IV. INVESTIGATION GUIDELINES

A workplace noise investigation typically involves:

- *Advance planning, including determining whether sound levels at the site might be hazardous.*
- *Reviewing employer records.*
    - *Reviewing the Hearing Conservation Program and audiograms.*
    - *Reviewing the OSHA 300 Log for hearing loss cases.*
    - *Determining if workers have hearing loss.*
- *Conducting the walkaround evaluation.*
    - *Identifying the sources of noise.*
    - *Documenting noise levels.*
    - *Conducting follow-up monitoring.*
    - *Determining the noise's potential effect on workers.*
- *Evaluating the employer's efforts to protect workers' hearing (hazard abatement and control).*

In some workplaces your visit will be the first time a thorough investigation has been performed; frequently, however, at least some aspects of noise investigations will have been completed previously through the employer's workplace health and safety measures or sometimes as part of seemingly unrelated activities, such as expanding operations or upgrading equipment. To conduct an investigation, you will need to determine what information is already available through employer or industry records, and then confirm it and fill in the gaps. To ensure that the investigation is efficient, however, you must be prepared to accomplish both these steps simultaneously, which requires some advance planning.

A. Planning the Investigation

An effective noise investigation begins before you arrive on site. First, conduct a little research to determine whether noise hazards are likely. If so, plan to conduct noise measurements and monitoring. Confirm that the instruments' annual calibrations are current (i.e., have not expired), ensure that the batteries are fresh, and calibrate the sound level meter and noise dosimeters before the opening conference. This will permit you to begin obtaining sound level measurements during your initial walkaround at the site. After these preparations, you will also be ready to start obtaining personal noise dosimetry samples early in the visit, while you have an opportunity to collect samples of significant duration. The resulting noise dosimetry might not be full shift, but it will provide valuable information regarding worker noise exposure that first day on site.

Sources of information about whether you are likely to encounter noise hazards at an establishment include:

- *Previous inspection records for the establishment, employer, or other facilities in the same or similar industries.*
- *BLS information summarizing state or national data from the "hearing loss" column of employers' OSHA 300 Logs.*

- *OSHA IMIS records on noise-related citations from inspections conducted across the nation.*
- *NIOSH reports on the industry, including Health Hazard Evaluations (HHEs).*
- *Your own knowledge of or experience with the industry and its processes.*

1. Searching Online for Industry Noise Statistics

i) BLS Report on Hearing Loss in an Industry

Reports of hearing loss by industry are summarized in BLS's "Table SNR08: Incidence Rates of Nonfatal Occupational Illness, by Industry and Category of Illness." This extensive table lists, by industry, the incidence of reported illnesses per 10,000 full-time workers, as shown on OSHA 300 Logs that employers are required to submit. The table includes a column for hearing loss. Comparing the hearing loss reporting rates in various industries will give you an estimate of the impact that noise has on the industry you are inspecting compared with other industries. Note that variations in hearing loss reporting rates can influence the apparent incidence rate.

BLS publishes this information annually each fall, covering the previous year's data. Check for the latest edition of Table SNR08, or for previous years' tables, at http://www.bls.gov/search/?cx=011405714443654768953:btgxl8qv780&cof=FORID:10;NB:1&ie=ISO-8859-1&prefix=&query=table+SNR08&submit.x=28&submit.y=5&filter=0&sa=Search.

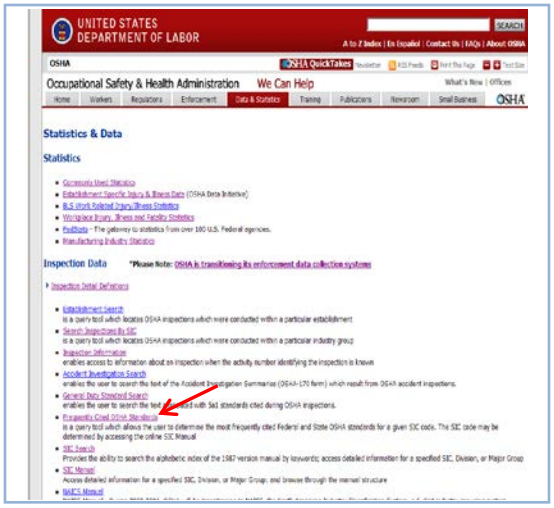
Table IV–1 shows an example from BLS Table SNR08 for NAICS 311111 (Dog and Cat Food Manufacturing); 12.8% of the 2009 reported occupational illnesses were related to hearing loss.

