NORTH CAROLINA DEPARTMENT OF LABOR
DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
RALEIGH, NORTH CAROLINA

Chapter 7 CFR Revision 146
Subchapter 7F CFR II

Field Information System
Respiratory Protection
29 CFR 1910 General Industry; 29 CFR 1926 Construction;
29 CFR 1915 Shipyard; 29 CFR 1917 Marine Terminals
Final Rule

DISCUSSION:

In the January 8, 1998, *Federal Register*, OSHA published the long-awaited revised respiratory protection standard. The final standard replaces the respiratory protection standards adopted by OSHA in 1971 (29 CFR 1910.134 and 29 CFR 1926.103) and impacts general industry, construction, shipyard, and marine terminal standards that address or reference respiratory protection, especially as they relate to respirator use.

In addition to updates that reflect current respirator technology, the revised standard clarifies the responsibility of the employer for administering a respiratory protection program and its provisions. Further, the final standards add definitions, and provides specific guidance on respirator selection, use, hazard evaluation, medical evaluation, fit testing, and training.

One of the significant changes addresses voluntary respirator use. The employer is now required to exercise certain controls over the voluntary use of respirators (i.e. where employee exposure to airborne contaminants is below recognized permissible exposure limits). The new standard also addresses the use of respirators in Immediately Dangerous to Life or Health (IDLM) atmospheres, including firefighting. Of note is that the IDLH requirement will be applicable to state and local government firefighters only in the state plan states, including North Carolina, that administer their own occupational safety and health programs. Federal OSHA only covers firefighters who are Federal employees and private sector employees who fight fires (e.g., those in industrial fire brigades) in federal OSHA states.

Note, however, that several record keeping provisions will not become effective until the Office of Management and Budget (OMB) issues approval numbers for these provisions. Meanwhile, employers must comply with those requirements of the existing respiratory protection standard which have already been approved by OMB.

These include the written program, emergency-use certification records, and emergency use respirator compartment marking.

ACTION:

The respiratory protection final rule was adopted verbatim with an effective date of April 8, 1998. The adopted standard contains the following compliance dates:

- September 8, 1998 -- Determination that respirator use is required.
- October 5, 1998 -- Compliance with all other provisions of the standard.

A copy of the final rule (63 FR 1151-1300, 1/8/98) is attached. Copies of the associated *NC Administrative Code* rules are available upon request.

Please file this as NC CFR Revision 146 in CFR II of your Field Information System.

Robert K. Andrews, Jr., Director
Division of Occupational Safety and Health
(Signed on original)
2-6-98

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Part II

Department of Labor

Occupational Safety and Health Administration

29 CFR Parts 1910 and 1926
Respiratory Protection; Final Rule

DEPARTMENT OF LABOR

Occupational Safety and Health Administration

29 CFR Parts 1910 and 1926

[Docket No. H–049]

RIN 1218–AA05

Respiratory Protection

AGENCY: Occupational Safety and Health Administration (OSHA), Department of Labor.

ACTION: Final rule; Request for comment on paperwork requirements.

SUMMARY: This final standard, which replaces the respiratory protection standards adopted by OSHA in 1971 (29 CFR 1910.134 and 29 CFR 1926.103), applies to general industry, construction, shipyard, longshoring, and marine terminal workplaces. The standard requires employers to establish or maintain a respiratory protection program to protect their respirator-wearing employees. The standard contains requirements for program administration; worksite-specific procedures; respirator selection; employee training; fit testing; medical evaluation; respirator use; respirator cleaning, maintenance, and repair; and other provisions. The final standard also simplifies respirator requirements for employers by deleting respiratory provisions in other OSHA health standards that duplicate those in the final standard and revising other respirator-related provisions to make them consistent. In addition, the standard addresses the use of respirators in Immediately Dangerous to Life or Health (IDLH) atmospheres, including interior structural firefighting. During interior structural firefighting (an IDLH atmosphere by definition), self-contained breathing apparatus is required, and two firefighters must be on standby to provide assistance or perform rescue when two firefighters are inside the burning building.

