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# A Survey of Private Sector Respirator Use in the United States: An Overview of Findings

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*Limitations of previous surveys of respirator use led the National Institute for Occupational Safety and Health (NIOSH) and the Bureau of Labor Statistics to undertake a survey of respirator use and practices among U.S. private sector employers. The survey was mailed to 40,002 private sector establishments in August 2001; the responses were used to develop national estimates. Respirator use was required in 4.5% of establishments and for 3.1% of employees. Of the establishments requiring respirator use, 95% used air-purifying respirators and 17% used air-supplied respirators. Manufacturing; mining (including oil and gas extraction); construction; and agriculture, forestry, and fishing had the highest rates of establishment respirator use. Respirators were used most frequently to protect against dust/mist, paint vapors, and solvents. Large percentages of establishments requiring respirator use had indicators of potentially inadequate respirator programs. Of establishments requiring respirator use, 91% had at least one indicator of a potentially inadequate respiratory protection program, while 54% had at least five indicators. The survey findings suggest that large numbers of employers may not follow NIOSH recommendations and Occupational Safety and Health Administration (OSHA) and Mine Safety and Health Administration (MSHA) requirements for the selection and use of respirators, potentially putting workers at risk. The findings will aid efforts to increase the appropriate use of respirators in the workplace.*

**Keywords** respirator use and programs, survey, fitness, fit testing, training

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## INTRODUCTION

Previous surveys of respirator use within the private sector of U.S. business establishments<sup>(1–6)</sup> are either outdated or limited in scope. For this reason, many fundamental questions about respirator use in the United States remain unanswered.

A number of issues, such as the extent of fit testing, methods for determination of workers' medical fitness, and the extent of air sampling associated with respirator selection, have not been systematically investigated. This type of information is critical to ensuring that respirator programs adequately protect U.S. workers.

The National Institute for Occupational Safety and Health (NIOSH), the Occupational Safety and Health Administration (OSHA), and the Mine Safety and Health Administration (MSHA) each have specific responsibilities in ensuring U.S. workers have adequate respiratory protection. OSHA and MSHA share regulatory responsibility for one standard industrial classification (SIC)—Mining.<sup>(7)</sup> Mining is an industry division (a grouping of two-digit SICs) that includes oil and gas extraction, regulated primarily by OSHA, as well as more traditional mining activities regulated by MSHA.

NIOSH has played an active role in respirator testing, certification, and research since the early 1970s.<sup>(8)</sup>

OSHA mandates the use of NIOSH-certified respirators when there is a potential for a contaminant's airborne concentration to exceed its established exposure limit or if the employer requires respirator use.<sup>(9)</sup>

MSHA regulations provide that approved respiratory protection be made available to all affected underground coal miners, but it is not required to be worn.<sup>(10)</sup> MSHA's standards for metal/nonmetal mines require that respiratory protection be used when (a) an air quality standard is exceeded and controls are either not feasible or are being established, or (b) during the occasional entry into hazardous atmospheres to perform maintenance or investigations.<sup>(11,12)</sup> When respirators are required, metal/nonmetal mine operators must establish a respiratory protection program consistent with the requirements of ANSI Z88.2-1969.<sup>(13)</sup>

In addition to the respirator testing, research, and certification roles, NIOSH undertakes surveillance regarding respiratory protection. As part of this surveillance activity, NIOSH investigators collaborated with the Bureau of Labor Statistics

(BLS) staff to design and undertake a survey to obtain representative data regarding respirator use and practices by private sector employers within the United States. The survey was conducted in 2001. This article summarizes the results and provides: (1) a brief overview of the survey; (2) a summary of the extent of respirator use; (3) a comparison of the respirator practices among employers to federal respirator use regulations and guidelines; and (4) a comparison with results from the OSHA PPE Cost Survey.<sup>(6)</sup> The complete respirator survey results were published as a joint BLS/NIOSH report,<sup>(14)</sup> which can be obtained from NIOSH by telephoning 1(800)35NIOSH, or from [www.cdc.gov/niosh/docs/respsurv/](http://www.cdc.gov/niosh/docs/respsurv/).

## METHODS

The survey was designed to obtain information from private sector establishments on respirator use and practices. Most of the survey questions address respirator use that is “required” by the employers or by federal regulation, rather than “voluntary” use by employees (voluntary use is a practice accepted by OSHA since 1998<sup>(9)</sup>). The survey was developed in several stages. In the first stage, NIOSH investigators provided BLS with an initial set of survey questions, a list of specific substances believed to require respirator use, and direction in technical matters, such as respirator types and uses, and regulations associated with respirator use.

In the second stage, BLS pretested the questionnaire to gauge its content as well as semantic and linguistic features and obtain respondent reaction. Twelve cognitive interviews were conducted with 11 establishments during two rounds of pretesting.<sup>(15)</sup> After modification, the questionnaire was field-tested in the third stage at 120 establishments to obtain additional data on the cognitive, linguistic, and measurement issues.<sup>(16)</sup> In the final stage, the results of the field testing were discussed with the BLS Business Research Advisory Committee and the Labor Research Advisory Committee to produce a final survey questionnaire, which is included in the BLS/NIOSH report.<sup>(14)</sup>

Questions were included to allow estimation of the number of establishments and number of employees who use respirators by type of respirator, defined as: (1) air-purifying respirators (APRs), and (2) air-supplied respirators (ASRs). Additional questions were asked to allow estimation of the number of establishments that use respirators by type of use, defined as: (1) voluntary use, (2) required nonemergency use, and (3) required emergency use.

Questions also addressed the characteristics of the respirator program at each surveyed establishment, including: (1) respirator selection methods, (2) qualifications of program administrator, (3) training of respirator users, (4) assessment of fitness to wear respirators, (5) fit testing methods used for respirators, (6) cartridge/canister change-out schedules, (7) airline respirator requirements, (8) maintenance and care of respirators, and (9) review of program effectiveness.