Table IV–1. Example Incidence Rates of Nonfatal Occupational Illness

Industry	NAICS Code	2009 Annual Average Employment (Thousands)	Incidence rates per 10,000 full-time workers					
			Total Cases	Skin Diseases or Disorders	Respiratory Conditions	Poisonings	Hearing Loss	All Other Illnesses
Animal food manufacturing	*3111*	*52.0*	*30.7*	*—*	*—*	*—*	*9.4*	*18.2*
Dog and cat food manufacturing	**311111**	**19.7**	**20.8**	**—**	**—**	**—**	**12.8**	**—**

Extracted from BLS Table SNR08, published in 2010. Available at http://www.bls.gov/iif/oshwc/osh/os/ostb2430.pdf.

Figure 24. Navigating to IMIS Noise Citations



ii) IMIS Noise Citations by Industry

If the establishment has not been inspected previously, OSHA's online records can show you whether the noise and hearing conservation standards are among those frequently cited in this industry, or whether the industry is listed as one that receives a lot of noise citations.

The CSHO can easily search the inspection information database to determine whether previous inspections of that industry, or a similar industry, resulted in citations under OSHA's noise standards. To access inspection

records, start at OSHA's website home page and choose the "Data & Statistics" tab near the top of the page. Select "Frequently Cited OSHA Standards" from the options presented and enter the SIC or NAICS (Figure 24).

When the search page opens, enter the SIC of the industry of interest and click "Submit." If the SIC is not available, use the SIC lookup link on that page to select an appropriate code. The search provides a table of results—a ranked list of the standards cited in that industry for the previous fiscal year.

Using SIC 2047 (Dog and Cat Food Manufacturing) as an example again, the search showed that 1910.95 was the 10th most frequently cited standard in this industry that year. The search returns the information as a data table, shown below as Table IV–2.

Table IV–2. Inspection Statistics for SIC 2047 – Dog and Cat Food Manufacturing in FY 2011 (Organized by Most Frequently Cited Standard)

Standard	#Cited	#Insp	$Penalty	Description
Total	53	9	74774	
19100147	8	4	14345	The control of hazardous energy (lockout/tagout).
19100212	6	5	25466	General requirements for all machines.
19100027	5	1	3570	Fixed ladders.
19040029	4	1	2000	Forms.
19100305	4	3	1250	Wiring methods, components, and equipment for general use.
19100023	3	1	4641	Guarding floor and wall openings and holes.
19100120	3	1	2860	Hazardous waste operations and emergency response.
19101200	3	2	1250	Hazard communication.
19100022	2	2	3035	General requirements.
19100095	**2**	**2**	**1428**	**Occupational noise exposure.**
19100134	2	2	0	Respiratory protection.
19100303	2	2	3035	General requirements.
19100132	1	1	1250	General requirements.
19100242	1	1	1250	Hand and portable powered tools and equipment, general.

Notes: Standards are presented as eight-character part/section levels consisting of the part number followed by the standard number. Standard numbers less than 1000 require leading zeros: 1910.95 becomes 19100095.

For the row labeled "Total," the value in the "#Insp" column represents the number of inspections in which one or more citations were issued. Note that the total is not the sum of the number of inspections associated with each standard cited: multiple standards may be cited in one inspection.

Interpreting the table: Citations were issued during nine inspections conducted in SIC 2047 between October 2010 and September 2011 (FY 2011).[3] OSHA's noise standard, 1910.95, was cited during two (22%) of those nine inspections (see column #Insp). Overall, the noise standard was cited twice, putting it among the 10 most frequently cited standards in this industry for that year. The dollar penalties for noise standard violations accounted for 2% of the total $74,774 in penalties associated with citations issued in SIC 2047 in FY 2011.

