{L_n}{10}}\right) dB$$

NOTE: In the determination of either the “Fractional Sum” or the “Sum of Acoustic Energy” (SAE), peak impact sound pressure levels must be determined using an instrument capable of measuring the un-weighted true dB peak sound pressure level. This measurement CANNOT be made with a conventional sound level meter set on “FAST” response.

An example of this procedure is presented in APPENDIX F-EXAMPLES, Section F.4.

D. Forms

D.1 Survey Information Worksheet

SURVEY INFORMATION WORKSHEET											
DEPARTMENT INFORMATION		# JOBS TO BE SAMPLED	CURRENT EMPLOYEE DISTRIBUTION BY CODE								
			JOB CODE	JOB CLASSIFICATION	EMPLOYEE HEADCOUNT				EST. # PROFILES	(X) IF CHANGES
NO	NAMES				1st	2nd	3rd	TOTAL		

D.2 Sound Exposure Profile Data Collection Form

SOUND EXPOSURE PROFILE DATA COLLECTION FORM

Site ID:	(First Page)	Pg __ of __

Test Date:	Surveyor:	Plant/Bldg:	
Dept. No:	Dept. Name:		
Operation No:	Proc. No:	Shift:	Prod. Rate:
Job Code:	Job Class.:		
Job Function:			
Job Desc.:			
	Group Headcou 1st: 2nd: 3rd: Total:		
JF Note:			

Sam.# / -	Activity					Act. Duration:
Bay	Loc:					
Lavg.	Lmin:	Lmax:	Lpk:	Sample Desc:		
Mic: H-Zn Lape Shld Pckt Sym Sim Note	Smpl. Start Time:	Smpl. Start Stop:	Total Time:	Status: Act. Void nac ?		
Noise Source:						
Control:				Post treat: Noch Unkn Note > 90 85-90 <85		
Note:						

Sam.# / -	Activity					Act. Duration:
Bay	Loc:					
Lavg.	Lmin:	Lmax:	Lpk:	Sample Desc:		
Mic: H-Zn Lape Shld Pckt Sym Sim Note	Smpl. Start Time:	Smpl. Stop Time:	Total Time:	Status: Act. Void nac ?		
Noise Source:						
Control:				Post treat: Noch Unkn Note > 90 85-90 <85		
Note:						

Sam.# / -	Activity					Act. Duration:
Bay	Loc:					
Lavg.	Lmin:	Lmax:	Lpk:	Sample Desc:		
Mic: H-Zn Lape Shld Pckt Sym Sim Note	Smpl. Start Time:	Smpl. Stop Time:	Total Time:	Status: Act. Void nac ?		
Noise Source:						
Control:				Post treat: Noch Unkn Note > 90 85-90 <85		
Note:						

ISLM Mfg.	Model:	Serial No:	
Doubling rate:	Threshold:	Criterion:	
Calibration Level:	Before/After	Calibrator/Serial No.	

Results Based On	Measurement	Observation	Exposure Profile Type:	Worst Case	Typ. Workda	Spec. Cond	Active?	Yes No
							Comple	Yes No

Version: 8-4-92

E. Interview Guidelines

The supervisor and employee interview process is fundamental to achieving quality survey results. Although each survey must address the specific circumstances of the facility's operations and management philosophy certain standard information is also required. The information gathered from supervisors and employees will in most cases confirm information obtained during the record search. This appendix presents some rules and guidelines to use during the interview process.

Primary Rule: Before starting the survey of a particular organizational group inform the group's supervisor of your purpose in their area and explain the purpose and procedure involved in the sound survey.

E.1 Supervisor Interview

The interview process should start with the group supervisor (or designated representative) to confirm the information obtained through the record search and establish an overview of the group's structure, mode of operation and responsibilities.

Determine or verify the items listed below and record the results on the Job Function Data Collection Form:
1. Job Codes of employees assigned to this group.
2. Number of employees in each Job Code group.
3. Activities that comprise the various work assignments performed by employees in each Job Code group.
4. Locations where the activities are performed both in and out of the group's "normal" work area.
5. Duration of each activity and the number of repetitions-per-shift.
6. Duration of shift and frequency of over-time situations.
7. Length of lunch, break and other "down-time" conditions, plus location of employees during these periods.
8. Normalcy of current conditions with respect to production rate, process/machine operating conditions, tooling, etc..
9. Job Functions or activities which occur regularly, but not on every shift.
10. Job Functions or activities which occur only on certain shifts.
11. Concerns of the supervisor regarding sound levels in their area.
12. Unusual situations which may affect employee sound exposure.
13. Location of known noise sources and nearest employee work areas.
14. The "worst-case" or noisiest Job Function or activity performed by employees assigned to this supervisor.

Tabe E.1: Supervisor Interview Guidelines

E.2 Employee Interview

More specific information regarding Job Functions, Activities and the tasks comprising them is often available during the employee interview. Also, before conducting sound level tests in an employee's hearing zone explain to the employee performing the activities the purpose and procedure involved in the test. Make sure that the testing is performed in a safe manner. Table E.2 presents a list of topics to discuss.

Determine or verify:	
1.	Is this the employee's normal work assignment?
2.	Is this work assignment normally done by an employee with a Job Code different than the current employee?
3.	Are processes or activities being performed at their normal rate?
4.	Is the employee relieved for breaks and lunch or does the process/activity stop during these periods?
5.	Where does the employee go during break, lunch and "down-time" periods.
6.	Does the employee spend all of the work-time at this location or does the employee go to other locations to check machinery, gauge parts, etc.?
7.	When more than one employee performs the same activity are there different locations or ways of performing it that make the activity noisier or quieter?
8.	What is the noisiest activity involved with the employee's work assignment

Table E.2: Employee Interview Guidelines

E.3 Observational Triggers

In addition to information obtained during the interview process certain types of processes, tools, machinery, etc. should trigger further investigation. Table E.3 provides examples of common triggers related to many manufacturing processes.