Based on the record in this rulemaking and the Agency's own experience in enforcing its prior respiratory protection standards, OSHA has concluded that compliance with the final rule will assist employers in protecting the health of employees exposed in the course of their work to airborne contaminants, physical hazards, and biological agents, and that the standard is therefore necessary and appropriate. The final respiratory protection standard covers an estimated 5 million respirator wearers working in an estimated 1.3 million workplaces in the covered sectors. OSHA's benefits analysis predicts that the standard will prevent many deaths and illnesses among respirator-wearing employees every year by protecting them from exposure to acute and chronic health hazards. OSHA estimates that compliance with this standard will avert hundreds of deaths and thousands of illnesses annually. The annual costs of the standard are estimated to be $111 million, or an average of $22 per covered employee per year.

DATES: The final rule becomes effective April 8, 1998.

Compliance: Start-up dates for specific provisions are set forth in § 1910.134(n) of the regulatory text. However, until the Department of Labor publishes in the **Federal Register** the control numbers assigned by the Office of Management and Budget (OMB), affected parties are not required to comply with the new or revised information collection requirements contained in the following paragraphs: § 1910.134(c) written procedures for selecting respirators, medical evaluations, fit testing, use of respirators, maintaining respirators, training, and periodically evaluating the effectiveness of the program; (e)(3)–(6) medical questionnaire, examination, and information for the physician or other licensed health care professional (PLHCP); (f)(1) fit testing; (i)(4) tagging sorbent beds and filters; and (m)(1)–(2) and (4) recordkeeping. Publication of the control numbers notifies the public that the OMB has approved these information collection requirements under the Paperwork Reduction Act of 1995. Although affected parties will not have to comply with the revised standard's information collection requirements until these have been approved by OMB, they must comply with those requirements of 29 CFR 1910.134 (OSHA's existing respirator protection standard) that have already been approved by the OMB under the Paperwork Reduction Act. Approved requirements include the written program, emergency-use respirator certification records, and emergency-use respirator compartment marking.

Comments: Interested parties may submit comments on the information collection requirements for this standard until March 9, 1998.

ADDRESSES: In compliance with 28 U.S.C. 2112(a), the Agency designates the Associate Solicitor for Occupational Safety and Health, Office of the Solicitor, Room S–4004, U.S. Department of Labor, 200 Constitution Avenue, N.W., Washington, D.C. 20210, as the recipient of petitions for review of the standard.

Comments on the information collection requirements of this final rule (see **SUPPLEMENTARY INFORMATION**) are to be submitted to the Docket Office, Docket No. ICR 97–5, U.S. Department of Labor, Room N–2625, 200 Constitution Avenue, N.W., Washington, D.C. 20210, telephone (202) 219–7894. Written comments limited to 10 pages or less in length may also be transmitted by facsimile to (202) 219–5046.

Copies of the referenced information collection request are available for inspection and copying in the Docket Office and will be mailed immediately to persons who request copies by telephoning Adrian Corsey at (202) 219–7075. For electronic copies of the Respiratory Protection Final Standard and the Information Collection Request, contact OSHA's WebPage on the Internet at http://www.osha.gov/.

FOR FURTHER INFORMATION CONTACT: Bonnie Friedman, Director, OSHA Office of Public Affairs, Room N–3647, U.S. Department of Labor, 200 Constitution Avenue, N.W., Washington, D.C. 20210; Telephone (202) 219–8148. For additional copies of this regulation contact: OSHA, Office of Publications, U.S. Department of Labor, Room N–3101, 200 Constitution Avenue, N.W., Washington, D.C. 20210; Telephone (202) 219–4667.

SUPPLEMENTARY INFORMATION:

1. Collection of Information: Request for Comment

This final Respiratory Protection standard contains information collection requirements that are subject to review by OMB under the Paperwork Reduction Act of 1995 (PRA95), 44 U.S.C. 3501 *et seq.* (see also 5 CFR 1320). PRA95 defines collection of information to mean, ''the obtaining, causing to be obtained, soliciting, or requiring the disclosure to third parties or the public of facts or opinions by or for an agency regardless of form or format.'' [44 U.S.C. § 3502(3)(A)]

The title, the need for and proposed use of the information, a summary of the collections of information, description of the respondents, and frequency of response required to implement the required information collection are described below with an estimate of the annual cost and reporting burden (as required by 5 CFR 1320.5 (a)(1)(iv) and § 1320.8 (d)(2)). Included in the estimate is the time for reviewing instructions, gathering and maintaining the data needed, and completing and reviewing the collection of information.