[3] *OSHA might also have conducted other inspections in that SIC that did not result in citations. Inspections that did not include citations are not counted in this table.*

Few inspections likely occurred in a small industry during a single year. For this reason, for smaller industries, the CSHO might obtain additional useful information by searching a wider range of dates (e.g., several years). Select "Search Inspections By SIC" and enter the SIC or NAICS and the date range desired. The resulting data table shows all the inspections conducted in that industry within the requested time period. The table indicates the number of violations for each inspection but does not list them individually. Clicking on the inspection number, however, will open the inspection's information screen, showing which standards were violated.

iii) NIOSH HHEs by Industry

To access NIOSH HHEs that mention noise exposure levels or dosimetry data, go to http://www.cdc.gov/niosh/hhe and select "Find an HHE Report." In the search screen that appears, search by keyword "noise," choose an industry category, and limit the dates, if desired. Between 2000 and the end of 2011, NIOSH reported on 62 HHEs that included an evaluation of occupational noise exposure.

2. Equipment Needed for Worksite Noise Evaluations

You will need a sound level meter (Type 2 or Type 1) and, depending on the extent of the evaluation, an octave band analyzer that is compatible with your sound level meter and noise dosimeters. A noise instrument calibrator also will be required.

Additional equipment includes spare batteries for all instruments. Check that you have the correct batteries. Calibrators often require a different size battery than sound level meters or noise dosimeters.

Pack so that you have the following readily accessible: tape measure, preferably a 100-foot length; pens and paper for sketching the worksite layout; and standard noise measurement forms.

While conducting noise evaluations, you should wear protective equipment appropriate for the site, including hearing protection. Keep earplugs or muffs with you at all times and wear them whenever you are in an area that the employer has designated as a noise-hazardous zone (e.g., by posting signs or if your escort tells you hearing protection is required), when you find that measured noise levels approach 85 dBA, and any other time that you suspect that noise levels are elevated. Use hearing protection anywhere it is noisy enough that you would have to raise your voice to carry on a conversation with someone 3 feet away. In some situations, double hearing protection might be necessary (see ADM 04-00-001, OSHA Safety and Health Management System).

B. Reviewing Employer Records

Review employer records to determine whether hazardous noise levels have been found in the past and to evaluate the employer's hearing conservation and recordkeeping programs. The records can also indicate what steps the employer has taken to reduce any excessive noise exposure and whether there is evidence that workers are experiencing noise-induced hearing loss. Also, ask the employer for noise questionnaires that may be in use. Refer to CPL 02-02-072, Rules of Agency Practice and Procedure Concerning OSHA Access to Employee Medical Records (8/22/07), for guidance on appropriately requesting, reviewing, documenting, and retaining worker audiogram records.

If you can conduct the walkaround inspection before the records review, review the employer's records while noise dosimeters are operating. (Periodically return to the work area to confirm

that the equipment is still operating properly and to collect sound level measurements to compare with the dosimeter data.)

Request copies of previous noise surveys or evaluations that included sound level measurements. Note noise levels that exceed the AL, along with the associated location, equipment, and activities. Inquire about the duration of exposure and determine which workers might be exposed to the noise by using the equation for calculating the TWA for the percent dose (see Appendix B). Look at noise dosimetry data to determine whether workers were exposed over the AL or the PEL. If the measurements are being used to show compliance, check that the equipment used to make the measurements was at least a Type 2 sound level meter (or dosimeter) with periodic and daily calibration fully documented.

1. <u>Reviewing Audiograms</u>

Look at the results of any audiometric evaluations. Determine whether the audiometry was performed by a qualified individual using calibrated equipment and whether results of audiometric testing are compared to the worker's previous audiometric test results. If a worker exhibited a temporary threshold shift, consider whether facility managers took appropriate action. Check the OSHA 300 Logs to determine whether the employer has reported cases of hearing loss. The employer should be asked how the determination was made to re-establish baselines and about any apparent hearing loss cases recorded (or those cases not recorded) on the OSHA 300 Logs.

