# Can you hear me now? Occupational hearing loss, 2004–2010

*From 2004 to 2010, the manufacturing and utilities sectors had the highest rates of occupational hearing loss of all sectors listed at the two-digit level in the North American Industry Classification System (NAICS); primary metal manufacturing had the highest rate at the three-digit level*

Luis Felipe Martínez

Occupational hearing loss is a condition that results from exposure to noise or to nonnoise agents in a work environment. For example, loggers might experience hearing loss due to the loudness of their chainsaws, and professional disk jockeys might suffer hearing loss through listening to constant loud music. Occupational hearing loss continues to be a critical issue in the safety and health community. The National Institute for Occupational Safety and Health (NIOSH) estimates that 30 million workers are exposed to noise levels high enough to cause irreversible hearing loss. An additional 9 million workers are at risk of hearing loss from nonnoise agents,[1] such as organic solvents, certain metals, and carbon monoxide.[2] Sounds above 90 decibels can be harmful enough to cause hearing loss, especially when the exposure lasts for an extended time. (See exhibit 1.) Without preventative measures, many occupations—from assembly linesman, to airport baggage handler, to orchestra conductor—can experience permanent hearing loss from sources of noise in the workplace.

This article begins by relating the history of occupational hearing loss regulation and then goes on to analyze the most recent hearing loss data available. The article is the first to use illness data exclusively from the Bureau of Labor Statistics (BLS, the Bureau) to document trends in occupational hearing loss by industry. Among the topics covered are how the Occupational Safety and Health Administration's (OSHA's) recordkeeping guidelines helped establish the BLS data, what caveats there are in those data, and which industries have high rates of hearing loss.

## BLS hearing loss data

The Bureau provides annual statistics on occupational injuries and illnesses on the basis of employer reports. Categories of occupational injury and illness are defined by OSHA. Prior to 2004, the OSHA recordkeeping log did not separately identify hearing loss from other illnesses, so the Bureau lacked comprehensive data on the condition. Any hearing loss data before 2004 were captured in the Survey of Occupational Injuries and Illnesses (SOII) case and demographic data, a dataset that comprises only cases that involved at least 1 day away from work. Only a small fraction of recordable hearing loss cases involve days away from work.[3]

In 2002, OSHA added a specific hearing loss column to the agency's 300 recordkeeping

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**Exhibit 1. Occupational decibel levels**

| Decibels | Source of noise |
|---|---|
| 90 | Large truck 5 yards away |
| 100 | Typical rock concert |
| 120 | Jackhammer 3 feet away |
| 130 | Jet engine 100 feet away |

SOURCE: NIH- **http://www.nlm.nih.gov/medlineplus/ency/article/001048.htm**.

form, used by employees to record workplace injuries and illnesses.[4] OSHA cited the following reasons for the addition:

1. To improve the nation's statistical information on occupational hearing loss;
2. To facilitate analysis of hearing loss data at individual workplaces;
3. To improve the agency's ability to assess this common occupational disorder.

The effective date of OSHA's final rule was January 1, 2003. As a result of OSHA's actions, the SOII was able to capture hearing loss cases and began producing counts and rates by industry in 2004, releasing survey year 2004 data in November 2005.

## The SOII

The SOII estimates the number and the incidence rates of nonfatal recordable workplace injuries and illnesses on the basis of the OSHA recordkeeping logs kept by employers. Every year, a random sample of establishments is chosen across states, industries, and employment size categories for the SOII. Estimates[5] are then produced from the data provided by the establishments. In 2010, there were approximately 3.1 million recorded injuries and illnesses in private industry, of which only about 5 percent were illnesses. Of these illnesses, about 12 percent were hearing loss cases.

Data for injuries and illnesses are provided to the Bureau in the first 6 months of the year following the incident, and estimates are produced annually. Because of this time line, illnesses with long latency periods or illnesses that cannot be directly linked to a work environment are difficult to capture in the SOII. However, certain specific categories of illness, such as skin diseases and disorders, respiratory conditions, poisonings, and hearing loss, are included in the OSHA recordkeeping summary, allowing the Bureau to produce SOII estimates for these illnesses even if the incident did not involve any days away from work.