The 40,002 surveyed establishments were selected from a sampling frame of 174,305 private sector establishments that were used in the BLS Survey of Occupational Injuries and Illnesses (SOII) in 1999.<sup>(17)</sup> The sampling frame represents approximately 2.8% of all private sector establishments in 1999. The SOII sample was originally drawn from the BLS Longitudinal Establishment Database and excluded agricultural establishments employing 10 or fewer workers.<sup>(18)</sup> All establishments in the sample were located in the 50 states or the District of Columbia. The sample was stratified by two levels of SIC and establishment employment size.

BLS selected the sample size (40,002) by considering the historical data that was available and making assumptions on standard errors and estimated sample sizes for various sample designs. The sample size was selected to assure that the industry division estimate would have a relative standard error of less than 5%. A probability proportional to size allocation was used with respect to the expected number of establishments that used respirators (based on historical OSHA data). This enabled BLS to sample more heavily from the industries where respirator use was expected.

The survey questionnaires were mailed by BLS to the selected establishments during August 2001. The cover letter and questionnaire both requested that the person best informed about respirator use at the establishment complete the questionnaire. Another copy of the survey questionnaire was sent in October 2001 to establishments that had not responded to the first mailing; those who still had not responded after the second attempt were called during the period from December 2001 through February 2002. The final response rate at the closing of the survey was 75.5%. BLS reviewed the returned questionnaires and tabulated the responses in NIOSH-defined tables.

The results of the survey are estimates based on a selected probability sample, rather than a census of the entire population. The survey estimating procedure generated respirator use and practices estimates for all industries at the two-digit SIC level, the industry division level, and the establishment employment size group. These estimates are based on the survey weighting and probability sample and are tabulated in the BLS/NIOSH report.<sup>(14)</sup>

The findings reflect efforts by the BLS to adjust for non-response bias, anomalous responses, and data that reflect respondent error and inconsistency; those efforts are described in the BLS/NIOSH report.<sup>(14)</sup> In addition, relative standard errors have been calculated for each estimate in the BLS/NIOSH report and are available on request.

## RESULTS

### Respirator Use Estimates

The survey generated estimates of two types of respirator use: (1) any respirator use, as indicated by responses to the question, “Do employees at this establishment use respirators (including dust masks with two headstraps)?” and (2)

required respirator use during the 12 months prior to each establishment's completion of the survey. The estimates are extrapolations resulting from the previously described survey estimating procedure.<sup>(14)</sup>

### Any Respirator Use

The responses to the question on any respirator use indicate that respirators were used at 619,430 establishments (or 10% of all establishments).<sup>(14)</sup> Among those establishments, 306,264 (49%) had voluntary use only, 196,545 (32%) had required use only, and 116,621 (19%) had a mix of voluntary and required uses. Mining (28%, with oil and gas extraction included) and manufacturing (27%) had the highest rates of establishments with any respirator use.<sup>(19)</sup>

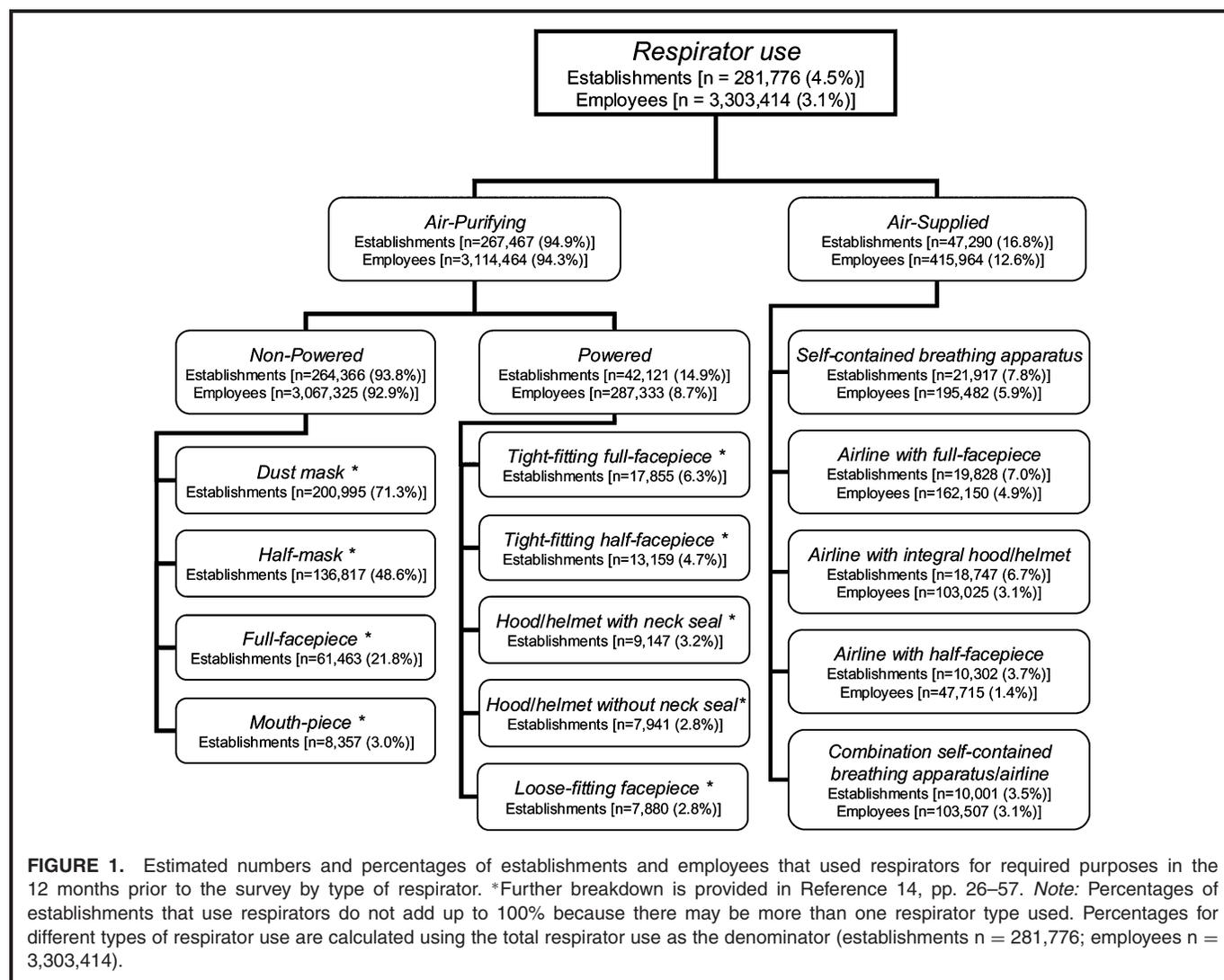
### Required Respirator Use During the 12 Months Prior to the Survey