OSHA invites comments on whether the proposed collection of information:

- Ensures that the collection of information is necessary for the proper performance of the functions of the agency, including whether the information will have practical utility;
- Estimates the projected burden accurately, including whether the methodology and assumptions used are valid;
- Enhances the quality, utility, and clarity of the information to be collected; and
- Minimizes the burden of the collection of information on those who are to respond, including the use of appropriate automated, electronic, mechanical, or other technological collection techniques or other forms of information technology, e.g., permitting electronic submissions of responses.

Title: Respiratory Protection, 29 CFR 1910.134.

Description: The final Respiratory Protection standard is an occupational health standard that will minimize occupational exposure to toxic substances. The standard's information collection requirements are essential components that will protect employees from occupational exposure to these toxins. The information will be used by employers and employees to implement the protection required by the standard. OSHA will use some of the information to determine compliance with the standard.

Respondents: The total number of respondents for the first year is 1,300,000, and for the second year 1,430,000 (1,300,000 (1st year) plus 10% (130,000)).

Average Time Per Response: 2.21 hours (this is the result of dividing the total number of responses (19,767,461) by the total number of burden hours (8,926,558)).

Average Time Per Firm: 6.87 hours (this represents the average time a firm would need to comply with all of the information collection provisions, including the written respiratory protection program. This is a result of dividing the total number of burden hours (8,926,558) by the total number of firms (1,300,000)).

SUMMARY OF THE COLLECTIONS OF INFORMATION

Information collection requirement	No. of responses (Yr 1)	No. of responses (Yr 2)	Frequency of response	Time per response	Total 1st year burden	Estimated cost (1st year)
Respiratory Protection Program 1910.134(c).	1,274,000	26,000	All Existing Firms to Update Existing Program.	2 Hours for Small Firms; 4 Hours for Large Firms.	2,652,000	$60,916,440
	127,400	2,600	Initially for New Employers.	8 Hours to Develop.		
			Updates (Every 5 Years).	30 Minutes for Small Firms; 1 Hour for Large Firms.		
Questionnaire Administration 1910.134(e)(3).	5,000,000	575,000	All Employees Will Receive in the First Year.	15 Minutes for Employees to Complete.	740,000	$13,593,800
			50% of those Receiving Exams Will Receive Follow-up Questionnaires.			
Medical Examinations 1910.134(e)(4)	1,150,000	287,500	23% of the Existing Employees.	All Medical Exams will Take 1.5 Hours to Complete which includes travel time.	1,021,200	$18,759,444
			2nd & Recurring Yrs—25% of the 23% would receive Follow-up Exams.			
Information Provided to PLHCP 1910.134(e)(5).	1,150,000	287,500	Dependent on the Number of Exams.	15 Minutes for Each Employee.	170,200	$2,358,972
Fit Testing 1910.134(f)(1)	4,335,000	4,335,000	346,800 Employees to Receive Quantitative Fit Tests.	30 Minutes for Employees to be Fitted (Quantitative and Qualitative Fit Testing).	3,780,140	$76,813,315
			799,640 Employees to Receive Qualitative Fit Tests.	30 Additional Minutes for Employers to Conduct (Only for In-House Fit Testing).		
			3,188,560 Employees to Receive In-House Fit Tests.			
			4,335,000 Total Employees.			
Emergency-Use Respirator Marking 1910.134(h)(2)(ii)(B).	0	260,000	Only New Employers E.	5 Minutes per Emergency-Use Respirator.	0	$0
			xisting Employers Have Already Complied (Old Requirement).			