1.	Elevated gons and baskets indicating part dumping or raking sounds.
2.	Metal (or other hard material) hammers.
3	Metal conveyors, chutes or material handling tables.
4.	Compressed air powered tools, such as, air chisels, grinders, sanders, wrenches or chippers.
5.	Compressed air "blow-off" wands, stations or fixtures used for cleaning, drying, parts/scrap removal from tooling areas, etc.
6.	High pressure spraying or cleaning equipment.
7.	Fans, blowers, vacuum systems.
8.	Booths for painting, inspection, etc.
9.	Noise control enclosures that may be left open and/or accessed by employees.
10.	Automated equipment, such as coil fed stamping presses, which require machine downtime to re-stock.

Table E.3: Triggers Indicating Need For Further Investigation

F. Examples

This appendix illustrates the procedures specified in this document. The first section discusses the organizational basis of the sampling method used in this procedure and Job Function analysis. It includes a discussion about Job Functions and an example application. The example is worked out in detail using the OSHA Cn/Tn formula for mixed exposures to demonstrate the traditional computational method presented in APPENDIX C - FORMULAS, Section C.1.1. Sections F.2 to F.4 illustrate application of special procedures for Canadian facilities.

F.1 Organizational Based Sampling Strategy

To achieve the purpose of this monitoring procedure it is essential that the samples used to identify which employees must be included in a Hearing Conservation Program reflect the worst-case sound exposure potential to which an employee could be routinely exposed. Sampling methods, such as random sampling, could provide this information, but would involve extensive testing. The organizational-based sample selection procedure used in this procedure aims to make use of the organizational constraints placed upon employee job assignment, information about known sound sources in the plant, and the relatively repetitious nature of work assignments to target those job assignments that are the most likely worst-case sound exposure candidates. Thus, the survey procedure starts by defining the organizational limits on employee job assignment. The first step of this process is to define the organizational structure using the SURVEY INFORMATION WORKSHEET as shown in Figure 7. Figure 8 shows this information as an organizational chart representing a department in a stamping plant. A department is used as the basis for the structure because it is the smallest organizational group used in a traditional department oriented plant. In plants organized differently, such as by teams or sections, the smallest group equivalent to the traditional department should be identified.

DEPARTMENT INFORMATION		# JOBS TO BE SAMPLED	CURRENT EMPLOYEE DISTRIBUTION BY CODE							(X) IF CHANGES
NO.	NAME		JOB CODE	JOB CLASSIFICATION	EMPLOYEE HEADCOUNT				EST. # PRO-FILES	
					1st	2nd	3rd	TOTAL		
200	High Speed Press		Salaried	Supervisor	1	1	0	2	1	
200	High Speed Press		265	Die Setter	2	1	1	4	1	
200	High Speed Press		279	Press Operator	9	4	0	13	3	
200	High Speed Press		205	Truck Driver	1	1	0	2	1	
300	Screw Machine		Salaried	Supervisor	1	1	0	2	1	
300	Screw Machine		200	Set-up	1	1	0	2	1	
300	Screw Machine		205	Truck Driver	1	1	0	2	1	
300	Screw Machine		275	Screw Machine Operator-Under 1”	5	2	0	7	1	

Figure 7: Survey Information Worksheet - Department 200

Job Functions performed by employees in the organizational group are derived from the possible work shift assignments available for employees with similar Job Codes in the group. In traditional department structured plants, Job Functions include the possible work assignments for each Job Code. In plants using different organizational structures (such as Teams, Sections, Associates, Quality Operators, etc.) the equivalent smallest employee grouping shall be identified and used for structuring the sound survey.

This structure is practical to use because employee mobility between different Job Functions is usually limited first by organizational boundaries and Job Code.

Representative monitoring permits sampling of only some of the sound-exposed employees. Each Job Function TWA level represents the sound exposure potential for all employees who are engaged in a similar kind of work and whose sound exposures are expected to be similar. When making these decisions, routine patterns of employee mobility between Job Functions within the organizational group must also be considered. If more than one type of work

assignment is possible within the organizational/Job Code group (or if sound exposure can vary significantly for the same work assignment) different Job Function's may be said to exist. At a minimum, the Job Function which is reasonably believed to have the highest sound exposure potential shall be monitored. Where there is doubt about which of two or more Job Functions present the highest exposure potential then the TWA level for each of the Job Functions shall be determined. The one with the highest TWA level is the worst-case Job Function.