All of the following findings are estimates based on questionnaire responses concerning required respirator use (emer-

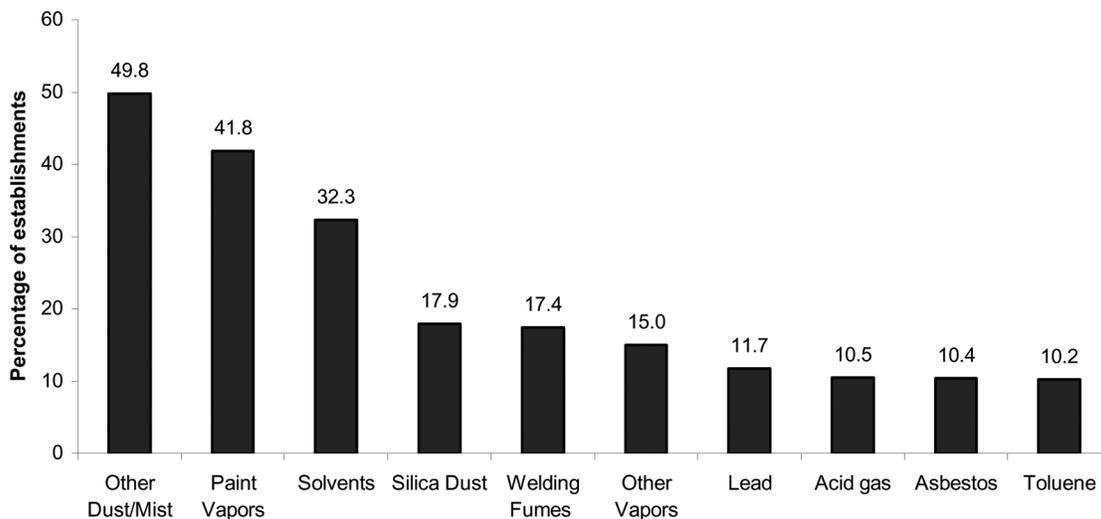
gency and nonemergency) during the 12 months prior to each establishment's completion of the survey.

Figure 1 presents the number and percentage of establishments and employees that used respirators by type of respirator. For the 281,776 establishments (or 4.5% of all establishments) that required employees to use respirators, the highlights include

- 95% required the use of air-purifying respirators (APRs) and 17% required the use of air-supplied respirators (ASRs)
- dust masks (disposable, filtering facepieces) were used in 71% of establishments that required respirator use and were the most commonly used nonpowered APRs, followed by half-mask respirators
- self-contained breathing apparatus (SCBA) respirators were the most commonly used ASRs, followed by airline respirators with full facepieces and airline respirators with integral hood/helmet.



**FIGURE 1.** Estimated numbers and percentages of establishments and employees that used respirators for required purposes in the 12 months prior to the survey by type of respirator. \*Further breakdown is provided in Reference 14, pp. 26–57. Note: Percentages of establishments that use respirators do not add up to 100% because there may be more than one respirator type used. Percentages for different types of respirator use are calculated using the total respirator use as the denominator (establishments n = 281,776; employees n = 3,303,414).



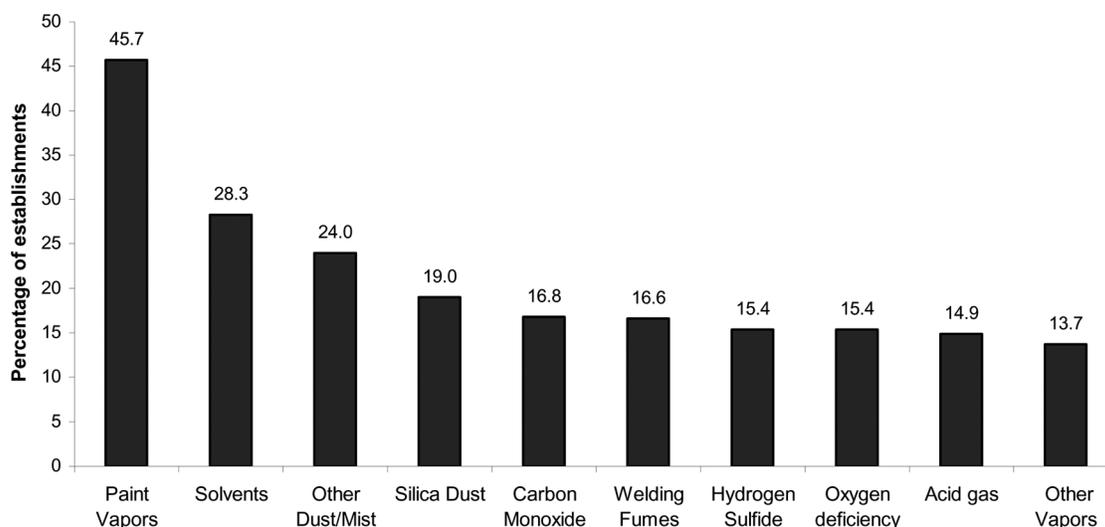
**FIGURE 2.** Percentage of establishments with air-purifying respirator use to protect against the ten most frequently indicated substances. *Note:* Denominator is the estimated total number of establishments with air-purifying respirator use ( $n = 267,467$ ). The category “other dust/mist” includes “other dust” and “other” text responses that were determined to be in the form of dust. The category “other vapors” includes “other vapors” and “other” text responses that were determined to be in the form of vapors. All substances are listed in Reference 14, pp. 149–157.