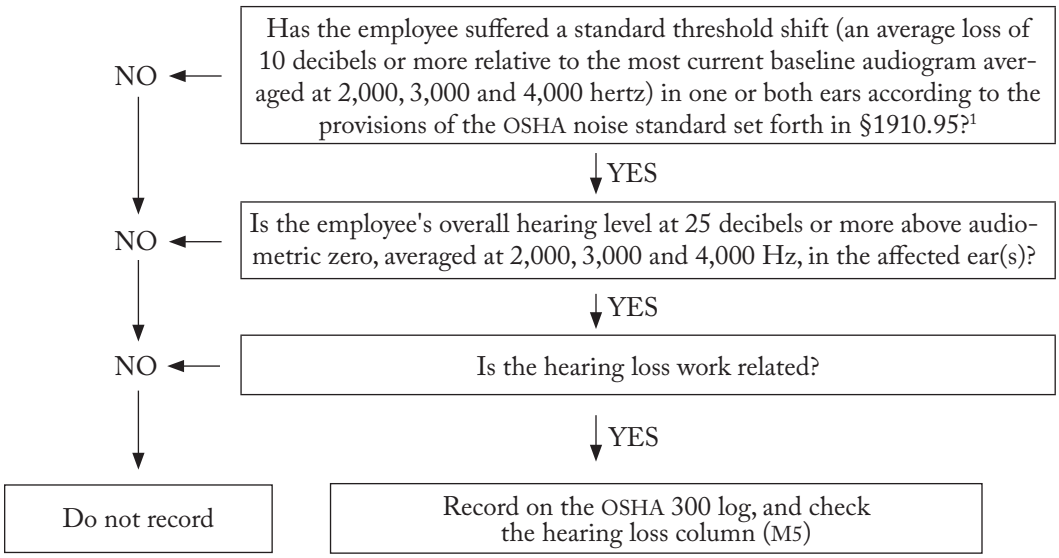
## OSHA's recordkeeping requirements

The Bureau produces hearing loss rates and counts by industry on the basis of the data it receives from respondents. Because of the inherent difficulty in capturing hearing loss cases, OSHA has strict recordkeeping criteria for these cases. There are three basic criteria for *recordability*. The first is that the employee experiences a standard threshold shift of at least 10 decibels in one or both ears, compared with the most current baseline audiogram[6] averaged at 2,000, 3,000, and 4,000 hertz. A difference of more than 10 decibels in hearing between the latest hearing test and the baseline hearing test is interpreted as hearing loss. The next criterion is that the employee's overall hearing is at least 25 decibels above audiometric zero.[7] This criterion determines whether the employee's overall hearing ability is acceptable, because hearing tests give hearing level results only above audiometric zero. The third criterion is that the hearing loss must be work related and thus not a preexisting condition or caused by sources outside of the workplace. To resolve any uncertainty about work relatedness, a physician or other licensed heath care professional may be consulted. (See chart 1 for the decision tree for OSHA's hearing loss recordability.)

Following are a few of the other recordkeeping rules besides the basic criteria:

- The standard threshold shift may be adjusted for aging. However, it cannot be adjusted during the determination of whether the overall hearing level is 25 decibels above audiometric zero.
- The employer may retest an employee within 30 days if the employer believes that the first result was faulty or if the employer suspects that the hearing loss is temporary.
- Employers must record a hearing loss case on their OSHA log within 7 days of the test (or retest).
- Hearing loss is presumed to be work related if the employee is exposed to workplace noise above OSHA's "action level," unless a physician determines otherwise. OSHA's action level is defined as exposure of 8 hours with a weighted average of 85 decibels.
- Hearing loss is recordable even if only one ear is affected.
- States that have their own OSHA plan still must adopt OSHA's federal recordkeeping rules.

**Chart 1. Decision tree for hearing loss recordability**




[1] The audiogram may be adjusted for presbycusis (aging) as set out in §1910.95.

NOTE: In all cases, to determine recordability, use the most current baseline in the same manner as you would to calculate a standard threshold shift under the hearing conservation provisions of the noise standard set forth in §1910.95. If a standard threshold shift occurs in only one ear, you may revise the baseline audiogram for that ear only.

SOURCE: *OSHA Recordkeeping Handbook*, §1904.10 (U.S. Department of Labor, 2005), **http://www.osha.gov/recordkeeping/handbook/index.html#1904.10**.