F.1.1 Elements Of A Job Function

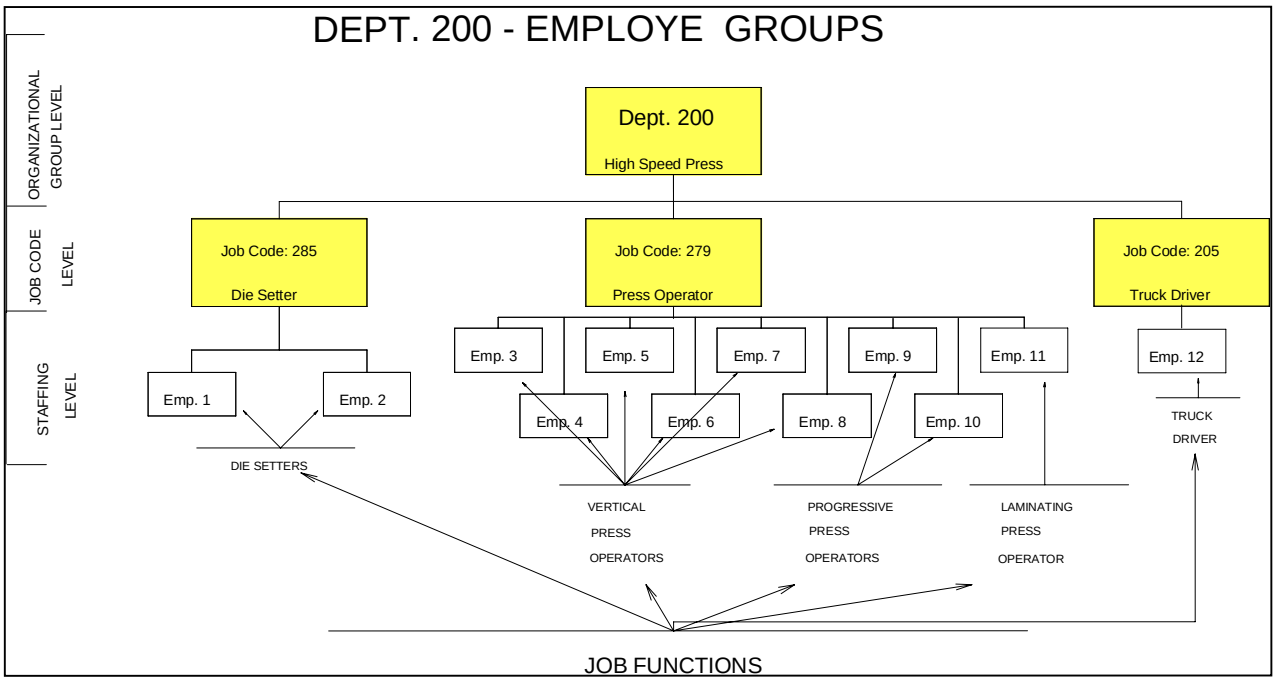

Figure 8: Organizational Basis For Job Functions

Once the surveyor has identified the significant Job Function activities to which employees may be assigned within a organizational/Job Code group and evaluated the effects of employee mobility on work assignment between these Job Functions it is necessary to conduct one or more Job Function analyses. A Job Function analysis requires the surveyor to determine the activities that comprise the employee's work assignment. The manner in which the activities are defined has significant bearing on the quality and reliability of the monitoring data. The surveyor must identify the activities that are performed in a manner that:

1. Separately details primary activities reflecting significant differences in sound exposure conditions,
2. Breaks the work assignment down into activities that are repeatable from one work period to the next.
3. provide reasonable activity duty cycle durations such that measurements can be conducted over a several full duty cycles to provide a sufficient period of observation for valid measurements, and
4. includes all sound exposure conditions that could occur during the Job Function in relative proportion to the way they occur over the typical work shift.

To illustrate how these guidelines are applied, Figure 9 shows the activities related to an automatic stamping press operator's Job Function. This example represents the minimum level of detail expected for proper documentation of a basic Job Function.

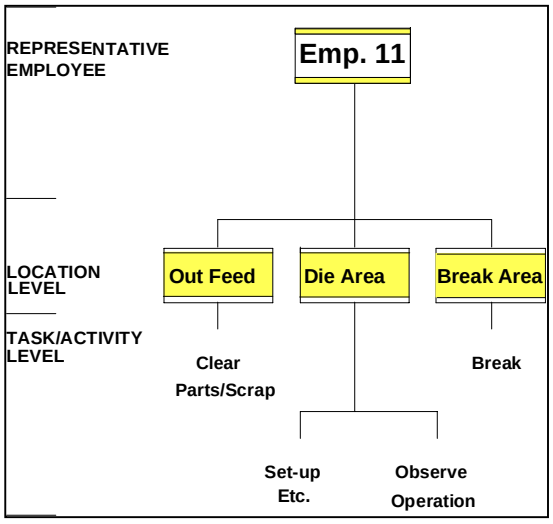

Figure 9: Automatic Press Operator's Job Function Activities

Prior to taking sound level measurements on the plant floor, the surveyor must familiarize him/herself with the activities and locations associated with each Job Function. To do this will require an understanding of the process flow, a familiarity with the plant equipment and interview time with plant supervision. The supervisor interviewed should be responsible for an area and able to provide information as to what each job entails, the percent of total shift time spent at each activity of the job, past-present-future manpower and production records and requirements.

During the interview with plant supervision, emphasis should be placed on the long-term activity of the Job Function, not what would occur on a specific day. During the interview, activity durations (in decimal hours) should be established. This includes those events that have a specific time period assignment, such as break and lunch periods. Performance of Job Function related activities can be evaluated as a percent (%) of work shift time that is allocated to performance of a given activity. This percentage can later be converted to a specific time interval (hours) once an average daily work shift is established.

The acquiring of information relevant to long-term exposure may require reference to past and future production schedule, maintenance records, etc. (for instance, machine downtime). Determining the contribution of regularly scheduled events on Job Function exposure is relatively straight forward. On the other hand, if machine downtime is a somewhat random, but habitual, event such as job shop die change or tooling change based on acceptable production tolerances, then reference to past production records will probably be required to determine a long-term average percentage of time representative of this event. One would also need to determine the routine activities and the corresponding sound exposure levels during this downtime. Figure 9 shows an example of what a detailed Job Function might look like for a press operator.