Of the establishments that required respirator use, almost 98% required nonemergency use, while 10% required emergency use (some establishments had both nonemergency and emergency use).<sup>(14)</sup>

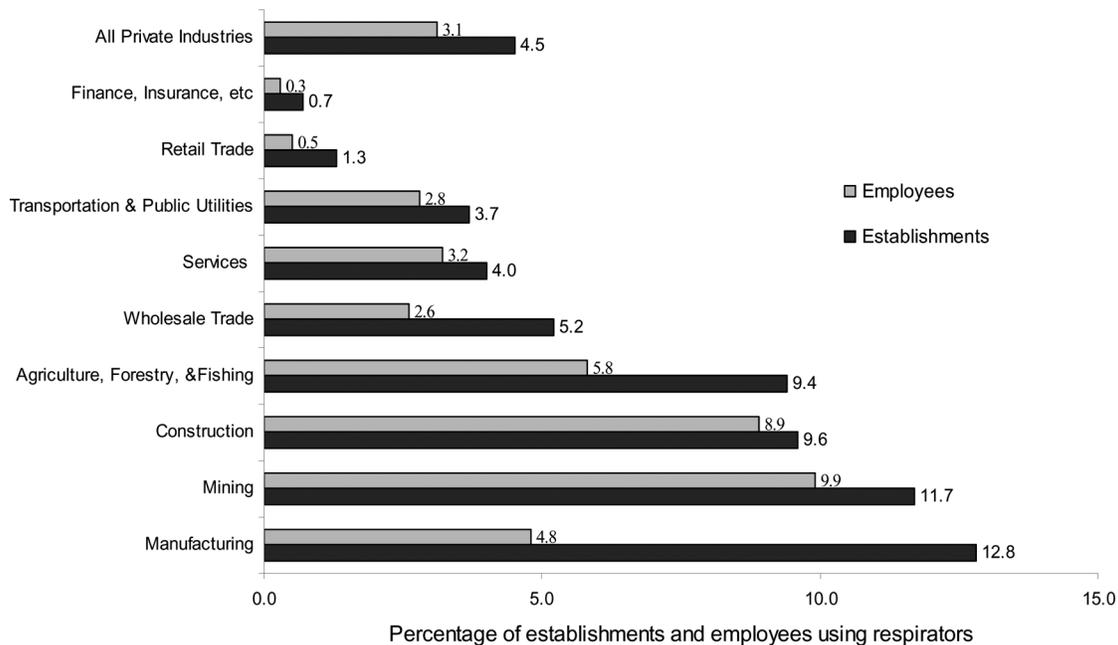
Other dust/mist, paint vapors, solvents, and silica dust were the most common substances that APRs (Figure 2) or ASRs (Figure 3) were used to protect against. Other analyses have found that a surprising number of establishments (24,497) used APRs to protect against carbon monoxide.<sup>(20)</sup>

Figure 4 indicates that respirator use among industries ranged from 1% of establishments in finance, insurance, and real estate to 13% in manufacturing. The percentage of employees using respirators, by industry, ranged from less than 1% in finance, insurance, and real estate to 10% in mining (with oil and gas extraction included).

Although employees in only 4% of the service industry establishments used respirators, this sector had the largest number of establishments that used respirators (89,600).<sup>(14)</sup> While



**FIGURE 3.** Percentage of establishments with air-supplied respirator use to protect against the ten most frequently indicated substances. *Note:* Denominator is the estimated total number of establishments with air-supplied respirator use ( $n = 47,290$ ). The category “other dust/mist” includes “other dust” and “other” text responses that were determined to be in the form of dust. The category “other vapors” includes “other vapors” and “other” text responses that were determined to be in the form of vapors. All substances are listed in Reference 14, pp. 159–167.



**FIGURE 4.** Percentage of establishments and employees with required respirator use in the 12 months prior to the survey by industry division. *Note:* Denominators are the BLS ES-202 estimates of the number of private sector establishments or employees in each respective industry division. 'Mining' includes oil and gas extraction. Reference 14, pp. 26–27.

only 3% of employees in the services industry used respirators, that industry employed the largest number of respirator users (one-third of all respirator users). The largest numbers of respirator-using employees within the services industry were found in

- health services (629,946)
- business services (129,152)
- automobile services (110,490)
- engineering and management services (94,559).

The percentage of establishments with respirator use was largest in establishments with a thousand or more workers and decreased substantially as employment size decreased (Figure 5). This was true for each type of respirator.

The overall estimate for required respirator use (281,776 establishments, or 4.5%) has a 95% confidence interval (CI) of  $\pm 506$  establishments. The overall estimate of the number of employees using respirators (3,303,414 employees, or 3.1%) has a 95% CI of  $\pm 691$  employees. The confidence intervals vary in relative size as the size of the population being addressed gets smaller. For example, the estimated number of employees using respirators in the business services industry (reported above as 129,152) has a 95% CI of  $\pm 23,354$  employees.