## OSHA standards for industry

OSHA's 2003 standard (§1910.95) treated the requirement of audiometric testing differently among industries. For a few selected industries, namely, construction, agriculture, and oil and gas drilling and servicing, audiometric testing is not required, even if employees experience noise levels at or above OSHA's action level. For what OSHA calls "general industry" (all industries except the selected industries), employers are required to administer audiometric testing through their hearing conservation program.[8] If any employers in the construction, agriculture, or oil and gas drilling and servicing industry voluntarily provide hearing tests for their employees and the hearing tests meet the recordability criteria, the employers must subsequently record the case on their OSHA 300 form. However, this difference in the requirement for audiometric testing makes data from general industry not directly comparable with data from the construction, agriculture, or oil and gas drilling industry.

## OSHA's interpretation of the rule

On October 19, 2010, OSHA formally announced that it would be pursuing a new interpretation of the term "feasible administrative or engineering controls" used in the occupational noise exposure standard. In essence, this interpretation questioned whether "personal protective equipment" (such as earplugs and ear muffs) was effective in preventing hearing loss or whether, instead, "administrative or engineering controls" (such as noise-canceling equipment for loud machines) were needed. OSHA's new interpretation also proposed "to consider administrative or engineering controls economically feasible when the cost of implementing such controls will not threaten the employer's ability to remain in business, or if such a threat to viability results from the employer's failure to meet industry safety and health standards."[9] In other words, under this new standard, employers would have to exchange personal protective equipment for administrative or engineering controls if they could afford it.

The new interpretation soon initiated a national debate. On one side, industry leaders, assisted by some U.S. Senators, argued that the changeover would cause an unnecessary economic burden to small and midsized employers.[10] Seconding this conclusion were several other stakeholders, such as the National Association of Manufacturers (NAM), the U.S. Chamber of Commerce, and the National Association of Home Builders. NAM's vice president of human resources policy opined that the new policy would "have a

massive impact in terms of lost jobs, stifling hiring."[11]

On the other side, safety and health advocates argued that the new interpretation was an essential step toward keeping employees safe from hearing loss in the workplace. A spokesperson for the AFL-CIO stated, "Hearing plugs and hearing muffs don't do an adequate job of protecting workers from noise compared to engineering controls,"[12] and the president of the American Academy of Audiology added, "The cost of implementation of these safeguards is a small price to pay for lessening the occurrence of noise-induced hearing loss."[13] NIOSH also was a strong proponent of the new interpretation.

On January 19, 2011, after a few months of deliberation, OSHA issued a press release in which it formally withdrew its new proposed interpretation.[14] The agency stated that the issue would need more discussion and public outreach from stakeholders. OSHA promised to

1. Conduct a thorough review of comments that had been submitted in response to the notice in the *Federal Register* and of any other information it might receive on this issue.
2. Hold a stakeholder meeting on preventing occupational hearing loss, in order to elicit the views of employers, workers, and noise control and public health professionals.
3. Consult with experts from NIOSH and from the National Academy of Engineering.
4. Initiate a robust outreach and compliance assistance effort to provide enhanced technical information and guidance on the many inexpensive, effective engineering controls for dangerous noise levels.

On November 3, 2011, OSHA held a stakeholder meeting to address concerns stemming from the new proposed interpretation of the hearing loss rule.[15] The meeting dealt with major hearing loss safety issues, such as best practices for hearing conservation programs, concerns and best practices regarding personal protective equipment and engineering and administrative controls, and real-life examples of companies that used their hearing conservation program effectively and what others can learn from their experience.

## Previous research on occupational illness

Although BLS hearing loss data are available only from 2004 onward, Sangwoo Tak and Geoffrey Calvert studied occupational hearing loss by industry from 1997 to 2003 and published their results in 2008.[16] They used data from 130,102 respondents to the National Health Interview Survey (NHIS), an annual cross-sectional survey that includes questions on hearing difficulty, among other health-related conditions. The survey asks its respondents, "Which statement best describes your hearing?" with the options of answering "good," "a little trouble," "a lot of trouble," and "deaf" available. The survey also asks about the subjects' places of work (industries). The results show that the prevalence of hearing difficulty was greatest for railroads, followed by mining;[17] primary metal manufacturing; furniture, lumber, and wood manufacturing; and transportation equipment manufacturing. The analysis also found that the construction industry had the most workers with hearing difficulty attributable to employment. Some limitations of Tak and Calvert's study are that (1) data are self-reported and not from audiometric testing, (2) there is no control for worker mobility between industries, (3) the series ends in 2003, and (4) the NHIS study design does not necessarily ascertain a causal relationship. However, the findings are generally consistent with BLS data for in-scope industries.