The main focus of the Job Function Activity study is to identify the habitual long-term average of the activities involved with a specific Job Function assignment. A later section of this appendix includes examples of Job Functions showing the various levels of detail required for properly defining activities.

Once a complete set of Job Function TWA's are obtained, it is necessary to assign to each employee a sound exposure potential based on current job assignment. This process is simplified by this procedure since the sample selection method used accounts for the routine mobility between job assignments within each organizational/Job Code group. Flexibility in work assignment means the employee's sound exposure may vary from day-to-day, and job-to-job. Often, any employee within the organizational/Job Code group may occasionally work the Job Function with the highest sound exposure potential. Thus, to avoid having to track this day-to-day mobility employee assignment to the program is accomplished by applying the following rules[4].

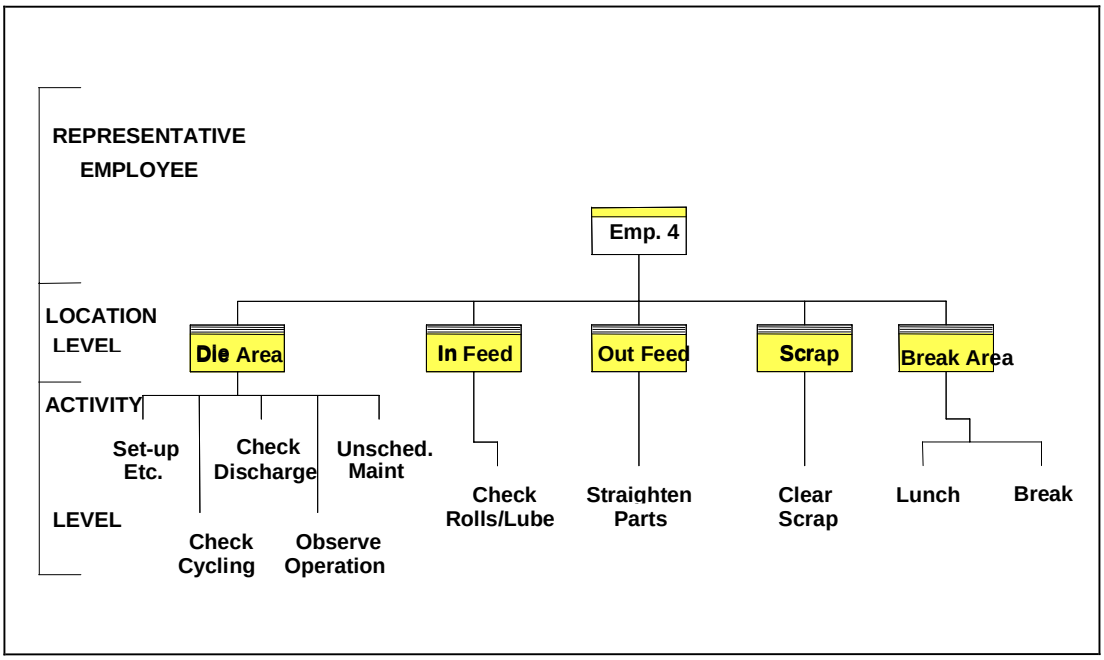

Figure 10: Example of Press Operator Job Functions

1. For purposes of assigning employees to the audiometric testing, training, notification and recordkeeping elements of the Hearing Conservation Program an employee's NOISE EXPOSURE ASSESSMENT is the 8-hour, time-weighted average (TWA) sound level associated with the Job Function believed to present the highest sound exposure level (TWA) within the organizational/Job Code to which the employee is assigned.
2. For purposes of determining an employee's hearing protection needs on a day-to-day basis an employee's NOISE EXPOSURE ASSESSMENT may be either the 8-hour, time-weighted average (TWA) sound level associated with the Job Function believed to present the highest sound exposure level (TWA) within the organizational/Job Code to which the employee is assigned or the sound level associated with the Job Function the employee is currently performing, if known.

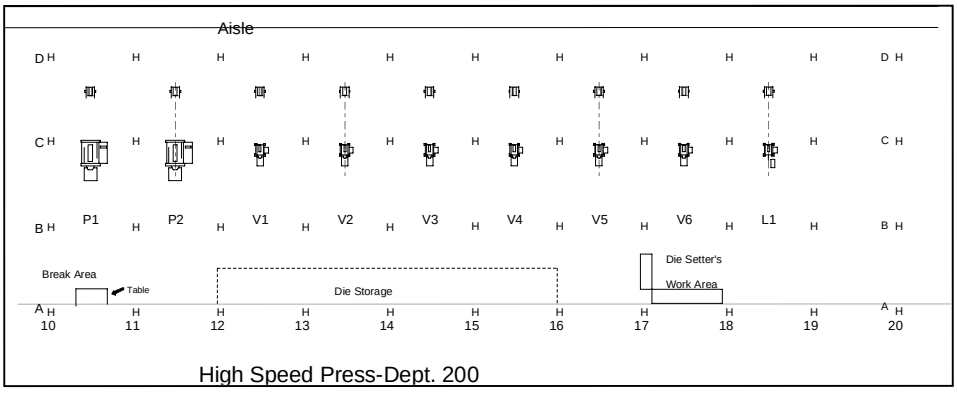

Figure 11: Layout of Department 200

3. For purposes of the Noise Control Program, investigation of feasible sound controls is required when a Job Function TWA is greater than 90 dB(A).