## RESULTS

### Characteristics of Respirator Programs

This section compares the respirator use and practices among employers with respirator regulations and/or guidelines. It includes a summary of various indicators of potentially

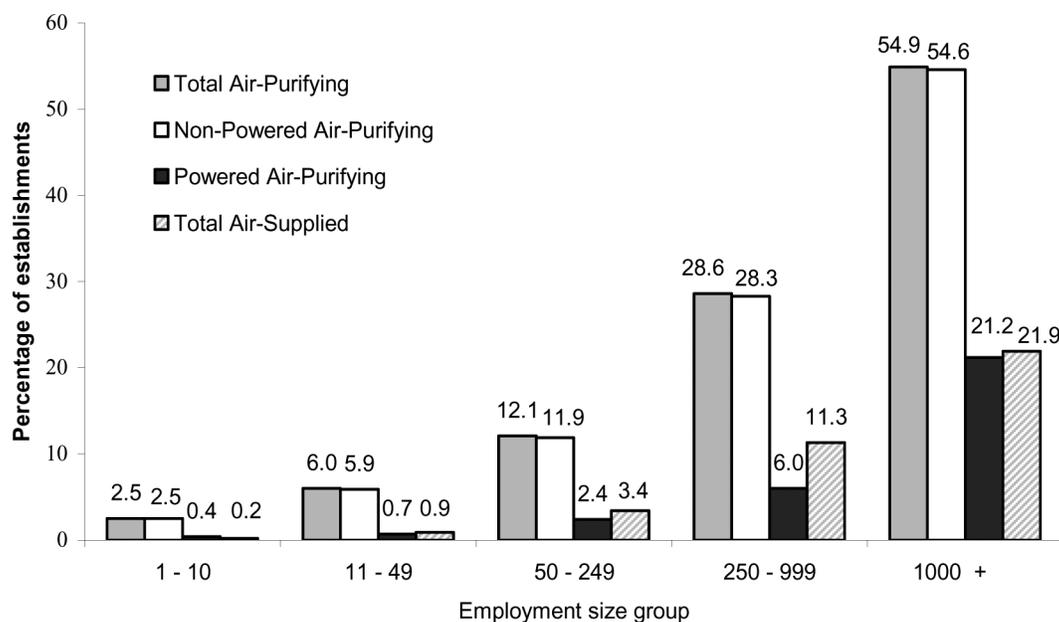
inadequate respiratory protection programs, as summarized in Table I.

### Respirator Program Administrator Training

OSHA regulations require the employer to designate a program administrator who is qualified, by appropriate training, to administer or oversee the respiratory protection program and evaluate the program's effectiveness.<sup>(9)</sup> There was no person designated as the program administrator in approximately 14% of all establishments requiring respirators. The greatest percentages of establishments with no program administrator were in the retail trade (24%), the construction (17%), and the services (14%) industries. The program administrator had received no specific respirator training in approximately 42% of all establishments requiring respirators. The training of the program administrator can be important to the respirator program. For example, in establishments with a trained administrator, a written procedure for maintaining (cleaning, disinfecting, discarding, replacing) respirators was found in 70% of them, and a written procedure for periodically evaluating the effectiveness of respirator use was found in 55%.<sup>(19)</sup> However, in establishments without a trained administrator, only 23% had a written procedure for maintaining (cleaning, disinfecting, discarding, replacing) respirators, and only 11% had a written procedure for periodically evaluating the effectiveness of respirator use.<sup>(19)</sup> Both of these respirator program elements are required by regulation.<sup>(9)</sup>

### Written Respirator Program

OSHA regulations require the employer to develop and implement a written respiratory protection program with



**FIGURE 5.** Percentage of establishments with various types of respirators used for required purposes in the 12 months prior to the survey by employment size group. *Note:* Denominators are the BLS ES-202 estimates of the number of private sector establishments or employees in each respective employment size group.

worksite-specific procedures and elements for required respirator use.<sup>(9)</sup> Only 34% of the respirator-using establishments based respirator use on a written program adopted by management as specified by regulations (Figure 6). Among those with 1 to 10 employees, only about 23% based respirator use on a written program. Survey results showed that instead of written programs, supervisors decided how respirators are used in 23% of respirator-using establishments, employees decided in 22%, and the respirator manufacturers' written instructions were used in 20%.

### Respirator Selection

Another critical feature of a respirator program is the proper selection of respirator type. It is recommended that establishments evaluate their own workplace air sample results or those from another establishment with very similar operating conditions.<sup>(8,21)</sup> Air sampling results indicate the concentration of airborne contaminants, and this information can help the program administrator determine the appropriate type of respirator needed to protect the workers. Of establishments requiring respirator use, 24% used air sampling done at the establishment and 6% used air sampling done at another establishment with similar operating conditions. For small establishments (1 to 10 employees), 13% used air sampling done at the establishment and 5% used air sampling done at establishments with similar operating conditions.

### Respirator Training, Medical Evaluations, and Fit Testing

Federal regulations require the employer to provide effective training to employees who are required to use respirators so they understand the need, use, limitations, and capabilities

of the respirators they wear.<sup>(9,11-13)</sup> Of establishments with respirator use, 59% trained their employees to understand the substances for which they are used and the use and limitations of the respirators they wear.

OSHA regulations state that, before the employee is fit tested or required to use the respirator in the workplace, the employer must provide a medical evaluation to determine the employee's fitness to use a respirator in the conditions for which they are required.<sup>(9)</sup> Employees were not assessed for medical fitness to wear a respirator or respondents did not know if they were assessed in 51% of establishments where respirators were required.