Compare the most recent audiogram with the baseline audiogram. If a Standard Threshold Shift (STS) is observed, review data for intervening years to determine when the STS occurred. The baseline audiogram is usually, but not always, the first audiogram. If a later audiogram shows lower hearing thresholds, that would be the baseline. If a persistent STS is identified, the following audiogram would be adopted as the revised baseline for future comparisons.

Evaluate data for each ear separately. A threshold shift can occur in one ear and not the other. Use threshold data only for the three required frequencies: 2,000, 3,000, and 4,000 Hz. Compare each audiogram to the baseline and take the average of the difference in the threshold at the three required frequencies. If the average is less than 10 dB, no STS has occurred. If the average is 10 dB or more, the age correction values must be applied to determine whether an STS has occurred.

To apply the age correction values, subtract the age correction value for the worker's age at the time of the baseline audiogram from their age at the time of the suspected threshold shift. Subtract the difference in the age correction values from the difference between the current and baseline audiograms. Take the average of the age-corrected threshold shifts at the three required frequencies; if the average is 10 dB or higher, an STS has occurred. See Appendix J for more information about adjusting audiograms for age.

2. <u>Extended Workshifts</u>

For workers working longer than an 8-hour shift, the AL for hearing conservation is reduced proportionately from 85 dBA. For the reduction equation, see Appendix B. Table IV–3 shows the AL (50% dose) based on shift duration:

Table IV–3. Extended Workshifts and Action Level Reduction

Exposure Time (hours)	Action Level (dBA)
8	*85*
9	*84.2*
10	*83.4*
12	*82.1*
16	*80*

It is preferable to determine compliance with the reduced AL by performing dosimetry for as much of the shift as possible. Perform full-shift dosimetry whenever possible. Use a dosimeter set to a 90-dBA PEL, 80-dBA threshold, 5-dB exchange rate, and slow response.

CSHOs who use representative sound level meter readings instead of dosimetry to document exposures should ensure that such readings are taken as close to the hearing zone of the worker as possible, and that the period of time represented by each segment of exposure is documented.

Table G-16A in Appendix A of 1910.95 lists the reference duration for various sound levels. The reference duration in Table G-16A is the exposure duration for a specified TWA sound level at which a dose of 100% will occur. Also, the PEL is <u>not</u> reduced for extended workshifts. PEL compliance is measured using a dosimeter set with a threshold of 90 dBA; any noise below 90 dBA is not integrated into the dose measurement.

Extended Workshifts

Standard Interpretation (OSHA, 1982)

Extended workshifts do not affect the PEL, but do affect the Action Level (AL) using the following equation:

$$AL = 16.61\log_{10}\left[\frac{50}{(12.5)(hours)}\right] + 90$$

For example, workers exposed to a noise over a 10-hour workshift will have the following AL:

$$AL_{10} = 16.61\log_{10}\left[\frac{50}{(12.5)(10)}\right] + 90 = 83.4\ dBA$$

For compliance purposes, readings with a Type 2 sound level meter and dosimeter are considered to have an accuracy of ±2 dBA. Therefore, the adjusted AL_{10} = 83.4 + 2 = 85.4 dBA.

If a worker works an 8-hour shift and has a noise exposure of 85.7 dBA as an 8-hour TWA, there is no violation. This is because the measured noise exposure does not exceed the adjusted AL of 87 dBA (85 dBA +2 dBA allowed for Type 2 meter accuracy).

Extended Workshifts
Another Sample Calculation

Given:

- *9.5 hour workshift*
- *Employee noise dose was 53% during a 460 minute sample*

$$AL_{9.5} = 16.61\log_{10}\left[\frac{50}{(12.5)(9.5)}\right] + 90 = 83.8\ dBA$$

$$Adjusted\ AL = 83.8 + 2\ (meter\ accuracy) = 85.8\ dBA$$

Employee Exposure:

$$TWA = 16.61\log_{10}\left[\frac{53}{100}\right] + 90 = 85.4\ dBA$$

For more information about extended workshift sampling, see Appendix H.