These rules may be used to develop an initial list of Hearing Conservation Program candidates, identify plant hearing protection boundaries, and establish noise control priorities. Employee mobility between organizational groups that occurs after developing this initial list, especially where the transfer moves the employee into a higher sound

exposure category, is addressed by that employee being assigned the sound exposure of the new Job Function. The survey procedure does not provide a method for performing the post-survey update of the candidate list.

F.1.2 Example Job Function Breakdowns

To illustrate these concepts an example is provided that builds upon the stamping plant department used in the above discussion. It is a detailed Job Function analysis of a stamping press operator tending an automated machine. The example presumes the use of an integrating sound level meter set to a 5 dB exchange rate and a cut-off threshold of 80 dB. The example is used to demonstrate the calculation methods presented in APPENDIX C-FORMULAS.

Example: Detailed Analysis of a Press Operator-Traditional Computational Method

The example involves determining the Job Function TWA for employees assigned to operate the Vertical presses shown in Figure 9. The layout of the department is shown in Figure 11. The department layout shows work areas accessed by the vertical press operator while performing a typical day's job activities.

The Job Function Activity study yielded the following:

1. Two 10-minute relief breaks were primarily spent in the plant canteen area. A short duration (1 minute) measurement of the time-weighted average sound level (Lavg) in the canteen area during production indicated 88 dB(A).
2. A 20-minute lunch period is spent in the canteen area [Lavg (1 minute) <80 dB(A)--press department not in operation], or in the plant cafeteria [Lavg (1 minute) <80 dB(A)]. Since levels are below the 80 dB cutoff, the contribution to employee exposure is zero. The two break periods and the lunch period make up 0.67 hour. Since the Average Daily Work shift was determined to be 8 hours, 7.33 hours of production time remains.
3. Review of production records indicated the press was down for unscheduled maintenance approximately 5.4% of the time. During these times, the press operator normally remained in the immediate area of the press unless maintenance took place during a scheduled break or lunch period. Due to uncertainty in employee location during this maintenance period, 5.4% of production time was allocated to this item.
4. The % of production time allocated to the remaining Job Function Activities listed were determined by supervisor interview and surveyor observation.
5. Figure 13 shows the variation in sound level in the employee's hearing zone as the various activities are performed over the work shift. The sound levels reported in the table for each activity were determined by taking short duration time-weighted average sound level measurements (Lavg) in the employee's hearing zone while the employee is performing the activity using an integrating sound level meter. (Monitoring time per activity was long enough to encompass several full duty cycles of the activity. Sampling continued until the Lavg level on the integrating meter reached a relative steady-state reading. For highly repetitive sound sources, such as stamping presses, this usually occurs within 3 to 5 duty cycles.)

Figure 12 summarizes these findings and demonstrates the results of the calculations required to convert single duty-cycle activity durations to full shift activity durations.

	Activity Description	Prod. Time As %	Shift Time As %	Shift Time As Hrs.	Activity L_j dB(A)	Permitted Exposure Time (hr)	% Dose Per Shift
1	BREAKS (Canteen-Production)		4.1	0.33	88	10.6	3.1
2	LUNCH (Canteen-No Production)		4.1	0.33	45	∞	0.0
3	SET-UP & MAINT. (SCHED.)	30.0	27.5	2.20	90	8.0	27.5
4	CHECK CYCLING	4.0	3.6	0.29	106	0.87	33.3
5	CHECK FEED ROLL, ADJ. LUBE	1.5	1.4	0.11	108	0.66	16.7
6	CHECK PARTS DISCHARGE AREA	4.0	3.6	0.29	104	1.1	25.2
7	CLEAR SCRAP CHUTE	3.6	3.3	0.26	105	1.0	26.0
8	STRAIGHTEN PARTS AT OUTFEED	40.0	36.6	2.93	91	7.0	42.1
9	OBSERVE OPERATION AT DIE CAVITY	11.5	10.5	0.84	106	0.87	96.5
10	PRESS MAINT. (UNSCHED.)	5.4	5.0	0.40	90	8.0	5.0
		SHIFT LENGTH (HRS) 7.98					
		JOB FUNCTION TWA 97.3 dB(A)					
		JOB FUNCTION DOSE (%)					275.4

Figure 12: Job Function Breakdown

6. Traditional Computational Method To determine the % Noise Dose associated with this Job Function:

$$\%Dose = 100 * \left[\frac{C_1}{T_1} + \frac{C_2}{T_2} + \frac{C_n}{T_n} \right]$$

Where:

C = Full shift activity exposure time associated with given measured Lavg as determined from Job Function Activity Study.

T = Allowable time of exposure for measured Lavg obtained from Table G-16a of 29-CFR 1910.95 Department of Labor Occupational Noise Exposure Standard as amended and effective April 7, 1983.

$$\%Dose = \frac{0.33}{10.6} + \frac{0.33}{\infty} + \frac{2.20}{8.00} + \frac{0.29}{0.87} + \frac{0.22}{0.66} + \frac{0.29}{1.10} + \frac{0.26}{1.00} + \frac{2.93}{7.00} + \frac{0.84}{0.87} + \frac{0.40}{8.00}$$

$$\%Dose = 3.1 + 0.0 + 27.5 + 33.3 + 16.7 + 25.2 + 26.0 + 42.1 + 96.5 + 5.0$$

$$\%Dose = 275.4$$

To convert the % Dose to its equivalent 8-hour, time-weighted average sound level:

$$TWA = 90 + 16.61 * \log\left[\frac{\%Dose}{100} \right] dB(A)$$

$$TWA = 90 + 16.61 * \log\left[\frac{275.4}{100} \right] dB(A)$$

$$TWA = 97.31 dB(A)$$

Although the length of shift is 8 hours in Figure 13, a longer shift time would not change the procedure. % Dose is an accumulated amount of exposure and therefore in determining the TWA from % Dose, shift length has already been taken into account.