It is critical that fit testing be conducted to ensure that wearers of tight-fitting respirators receive the appropriate protection while working with toxic and potentially lethal substances. Before an employee is required to use any respirator with a negative- or positive-pressure tight-fitting facepiece, the regulations require the employee to be fit tested.<sup>(9)</sup> All tight-fitting respirator wearers were fit tested in 57% of their establishments. Of the small establishments (1 to 10 workers) that used tight-fitting respirators, fewer (46%) reported that they provided respirator fit tests. Irritant smoke and saccharin were the most common methods of fit testing. Qualitative methods of fit testing were used by a greater number of establishments than quantitative methods.<sup>(14)</sup>

### Cartridge/Canister Change-Out Schedules

The timely replacement of gas/vapor filtering cartridges/canisters for air-purifying gas/vapor respirators is important because many substances do not have warning properties of taste or odor that would alert the wearer of the need to replace

**TABLE I. Selected Indicators of Potentially Inadequate Respiratory Protection Programs with Percent Occurrence Among Establishments Requiring Respirator Use**

Definition of Indicator	Estimated Number of Establishments with Indicator/Estimated Denominator	Percent
No written change-out schedule for establishments with the use of air-purifying gas/vapor filters	95,700/122,459	78.1%
Improper method of setting air pressure to control airflow on airline respirators, or don't know which method is used	32,105/41,562	77.2%
No written program for deciding how respirators are used	184,610/281,776	65.5%
No written procedures to periodically evaluate the effectiveness of respirator use, or don't know if such procedures exist	181,124/281,776	64.3%
No assessment of the medical fitness of respirator-wearing employees, or don't know if an assessment is done	144,245/281,776	51.2%
No written procedures and schedule for maintaining respirators, or don't know if such procedures exist	140,584/281,776	49.9%
No fit testing for each tight-fitting respirator wearer, or don't know if fit testing is done	116,760/269,389	43.3%
No specific respirator training for program administrator	118,138/281,776	41.9%
No training for employees regarding respirator use and limitations	116,715/281,776	41.4%
Used dust masks (disposable) to protect against gases or vapors	50,832/200,995	25.3%
Airline respirator hose couplings are compatible with couplings for other air or gas supply lines, or don't know about compatibility	9846/41,562	23.7%
No one assigned to be responsible for directing and overseeing the use of respirators	38,547/281,776	13.7%
Didn't know which method or who was responsible for assessing employees' medical fitness, or didn't know what method was used to fit-test employees	33,987/281,776	12.1%
Didn't know if air sampling was conducted for substances during jobs requiring the use of either air-purifying or air-supplied respirators	11,424/246,685	4.6%
Not familiar with respirator terms/language used in at least two of nine questions regarding respirator selection, types of respirators/hazards, and fit-test methods	2248/281,776	0.8%

*Note:* Data in this table were obtained from Reference 14, *Respirator Usage in Private Sector Firms, 2001*, published by NIOSH and the Department of Labor's Bureau of Labor Statistics, and an unpublished Bureau of Labor Statistics analysis of the survey data described in Reference 14. The analysis is available from the authors on request.

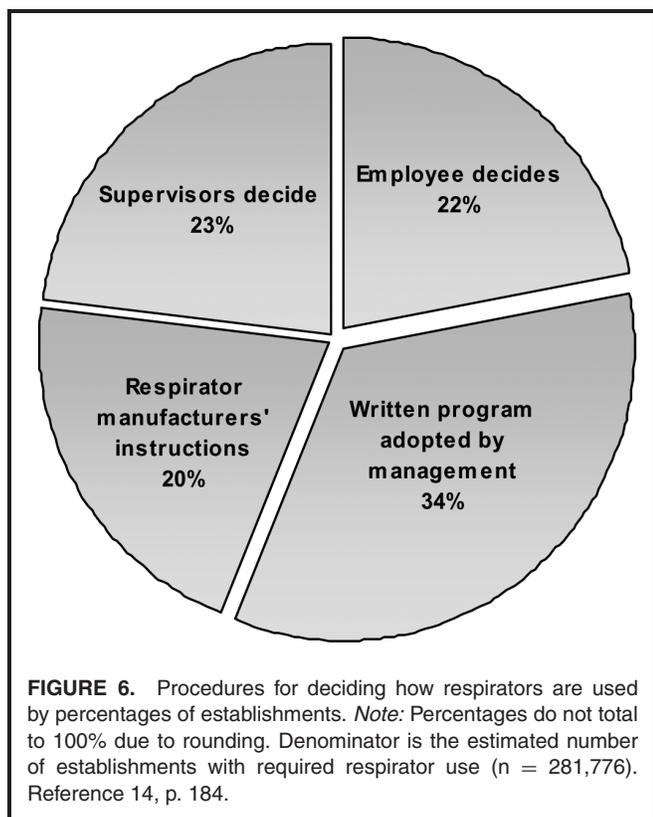
the cartridge/canister. Cartridges/canisters have finite service times that can be very short for some substances. If an end-of-service-life indicator (ESLI) appropriate for conditions in the employer's workplace is not available, the OSHA-regulated employer must implement a change-out schedule for cartridges/canisters.<sup>(9)</sup> Without a change-out schedule, workers could unknowingly wear respirators having spent cartridges/canisters, thus deriving little or no protection, and putting themselves at risk. A written change-out schedule to replace cartridges/canisters was not part of the establishment's policy for 78% of establishments requiring air-purifying respirators for gases/vapors. (However, some of those establishments could have used ESLI for some or all of the substances. ESLIs are available for a limited number of substances.)

#### *Airline Respirator Requirements*

For airline respirators to meet NIOSH certification, the airflow must be controlled where the air hose connects with the compressed air source and must be set according to the pressure

given on the certification label or in the user's instructions from manufacturers.<sup>(8)</sup> The rate of airflow is essential if a wearer is to be provided adequate protection. Of all establishments requiring the use of airline respirators, 77% either did not appropriately use the air pressure range given on the certification label or in the user's instructions or did not know if the appropriate air pressure was used.