## BLS hearing loss data

Hearing loss is one of the five categories of occupational illness for which the Bureau collects data. As shown in chart 2, hearing loss constituted about 12 percent of total nonfatal occupational illnesses in private industry in 2010.

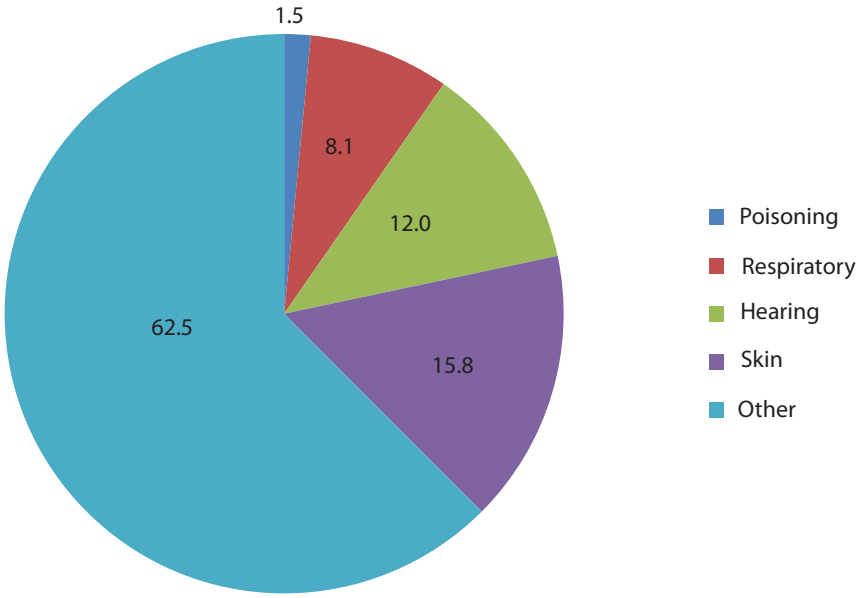
The Bureau started producing industry estimates of rates and counts of hearing loss beginning in survey year 2004. From 2004 to 2010, the private industry occupational hearing loss rate declined from 3.2 to 2.2 cases per 10,000 full-time workers. Chart 3 shows the trend in the hearing loss rate for private industry over the 2004–2010 period. The rate fell by 31 percent in that 7-year span, compared with a drop of 27 percent for total recordable injuries and illnesses in private industry over the same period.

As mentioned before, the construction, agriculture, and oil and gas drilling and servicing industries have audiometric testing standards different from those of all other industries. Accordingly, the analysis that follows excludes those three industries.[18]

## BLS hearing loss data by industry

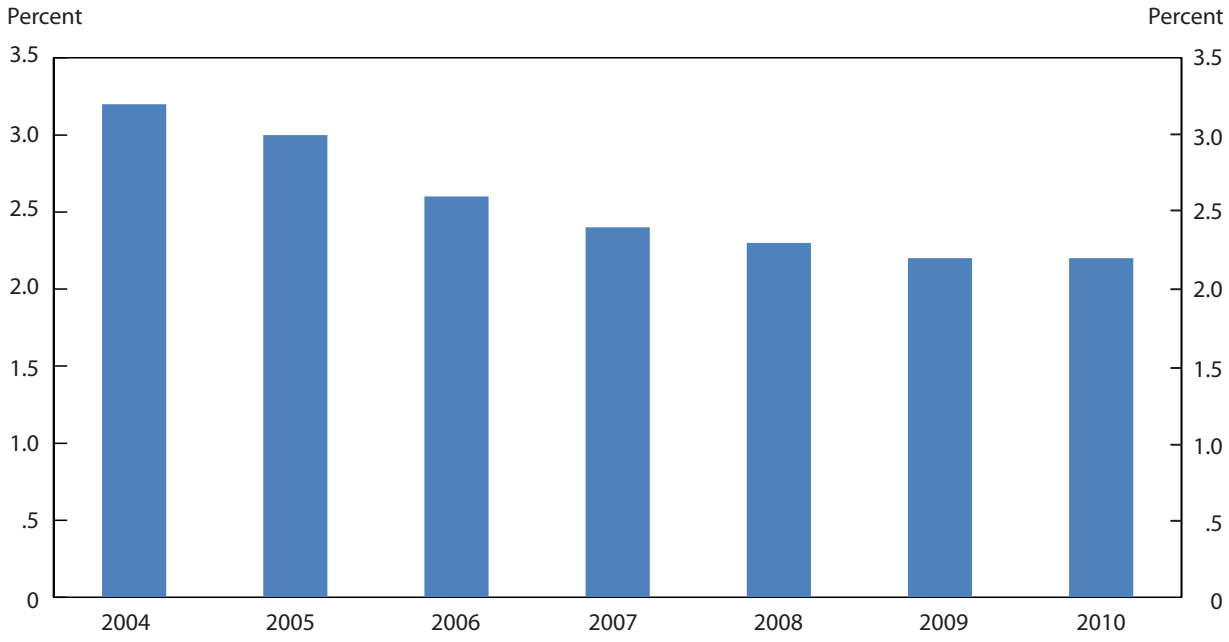
BLS estimates show that manufacturing and utilities consistently have the highest hearing loss rates among private sector industries. Other industry sectors, such as mining (except oil and gas), wholesale trade, and transportation and warehousing have rates typically close to the private