3. <u>Hearing Conservation Program</u>

If the walkaround has not yet been completed, follow through by investigating noisy locations in person. If the walkaround has already been conducted, review your noise measurements taken at high-noise-level operations.

Where workers are exposed to noise at the AL or higher, examine the employer's hearing conservation program. Check that the program includes the basic elements of a hearing conservation program (e.g., monitoring, training, noise exposure reduction measures, audiometric evaluation) and that noise-exposed workers are enrolled in the program. Look for evidence that noise-exposed workers are receiving hearing conservation training and have been fitted with and taught to use their HPDs correctly. Confirm that the employer provided a choice of hearing protectors and that this personal protective equipment provided an appropriate level of protection for the workplace noise level. For more information about determining whether the attenuation of a HPD is sufficient, see Appendix E.

C. <u>Conducting the Walkaround Evaluation</u>

The walkaround inspection is a chance for you to see the workers' working conditions first hand and to measure noise levels using the sound level meter or noise dosimeter (set to operate as a sound level meter). Use your senses to identify areas that might have hazardous noise, and then use the sound level meter to document the noise levels.

For each noise level, include a description of the noise source (including a photograph), record the distance from the source at which the measurement was made, and note how many and which workers are potentially exposed. Also note that if a noise is intermittent, the frequency and duration of the noise, as well as both A- and C-weighted noise levels, must be identified unless octave band analyzer readings are possible.

Interview workers and supervisors to inquire about which areas they think are most noisy at the site. Also, ask which are the noisiest areas in which they work. As you visit these areas, identify the sources of noise, and use the noise sound level meter to determine whether sound levels could be hazardous.

Select workers for noise dosimetry and carefully explain the process, including the fact that the microphone only measures how loud or quiet the noise is; it does not record speech. Follow the dosimeter manufacturer's instructions to set up and use the instrument, being careful to record the time the instrument is turned on and off. Throughout the day, use the sound level meter to corroborate the noise dosimeter readings. Readings taken at times when significant noise events occur can be particularly useful, as are series of sound level readings obtained at regular intervals (e.g., once or twice per hour, or 10 times per shift).

1. <u>Create a Noise Diagram (Noise Mapping)</u>

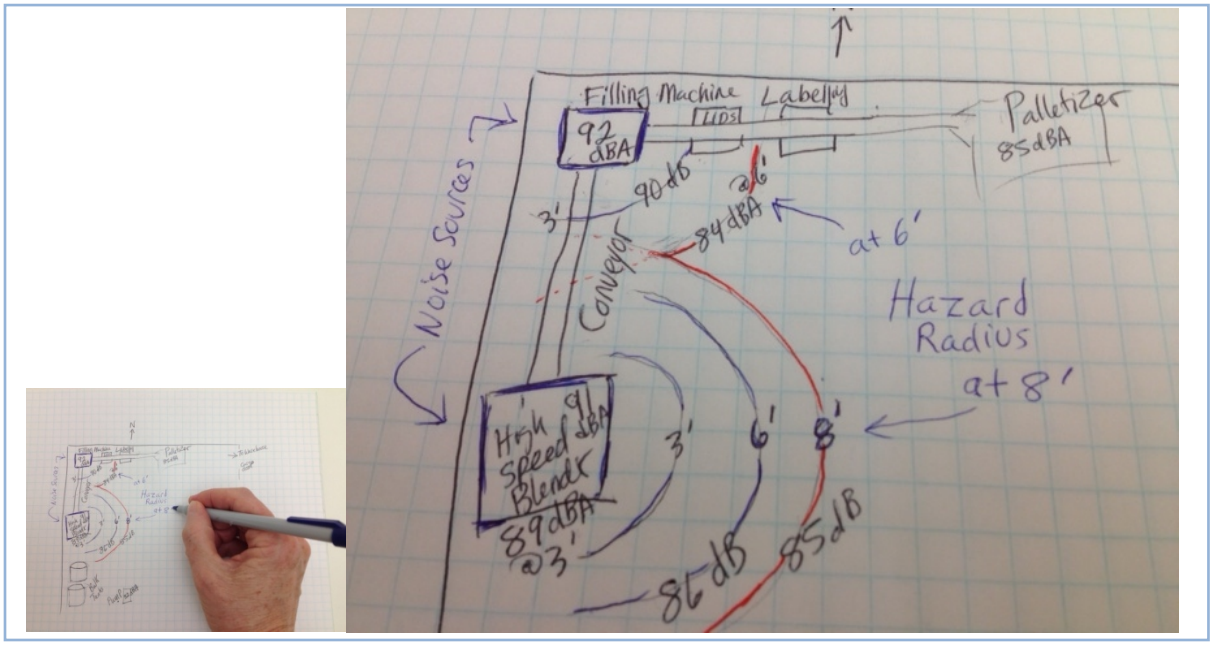
The noise diagram or schematic is a useful strategy for recording noise levels in context. The diagram can help determine which workers have noise exposure, and it is useful for communicating with workers and the employer. Use a plant schematic or sketch the general floor plan. Mark and identify noisy processes. Use the sound level meter to determine the noise level adjacent to the noisy equipment or process and at various distances from the noise source. Specifically, measure noise at the ear position of workers in the vicinity.