The wearers of airline respirators would be in imminent danger if an airline were inadvertently connected to a line that carried an asphyxiating substance such as nitrogen or argon. From 1984 through 1995, 15 deaths related to coupling compatibility between airline respirators and nonbreathable air supplies were identified.<sup>(22)</sup> The fatalities could have been prevented by compliance with existing respirator regulations. Those regulations require the employer to ensure that hose couplings of airline respirators are incompatible with outlets for nonrespirable worksite air or other gas systems.<sup>(9)</sup> Eighteen percent of establishments requiring the use of airline respirators had respirator hose couplings that were compatible



with couplings for other air or gas supply lines. Another 6% of establishments did not know if they were compatible with couplings for other air or gas supply lines. About 40% of the mining (includes oil and gas extraction) establishments that used airline respirators used respirator hose couplings that were compatible with other air or gas supply lines.

#### Indicators of Potentially Inadequate Respirator Programs

Certain responses to 15 questions in the survey can be considered indicators of potentially inadequate respirator programs. Eight of these 15 were previously discussed in this section. These eight, as well as seven additional indicators, are listed in Table I, along with their respective rates of occurrence.

Ninety-one percent of establishments requiring respirator use had at least one indicator of a potentially inadequate respiratory protection program, and 54% had at least five (Table II).

## DISCUSSION

This survey provides the most comprehensive and up-to-date information on respirator use and associated practices in a wide range of industries. The findings provide information useful in identifying interventions and research needed to improve the overall respiratory protection in occupational settings. The results disclose indicators of potentially inadequate respiratory protection programs and indicate that workers may be at risk.

The BLS/NIOSH survey has certain limitations. The findings do not apply to public sector use of respirators or agri-

**TABLE II.** Percent of Establishments Requiring Respirator Use that have Selected Numbers of Indicators of Potentially Inadequate Respirator Programs

Number of Potential Indicators	Percent of Respirator-Using Establishments	Cumulative Percent of Respirator-Using Establishments
9–15	5.2	5.2 (9 or more indicators)
7–8	25.6	30.8 (7 or more indicators)
5–6	23.0	53.8 (5 or more indicators)
3–4	17.3	71.1 (3 or more indicators)
1–2	19.5	90.6 (1 or more indicators)
0	9.4	

*Note:* The denominator is the number of establishments with required respirator use ( $n = 281,776$ ).

cultural establishments with 10 or fewer employees. In 2001, the public sector employed approximately 20 million workers, and agricultural establishments with 10 or fewer employees accounted for approximately 1.3 million employees.<sup>(23)</sup> As with any survey, there is potential for misunderstanding of the questions. Moreover, the accuracy of the responses is heavily dependent on the person who completed the questionnaire at the establishment. Although the survey instructions stated that the person most informed about respirator use at the establishment was to complete the questionnaire, there is no certainty that this occurred or that the person was totally familiar with all features of the respiratory protection program.

The BLS/NIOSH survey<sup>(14)</sup> and the 1998 OSHA PPE Cost Survey<sup>(6)</sup> (OSHA survey) are especially worthy of comparison because they are the two most recent respirator surveys. The BLS/NIOSH survey was substantially larger than the OSHA survey, including 40,002 establishments from the entire private sector (including the mining industry), whereas the OSHA survey sample consisted of 3722 business establishments under OSHA's jurisdiction (which includes oil and gas extraction but not other mineral extraction). The BLS/NIOSH survey used a mailed questionnaire and yielded a response rate of 75.5%, while the OSHA survey was conducted by telephone and yielded a lower response rate of 47.1% (includes only those establishments who were available at the time of telephone survey). However, if the establishments that were not available at the time of the OSHA survey are excluded from the response rate calculation, the OSHA survey response rate increases to 75.5%, the same rate as the BLS/NIOSH survey. There were also differences in sampling strategies, wording of the questions, and procedures for follow-up. The BLS/NIOSH survey divided establishment employment size into five categories, while the OSHA survey divided establishment employment size into three categories (Table III).

The BLS/NIOSH survey estimated that 10% of all establishments used respirators,<sup>(14)</sup> while the OSHA survey estimated that 13% of all establishments used respirators (Table III). A substantially smaller percentage of establishments used

**TABLE III. Percent of Establishments with Respirator Use by Employment Size Group**

OSHA PPE Cost Survey		BLS/NIOSH Survey		
Establishment Size Group <sup>A</sup>	Any Use (%)	Establishment Size Group <sup>A</sup>	Any Use (%)	Required Use 12 Months Prior to Survey (%)
<20	11.5	≤10	7.3	2.7
20–499	23.1	11–49	12.2	6.2
		50–249	22.3	12.4
≥500	56.5	250–999	47.4	29.8
		≥1000	77.2	55.5
All establishments	13.2	All establishments	9.8	4.5

Note: Cut points for the establishment size groups used by the two surveys differ, thus limiting the comparability of the data.

<sup>A</sup>Number of employees.

respirators (4.5%) when restricted to required use during the previous 12 months of the BLS/NIOSH survey.<sup>(14)</sup> The differences in results between the two surveys may be a reflection of differences in survey methods previously described. However, both surveys indicate that larger establishments are associated with substantially higher rates of respirator use. Larger establishments are generally more complex and are more likely to include operations in need of respiratory protection. Furthermore, smaller establishments may be less aware of the need for respirators.

Findings of the BLS/NIOSH survey suggest that large numbers of employers do not follow NIOSH recommendations for the selection and use of respirators. From October 2003 through September 2004, OSHA issued over 4100 citations for respiratory protection.<sup>(24)</sup> The same source indicates that the number of citations among all industries for violation of OSHA's 1910.134 respiratory protection standard were the fifth highest in a list of 378 different types of citations. The frequent issuance of respiratory protection citations is consistent with the BLS/NIOSH survey findings that 91% of establishments with respirator use had at least one indicator of a potentially inadequate respiratory protection program and 54% had at least five such indicators (Table II).