**Chart 2.** **Percent distribution of recorded illnesses, private sector, 2010**



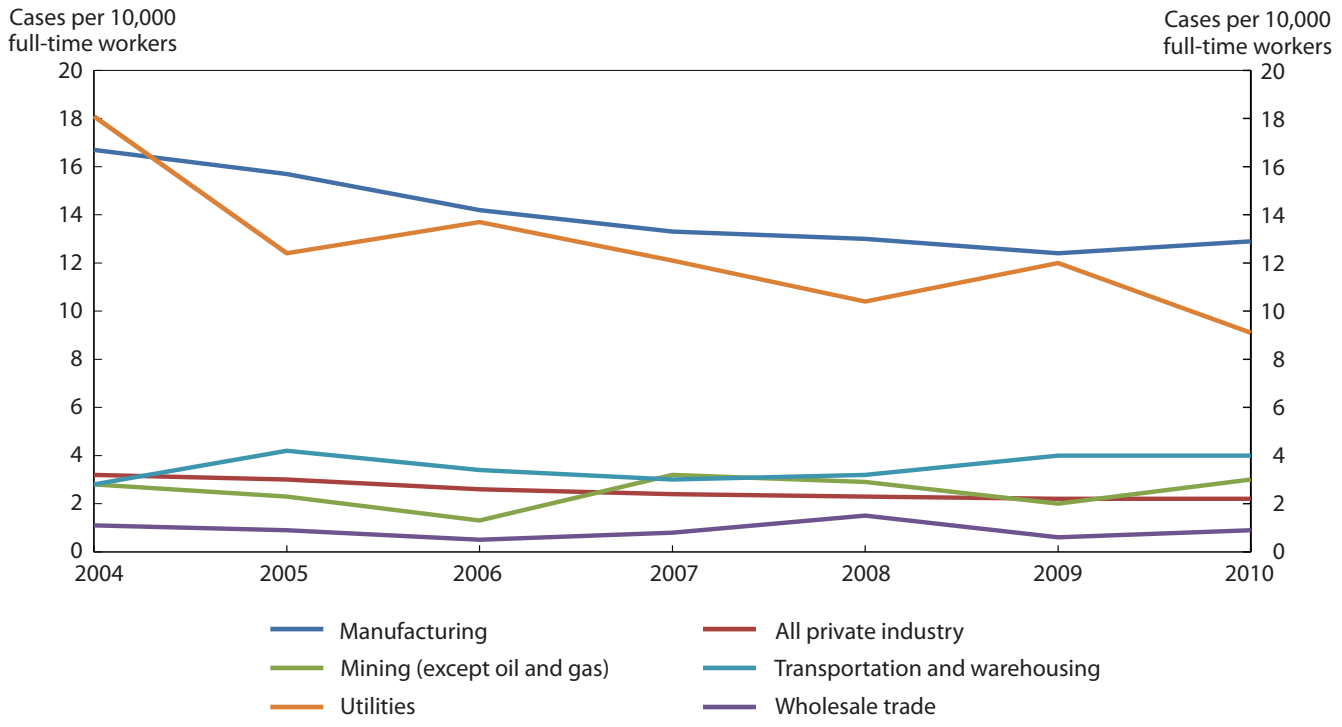

SOURCE: U.S. Bureau of Labor Statistics.

**Chart 3.** **Hearing loss rate, private industry, 2004–2010**




SOURCE: U.S. Bureau of Labor Statistics.