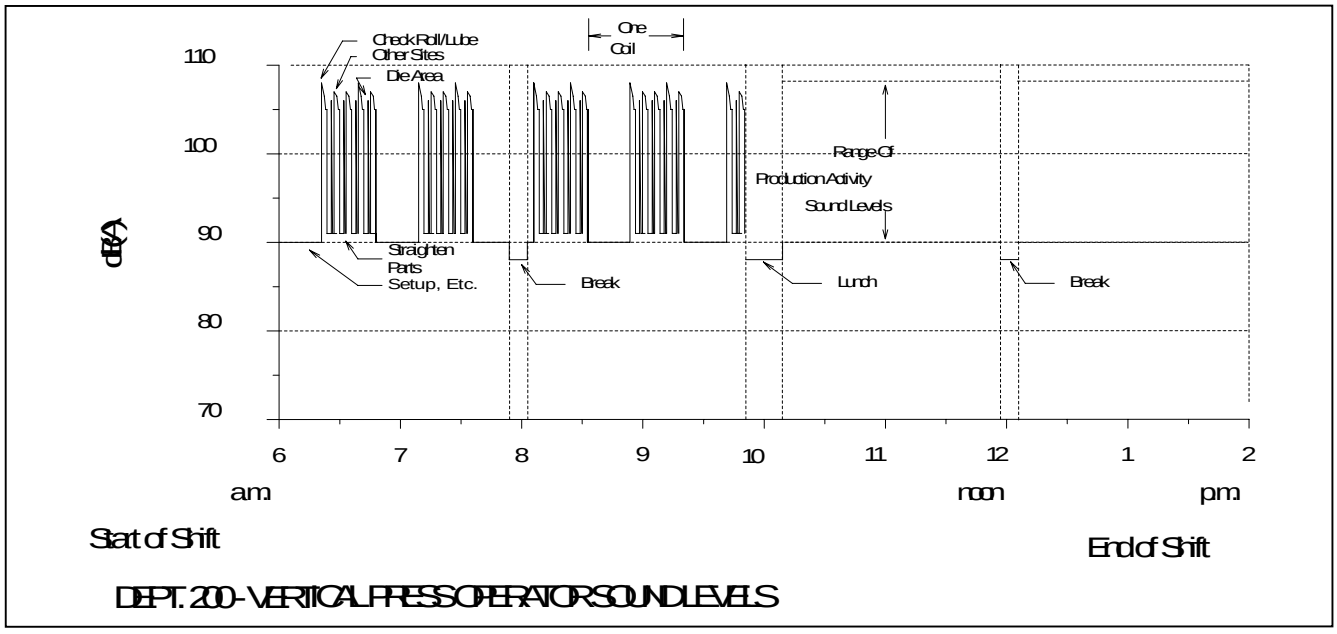

Figure 13: Hearing Zone Sound Levels For Press Operator

The degree of detail in this example may be more extensive than is necessary or desired for many employee Job Function evaluations; however, it does illustrate the basic concept of the activity study.

The Job Function TWA and Dose can also be calculated using the Alternate Computational Method shown in APPENDIX C-FORMULAS. However, since this method is implemented in the NEXTEER AUTOMOTIVE software program TWACALC™ it is best performed by means of the software.

After completing this procedure for all Job Functions, the required reports would be generated. Figure 14 shows a typical section of an Engineering Report.

```
                                SOUND EXPOSURE PROFILES REPORT
CORPORATION: NEXTEER AUTOMOTIVE                                                    FEB 11,1991
SITE       : CONSUMER PRODUCTS DIV., MICHIGAN PLANT                                PAGE   8
=============================================================================================================
|PLANT      : MAIN            DEPT. NO.: 200        HIGH SPEED PRESSES                    |
|JOB CODE    : 279      PRESS OPERATOR-HIGH SPEED      JOB DESC: VERTICAL PRESS OPERATOR          |
|JOB FUNCTION: PRESS OPERATOR-HIGH SPEED                  OP#:      SHIFT: 1    DATE: 1/23/91    |
|-----------------------------------------------------*****ACTIVITY*******----------------------|
|  #  SAMPLE NO.          ACTIVITY              HRS.  L(avg)  DOSE | TWA  :    97.3 dB     |
|  1 RRJ/910116-002 BREAK                       0.33   88.0   3.1 | DOSE :   275.4 %      |
|  2 RRJ/910116-001 LUNCH                       0.33   45.0       | Lpk  :   123.4 dB     |
|  3 MSS/910123-013 SET-UP AND MAINTENANCE           2.20   90.0   27.5 | MIN. NRR :    19        |
|  4 MSS/910123-016 CHECK CYCLING                 0.29   106.0   33.3 |-------------------------|
|  5 MSS/910123-017 CHECK FEED ROLL, ADJUST LUBE       0.11   108.0   16.7 | Lpk FROM: MSS/910123-017|
|  6 MSS/910123-018 CHECK PARTS DISCHARGE AREA         0.29   104.0   25.2 | Lmax    :   115.5 dB  |
|  7 MSS/910123-019 CLEAR SCRAP CHUTE               0.26   105.0   26.0 | Lmax FROM:MSS/910123-021|
|  8 MSS/910123-020 STRAIGHTEN PARTS AT OUTFEED        2.93    91.0   42.1 |                         |
|  9 MSS/910123-021 OBSERVE OPERATION AT DIE CAVITY    0.84   106.0   96.5 | LENGTH OF SHIFT: 7.98 Hr|
| 10 MSS/910123-022 PRESS MAINTENANCE (UNSCHEDULED)    0.40    90.0    5.0 |                         |
| 11                                            | EXCHANGE RATE : 5 dB    |
| 12                                            | PROFILE TYPE  : T       |
| 13                                            | TYPE OF TEST  : M       |
| 14                                            | ACTIVE RECORD?: Y       |
| 15                                            | COMPLETED?    : Y       |
|        PEAKS OCCUR EVERY CYCLE @ 90 CYCLES PER MINUTE                | EXPORTED?    : NO     |
=============================================================================================================
```