## CONCLUSION

The large disparity discovered between conditions of respirator use as estimated from the BLS/NIOSH survey and federal regulatory requirements for respirator use raises concerns. The survey findings suggest that respiratory protection programs have widespread inadequacies, indicating that employers are either unfamiliar with the regulatory requirements or are not applying appropriate resources to meet the regulatory requirements. Overall, the findings elucidate patterns of respirator use and practices in the workplace which could help target preventive interventions and research needed to improve the overall respiratory protection in occupational settings. Interventions and research might include:

- dissemination of additional respiratory protection information at the time of sale of approved respirators
- communication directed at workers to inform them of what employers should be doing when respiratory protection is required
- development of training modules for respiratory protection program administrators
- determination of reasons for the differences between OSHA requirements and the respiratory protection programs being provided to workers
- determination of factors that can motivate employers to provide adequate occupational respiratory protection programs.

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## REFERENCES

1. **National Institute for Occupational Safety and Health (NIOSH):** *National Occupational Hazard Survey Volume III Survey Analysis and Supplemental Tables* (NIOSH Pub. No. 78-114). Cincinnati, Ohio: NIOSH, 1978.
2. **National Institute for Occupational Safety and Health (NIOSH):** *National Occupational Exposure Survey Volume I Survey Manual* (NIOSH Pub. No. 88-106). Cincinnati, Ohio: NIOSH, 1988.
3. **National Institute for Occupational Safety and Health (NIOSH):** *Results from the National Occupational Health Survey of Mining (NOHSM)* (NIOSH Pub. No. 96-136). Cincinnati, Ohio: NIOSH, 1996.
4. **National Center for Health Statistics:** *Plan and Operations of the Third National Health and Nutrition Examination Survey* (DHHS Pub. No. PHS 94-1302). Washington, D.C.: Department of Health and Human Services, 1994.

5. "Respiratory Protection," (Compliance Cost Analysis: Current and Proposed Respiratory Protection Standards), *Federal Register* 59 (15 November 1994). p. 58892.
6. **Eastern Research Group:** *PPE Cost Survey Final Report* (Task Order 3, Contract J-9-F-0010). Washington, D.C.: Prepared for the Office of Regulatory Analysis, OSHA, June 23, 1999.
7. **Office of Management and Budget:** *Standard Industrial Classification Manual*. Washington, D.C.: U.S. Government Printing Office, 1987.
8. "Approval of Respiratory Protection Devices," *Code of Federal Regulations* Title 42, Part 84. 2002. pp. 470–472.
9. "Respiratory Protection," *Code of Federal Regulations* Title 29, Part 1910.134. 2002. pp. 421–431.
10. "Respiratory Equipment; Respirable Dust," *Code of Federal Regulations* Title 30, Part 70.300. 2002. pp. 426–427.
11. "Safety and Health Standards—Surface, Metal and Nonmetal Mines," *Code of Federal Regulations* Title 30, Part 56.5005. 2002. p. 267.
12. "Safety and Health Standards—Underground, Metal and Nonmetal Mines," *Code of Federal Regulations* Title 30, Part 57.5005. 2002. pp. 333–334.
13. **American National Standards Institute, Inc. (ANSI):** *American National Standard Practices for Respiratory Protection* (ANSI Z88.2-1969). New York: ANSI, August 1969.
14. **United States Department of Labor (USDOL), Bureau of Labor Statistics (BLS)/National Institute for Occupational Safety and Health (NIOSH):** *Respirator Usage in Private Sector Firms, 2001*. Washington, D.C.: USDOL, BLS, 2003.
15. **DeMaio, T.J, J. Rothgeb:** Cognitive interviewing techniques: In the lab and in the field. In *Answering Questions: Methodology for Determining Cognitive and Communicative Processes in Survey Research*, N. Schwarz and S. Sudman (eds.). San Francisco: Jossey-Bass, 1996. pp. 177–195.
16. **Fisher, S., K. Frampton, and R. Tran:** "Pretesting the Survey of Respirator Uses and Practices: Cognitive and Field Testing of a New Establishment Survey." Presented at the *American Association of Public Opinion Research*, Montreal, Canada, 2001.
17. **United States Department of Labor (USDOL), Bureau of Labor Statistics:** *Survey of Occupational Injuries and Illnesses, 1999*. Washington, D.C.: USDOL, BLS, 2000.
18. **Searson, M., K. Robertson, and R.L. Clayton:** "The U.S. Bureau of Labor Statistics Longitudinal Establishment Database." Presented at the *International Conference on Establishment Surveys II*, Buffalo, New York, 2000.
19. **United States Department of Labor (USDOL), Bureau of Labor Statistics (BLS):** *Survey of Programs Using Respirators (SPUR) Database*. Washington, D.C.: Unpublished database (Accessed March 14, 2002). pp. 258–259.
20. **Doney, B., M. Greskevitch, P. Middendorf, D. Groce:** Which Substances Prompt Respirator Use? *J. Int. Soc. Respir. Prot.* 20(Fall/Winter):125–135 (2003).
21. **National Institute for Occupational Safety and Health (NIOSH):** *NIOSH Respirator Selection Logic 2004* (NIOSH Pub. No. 2005-100). Cincinnati, Ohio: NIOSH, 2004.
22. **Suruda, A., W. Milliken, D. Stephenson, and R. Seseck:** Fatal injuries in the United States involving respirators, 1984–1995. *Appl. Occup. Environ. Hyg.* 18(4):289–292 (2003).
23. **United States Department of Labor (USDOL), Bureau of Labor Statistics:** *Employment and Wages Annual Average, 2001 (Bulletin 2554)*. Washington, D.C.: USDOL, BLS, 2002.
24. "Industry Profile for an OSHA Standard." [Online] Available at <http://www.osha.gov/oshstats/std2.html> (Accessed December 2, 2004).