**Chart 4. Hearing loss rates, selected industries and all private industry, 2004–2010**




SOURCE: U.S. Bureau of Labor Statistics.

industry average. As shown in chart 4, the hearing loss rate in manufacturing declined from 16.9 to 12.9 from 2004 to 2010, and the utilities rate declined from 18.1 to 9.1 over the same period. No other selected sector rate declined during that timeframe.

Table 1 shows hearing loss rates for selected three-digit North American Industry Classification System (NAICS) industries from 2004 to 2010. Primary metal manufacturing had the highest hearing loss rate by far in 2010, with a rate of 33.8 cases per 10,000 full-time workers. The same industry also had the highest hearing loss rate in 2004 (40.1), the first year BLS hearing loss data were available.

## Industry breakdown

Analyzing hearing loss rates by industry shows that certain industries have consistently high rates. The Bureau also produces a publication that gives information on occupations, training and advancement, earnings, and, most importantly for the purposes of this article, working conditions by industry.[19] Information from this guide can help shed some light on why certain industries have high hearing loss rates.

Primary metal manufacturing had the highest occupational hearing loss rate among selected industries in 2010. The *Career Guide to Industries* has no specific section on primary metal manufacturing, but a section on steel manufacturing has NAICS coverage of two of the five component primary metal manufacturing industries.[20] Steel manufacturing had the third-highest prevalence of hearing difficulty among all industry sectors in the Tak and Calvert study. Even though many formerly manual processes have been automated, primary metal manufacturers still have to deal with very loud production machines. In response, most primary metal manufacturers still obligate their workers to wear protective earplugs.

The air transportation industry has consistently shown high hearing loss rates since 2004. Although occupations such as pilots, flight attendants, and ticketing agents might be the most noticeable to the average traveler, occupations such as baggage handlers, mechanics, and service technicians make up a substantial proportion of employment in this industry. These types of workers experience loud noises from aircrafts and are thus susceptible to occupational hearing loss.

Both food manufacturers and textile mills had overall hearing loss rates well above the average for private industry in 2010. Food-manufacturing plants continue to be very

**Table 1. Selected industries with high hearing loss rates, 2004–2010**

| 3 digit NAICS code | NAICS description | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|
| 331 | Primary metal manufacturing | 40.1 | 48.5 | 36.9 | 29.1 | 29.7 | 40.6 | 33.8 |
| 481 | Air transportation | 11.4 | 20.5 | 17.1 | 15.8 | 16.4 | 24.7 | 24.7 |
| 311 | Food manufacturing | 30.3 | 23.8 | 23.4 | 24.2 | 19.4 | 20.3 | 22.9 |
| 322 | Paper manufacturing | 15.5 | 20.1 | 20.5 | 18.2 | 26.7 | 16.2 | 19.1 |
| 332 | Fabricated metal product manufacturing | 18.2 | 18.0 | 15.3 | 14.1 | 14.4 | 13.8 | 16.5 |
| 336 | Transportation materials manufacturing | 25.6 | 22.3 | 20.7 | 19.5 | 17.9 | 15.5 | 15.3 |
| 313 | Textile mills | 19.0 | 30.3 | 24.1 | 20.0 | 16.6 | 18.7 | 12.7 |
| 337 | Furniture and related product manufacturing | 24.5 | 20.7 | 13.0 | 12.5 | 13.7 | 13.2 | 12.4 |
| 326 | Plastics and rubber products manufacturing | 16.8 | 14.8 | 17.0 | 11.1 | 14.4 | 13.9 | 11.3 |

SOURCE: U.S. Bureau of Labor Statistics.

loud, partly because former manual processes have now become automated. Working conditions in textile mills differ vastly from one mill to another. Many textile mill employees work for long periods in close proximity to loud production machines. Recently, however, textile mills have been incorporating "noise shields" into their equipment in an effort to make the work environment safer. In some facilities, these machines generate floating filament, dust, and other nonnoise agents that can exacerbate hearing loss.

These are just a few examples of the many industries in which an employee's work environment can produce hearing loss.