Next move away from the noise source, making sequential measurements to determine the "hazard radius"—the distances from the noise source at which the noise level drops to the PEL and below the AL (Figure 25). Mark the distances in the sketch. Also, the dimensions of the work area and the materials that were used to construct the room should be identified.

Figure 25. Taking Measurements for a Noise Diagram

Your completed sketch will show a series of contours around the noise source(s) (Figure 26). Expect the contours for adjacent noise sources to overlap. Workers operating entirely outside the contour are not exposed to noise in excess of the AL. Workers whose tasks take them closer to the equipment might experience exposures between the AL and the PEL, or even in excess of the PEL. Take photographs to document the type of equipment or process.

Figure 26. Drawing a Noise Diagram



Where noise levels exceed the PEL, an octave band analyzer can help you determine the frequency profile of the sound. This information can aid in pinpointing the cause of the sound (e.g., slipping belt, vibrating supports) and will be useful for planning control measures.

The sound level meter is also useful for confirming the extent to which the employer's-noise reduction measures have reduced workers' noise exposure. In this case, octave band analysis can help confirm that the materials used are appropriate for controlling the particular noise.

When monitoring is complete at the end of the day, follow standard procedures for recording results from the instruments. If necessary, consult the instrument user's manual or contact CTC for assistance. Dosimeter output usually includes the TWA (normalized to 8 hours), the L_{AVG} or L_{EQ} representing the average dose for the period monitored, the percent dose, and the maximum or peak reading. Do not neglect to perform the post-use calibration check on each instrument.

D. <u>Follow-Up Monitoring</u>

If noise levels documented by sound level meter or dosimetry on the first day indicate that additional sampling is required, you will need to return to conduct follow-up monitoring. The additional monitoring could be necessary to confirm that workers are adequately protected or that an overexposure exists, or you might need to monitor another operation not being performed on the first day. Since the follow-up monitoring will focus on noise dosimetry, prepare to arrive in time to start monitoring with calibrated equipment just as the shift begins. The goal is to sample for a full 8 hours (or 8 hours plus the lunch break period if the break is not included in the dosimetry).

See Appendix H for extensive information on conducting noise inspections. The appendix addresses (by section):

- *Pre-inspection activities.*
- *The opening conference (including a list of documents to request).*

- *Suggestions for the walkaround portion of the investigation, including sample questions for workers.*
- *Advice on using noise dosimeters to collect full-shift samples when the workday is not exactly 8 hours long.*
- *Considerations for post-inspection activities, including a list of items to discuss at the closing conference.*
- *Follow-up inspections.*
- *A list of example questions to ask the employer about hearing conservation and noise.*