Figure 14: Example of a Sound Exposure Profile Report

Figure 15 shows a typical section of a Department Report. As part of a quality check the final headcount tallies should be checked against the SURVEY INFORMATION WORKSHEET headcounts.

```
                              DEPARTMENT REPORT OF REPRESENTATIVE SOUND EXPOSURES
CORPORATION: NEXTEER AUTOMOTIVE
SITE      : CONSUMER PRODUCTS DIV., MICHIGAN PLANT
FEBRUARY 11, 1991                                                                          PAGE 1
-------------------------------------------------------------------------------------------------

PLANT: MAIN
======================

DEPT. NO: 200         HIGH SPEED PRESSES
 ---------------------------------------------------------------------------
                                        **EMPLOYEE COUNT*******GROUP*********
JOB CODE   JOB CLASS              JOB FUNCTION          1st 2nd 3rd TWA   Lpk   Lmax NRR Class
-------- ----------------- ---------------------------------- ----- ----- ----- ----- ------ -----
SALARIED SUPERVISOR      DEPARTMENT FOREMAN                    1   1   0   91.2         98.2  13  D
205      TRUCK DRIVER    MATERIAL HANDLING                     1   1   0   94.3  128.8  103.2  16  D
265      DIE SETTER      DIE SETTER/SET UP HIGH SPEED PRESSE   2   1   1   95.6         105.9  18  D
279      PRESS OPERATOR  PRESS OPERATOR-HIGH SPEED             9   4   0  102.6  127.9  119.7  25  E
                                                          ----- ----- -----
                         DEPT. 200       TOTALS:   13     7     1
```

Figure 15: Example of a Department Report

F.2 Measuring Predominant Frequency Bands (Quebec, Canada)

The following example illustrates the analysis technique for determining the "dB(A) Corrected Continuous Level" when a "Predominant Frequency Band" situation exists.

Example: Determination of "dB(A) Corrected Continuous Level"

The data below represents the octave band frequency spectrum for a motor-generator (M-G) set. The M-G set has a characteristic "hum"—this is the 120 Hz electric hum often referred to as motor hum or transformer hum. The effect of this 120 Hz tone can be seen in the dominance of the 125 Hz octave band.

	Octave Band Center Frequency (Hz)									
	31.5	63	125	250	500	1000	2000	4000	8000	16000
Measured L_p dB	83	80.	92.5	85.	87.	84.	78.	72.	67.	55.
Predominant Frequency Band +5 dB Addition			5							
A-Weighting Factors	-39.4	-26.2	-16.1	-8.6	-3.2	0	+1.2	+1.2	-1.1	-6.6
Modified Octave Bands	43.6	53.8	81.4	76.4	83.8	84.0	79.2	73.0	65.9	48.4
$10^{(L/10)}$	22908.7	239883.3	13803842.	43651583	23988329	251188643	83176377	19952623	3890451	67608.3
Sum Bands	776247116.6									
$L_{Total} = 10 * \text{Log } \Sigma$	88.9									

Application of Schedule "F" Method of Measuring Predominant Frequency Bands (In Corrected dB(A))

Step (C.2.1.1): The arithmetic average of the sound pressure levels of the preceding (63 Hz) and following (250 Hz) octave bands is [(80 + 85)/2 = 82.5 dB]. The 125 Hz octave band sound pressure level (92.5 dB) exceeds this arithmetic average of the two adjacent octave band sound pressure levels (82.5 dB) by more than 4 dB; therefore, the definition criteria for "Predominant Frequency Band" exists. The 16 kHz upper limit octave band level of 55 dB and the 31.5 Hz lower limit octave band level of 83 dB do not exceed the levels in the contiguous octave bands (8 kHz = 67 dB and 63 Hz = 80 dB) by 5 dB, nor is there any other octave band with sound pressure level exceeding the arithmetic average of its adjacent octave bands by 4 dB or more.

Step (C.2.1.2): 5 dB is added only to the 125 Hz octave band sound pressure level since the 125 Hz octave band is the only octave band meeting the criteria of a "Predominant Frequency Band."

Step (C.2.1.3): The M-G set octave band spectrum, corrected for "Predominant Frequency Band," is now modified by subtracting the octave band A-weighting factors.

Steps (C.2.1.4) and (C.2.1.5): Using the equation:

$$L_{Total} = 10 * \log \sum_{i=1}^{n} 10^{\frac{L_i}{10}}$$

The modified octave band sound levels are added together. The resulting "dB(A) Corrected Continuous Level" is 88.9 dB(A).