OCCUPATIONAL HEARING LOSS CONTINUES TO BE an important topic in the safety and health community, especially for employers who try to balance hearing loss safety with prevention costs and for policymakers who try to balance U.S. workers' right to occupational safety with the potential regulatory burden on businesses. BLS data from 2004 onward show that certain industries have high rates and counts of hearing loss. At the two-digit NAICS level, manufacturing and utilities have had consistently high rates, while primary metal manufacturing always has the highest rate at the three-digit level. The findings presented in this article are consistent with those of previous research carried out on the topic of workplace hearing loss and can be used to develop policy to help abate occupational hearing loss in the most efficient ways possible. □

## NOTES

[1] "Work Related Hearing Loss" DHHS (NIOSH) Publication Number 2001–103 (Centers for Disease Control and Prevention, 2001), **http://www.cdc.gov/niosh/docs/2001–103.**

[2] SangWoo Tak and Geoffrey M. Calvert, "Hearing Difficulty Attributable to Employment by Industry and Occupation: An Analysis of the National Health Interview Survey—United States, 1997 to 2003," *Journal of Occupational and Environmental Medicine*, January 2008, pp. 46–56.

[3] "Occupational Injury and Illness Recording and Reporting Requirements" (U.S. Department of Labor, Occupational Safety and Health Administration, Dec. 17, 2002), **http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FEDERAL_REGISTER&p_id=17536**.

[4] *Ibid.*

[5] Estimates must meet or exceed criteria for confidentiality and reliability (the latter as measured by standard errors) in order to be published.

[6] A baseline audiogram test shows the acuity of a person's hearing at the beginning of an exposure period.

[7] The Free Dictionary online (**http://medical-dictionary.thefreedictionary.com/audiometric+zero**) defines audiometric zero as "A value arbitrarily assigned to 0 dB...hearing level, the average hearing acuity for a normal population, which corresponds to 24.5 dB...sound pressure level at 250 Hertz."

[8] *OSHA Recordkeeping Handbook: The Regulation and Related Interpretations for Recording and Reporting Occupational Injuries and Illnesses*, OSHA 3245–09R (U.S. Department of Labor, Occupational Safety & Health Administration, 2005), **http://www.osha.gov/Publications/recordkeeping/OSHA_3245_REVISED.pdf.**

[9] "Interpretation of OSHA's Provisions for Feasible Administrative or Engineering Controls of Occupational Noise," *Federal Register*, Oct. 19, 2010, pp. 64216–64221, **http://edocket.access.gpo.gov/2010/2010–26135.htm**.

[10] The letter setting forth this point is available online at **http://workingforsafety.com/wp-content/uploads/2010/12/OSHALetter-toSolis121310.pdf**.

[11] See Kevin Bogardus, "Change in noise standards grabs business groups," *The Hill*, Dec. 13, 2010, **http://thehill.com/business-a-lobbying/133285-noise-rule-change-grabs-business-groups-attention?page=2#comments**.

[12] *Ibid.*

[13] See Patricia Kricos's letter to the Assistant Secretary of Labor for Occupational Safety and Health, Docket No. OSHA-2010–0032, **http://www.audiology.org/advocacy/grnews/Documents/201012_OSHA.pdf**.

[14] See "U.S. Department of Labor's OSHA withdraws proposed interpretation on occupational noise," *News Release* (U.S. Department of Labor, Occupational Safety & Health Administration, Jan. 19, 2011), **http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=NEWS_RELEASES&p_id=19119**.

[15] See "Stakeholder Meeting on Preventing Occupational Hearing Loss, Washington, DC: Meeting Summary Report" (U.S. Department of Labor, Occupational Safety & Health Administration, Nov. 3, 2011), **http://www.osha.gov/dsg/noise/stakeholder-meeting.html**.

[16] Tak and Calvert, "Hearing Difficulty Attributable to Employment."

[17] The Bureau produces estimates for mining and railroad industries; however, these data are out of scope for collection by the SOII and come instead directly from the Mine Safety and Health Administration and the Federal Railroad Association. Therefore, estimates for the mining and railroad industries are not directly comparable with estimates for in-scope industries collected by the SOII.

[18] The analysis does, however, include mining (except oil and gas).

[19] See Career Guide to Industries, 2010–2011 (U.S. Bureau of Labor Statistics, 2011).

[20] In the *Career Guide to Industries*, steel manufacturing encompasses NAICS 3311 (iron and steel mills and ferroalloy manufacturing) and 3312 (steel product manufacturing from purchased steel) but does not include 3313 (alumina and aluminum production and processing), 3314 (nonferrous metal (except aluminum) production and processing), or 3315 (foundries), the other component industries of primary metal manufacturing.