The A-weighted sound level measured using a sound level meter set to or incorporating A-weighting, SLOW response was 88 dB(A). Note that, in this case, there is little difference between the sound level measured (88 dB(A)) and the "dB(A) Corrected Continuous Level" calculated (88.9 dB) from the measured octave band sound pressure levels. This is because the 125 Hz octave band, which is the only "Predominant Frequency Band" in this example, is severely A-weighted (-16.1 dB). Had more octave bands or higher frequency octave bands met the criteria of "Predominant Frequency Band," the difference between the measured A-weighted sound level and the "dB(A) Corrected Level" could have been significantly greater.

If the M-G set's sound emissions were the only sounds which contributed to a worker's exposure while said worker was performing the activities determined by the Job Function assignment, then the Job Function Exposure would be taken as 88.9 or 89 dB(A) (TWA).

If the M-G set sound comprises only a portion of the total sound contributing to a worker's exposure, i.e., the worker works other jobs or performs other activities which are a part or his/her Job Function assignment, which remove him/her from the area dominated by the M-G set sound, then the total Job Function Exposure is determined by the method of "Mixed Exposures" supported by TWACALC™ Versions 1 and 2. The "dB(A) Corrected Level" would be used as the exposure level (Lavg) during the time the worker's exposure is due to the M-G set sound.

F.3 Measuring Factional Sum Due

If impact/impulse sound(s) are present while an employee performs one or more Activities associated with a Job Function, the un-weighted, true peak sound pressure level(s) of the impact/impulse sound(s) must be measured along with a determination of the number of occurrences per work shift. (Only peak levels equaling or exceeding 120 dB need be considered.)

Example:

Assume plant measurements of impact/impulse sound during an Activity associated with a given Job Function assignment yield the following data:

Number Of Impacts/Impulses per Work shift	Un-Weighted Peak Level (dB)
2000	125
250	132
50	137

NOTE: The number of impacts occurring in a "representative" period of time were tabulated and this number prorated to the number that would occur within the total work shift period.

Referring to "METHOD FOR DETERMINATION OF THE FRACTIONAL SUM DUE TO IMPACT SOUND" in APPENDIX C.3.2 the following procedure is applied:

$$FRACTIONAL\ SUM = \sum \frac{C_i}{N_i} = \frac{2000}{3162} + \frac{250}{631} + \frac{50}{200} = 1.2787$$

Since the Fractional Sum exceeds unity (1), the impact/impulse exposure would exceed the allowable limit.

F.4 Measuring The "Sum of Acoustic Energy" (SAE), (Quebec, Canada)

Referring to APPENDIX C.3.3 "Method for Determining Sum Of Acoustic Energy (SAE)" and the table of impacts in example F.3, the procedure for determining SAE is performed as shown below.

$$SAE = 10 * \log\left[\sum_{n=1}^{N} 10^{\frac{L_n}{10}}\right] dB$$

$$SAE = 10 * \log\left[\left(2000 * 10^{\left(\frac{125}{10}\right)}\right) + \left(250 * 10^{\left(\frac{132}{10}\right)}\right) + \left(50 * 10^{\left(\frac{137}{10}\right)}\right)\right] dB$$

$$SAE = 10 * \log\left[\left(6.3246 * 10^{15}\right) + \left(3.9622 * 10^{15}\right) + \left(2.5059 * 10^{15}\right)\right] dB$$

$$SAE = 10 * \log\left[12.7927 * 10^{15}\right] dB$$

$$SAE = 161.1\, dB$$

Since the exposure SAE = 161.1 exceeds the maximum allowable of 160, the impact/impulse sound would exceed the allowable limit.

G. Citations

[1] Figure 1 presents the organizational chart approach used to identify Job Functions, and illustrates the concept of representative monitoring. Although a department-oriented plant is used here as the template for organizing Job Functions, "Section" or "Team" structured plants can be similarly organized.

[2] Personal dosimetry may be used to measure sound exposure levels associated with a specific work activity only when employee mobility or other factors preclude handheld measurement techniques. The surveyor must maintain continuous observation of any employee monitored using dosimetry. Full shift personal dosimetry should not be used. The Job Function Report must indicate work/task Activities obtained through personal dosimetry. If dosimetry is used the following information is to be recorded on the JOB FUNCTION SOUND EXPOSURE PROFILE DATA COLLECTION FORM:

- Period of Observation start and stop time,
- Microphone position, and
- A note indicating reason for dosimetry.

[3] For Job Functions with a TWA less than 85 dB(A): if a Job Function analysis based on actual sound exposure measurement was conducted, this measurement is to be reported. Where an exposure measurement was not conducted, but a TWA less than 85 dB(A) was determined by measurement of L(max) values less than 80 dB(A), those measurements must be recorded, and a Job Function created reflecting these L(max) values. A Job Function with a null TWA value and L(max) value(s) less than 80 dB(A) will provide sufficient documentation to substantiate that the Job Function TWA is less than 85 dB(A) based on observation. (Exposures less than 85 dB(A) (TWA) are not to be indicated by a single TWA level unless that level is the result of actual sound exposure measurements meeting requirements for measurement duration (Sufficient Period of Observation).

[4] Plant records of each employee's work assignment history can be used along with the monitoring data to construct an employee's occupational sound exposure history. This information may be useful in addressing questions regarding compensation for hearing loss.

RECORD OF REVISIONS

Revision No	Date	Section	Description
001	01OC99	ALL	Initial Release
002	03MR12	ALL	Revised
003	20OC23	ALL	Reformatted entire document, renamed to SD-019 from (SL 2.0)
004			
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