SUMMARY OF THE COLLECTIONS OF INFORMATION—Continued

Information collection requirement	No. of responses (Yr 1)	No. of responses (Yr 2)	Frequency of response	Time per response	Total 1st year burden	Estimated cost (1st year)
Emergency-Use Respirator Certification 1910.134(h)(3)(iv)(A)&(B).	671,880	67,200	Currently, 27,995 Employers Using Emergency-Use Respirators (1st Year). 2nd Year = 1st Year Employers plus 10%.	Assuming 2 Per Employer: 10 Minutes (Total Time Per Month).	114,220	$2,098,221
Certificate of Analysis of Cylinders 1910.134(i)(4)(i)(B).	0	0	All Existing and New Employers.	Provided by Supplier, therefore no burden incurred.	0	$0
Sorbent Beds and Filters 1910.134(i)(4)(iii)(B).	74,181	74,181	Currently, 24,727 Compressors in Use.	3 Changes Per Year, assuming 5 minutes per change.	5,934	$109,008
Medical Records 1910.134(m)(1)	1,150,000	287,500	Dependent on the Number of Exams.	5 Minutes Per Employee Examined.	54,464	$754,871
Fit Testing Records 1910.134(m)(2)	4,335,000	4,335,000	Dependent on the Number of Fit Tests.	5 Minutes Per Fit Test.	348,400	$4,828,824
Employee Access 1910.134(m)(4)	500,000	500,000	10% of the Total Number of Employees.	5 Minutes per Request.	40,000	$554,400
Totals	19,767,461	11,037,481	.....	.....	8,926,558	$180,787,295

MARGINAL DIFFERENCES IN BURDEN HOURS AND COSTS (I.E., BETWEEN THE EXISTING AND REVISED STANDARDS)

Information collection requirement	Current OMB inventory existing 1910.134	Adjustment (to 1st year only)	1st yr. burden revised 1910.134	Estimated cost	2nd & recurring yr. burden revised 1910.134	Estimated cost
Respiratory Protection Program	395,489	2,256,511	2,652,000	$60,916,440	1,570,400	$36,072,088
Questionnaire Administration	–	740,000	740,000	$13,593,800	85,100	$1,563,287
Medical Examinations	–	1,021,200	1,021,200	$18,759,444	255,300	$4,689,861
Information Provided to PLHCP	–	170,200	170,200	$2,358,972	42,550	$589,743
Fit Testing	–	3,780,140	3,780,140	$76,813,315	3,780,140	$76,813,315
Emergency-Use Respirator Marking	433	–433	0	$0	448	$8,230
Emergency-Use Respirator Certification ..	785,842	–671,622	114,220	$2,098,221	11,424	$209,859
Certificate of Analysis of Cylinders	–	0	0	$0	0	$0
Sorbent Beds and Filters	–	5,934	5,934	$109,008	5,934	$109,008
Medical Records	–	54,464	54,464	$754,871	13,616	$188,718
Fit Testing Records	–	348,400	348,400	$4,828,824	348,400	$4,828,824
Employee Access	–	40,000	40,000	$554,400	40,000	$554,400
Hour Kept in Inventory for Revised 1910.134	1	–1	0	$0	0	$0
Totals	1,181,765	7,744,793	8,926,558	$180,787,295	6,153,312	$125,627,333

Under the column for ''Current OMB Inventory,'' dashes denote burdens that were not taken for the Existing Respiratory Protection Standard, but are counted in the Revised Respiratory Protection Standard. Both Medical Examinations and Fit Testing are required by the existing standard; however, because these requirements are not accompanied by a recordkeeping requirement, no burden was taken. In the revised standard, recordkeeping is required for these provisions, and thus burden is counted for these provisions.

Interested parties are requested to send comments regarding this information collection to the OSHA Docket Office, Docket No. ICR 97–5 , U.S. Department of Labor, Room N–2625, 200 Constitution Avenue, N.W., Washington, D.C. 20210. Written comments limited to 10 pages or fewer may also be transmitted by facsimile to (202) 219–5046.

Comments submitted in response to this notice will be summarized and included in the request for Office of Management and Budget approval of the final information collection request; they will also become a matter of public record.

Copies of the referenced information collection request are available for inspection and copying in the OSHA Docket Office and will be mailed to persons who request copies by telephoning Adrian Corsey at (202) 219–7075. Electronic copies of the Respiratory Protection Final information collection request are available on the OSHA WebPage on the internet at http://www.osha.gov/ under Standards.

2. Federalism

This final standard has been reviewed in accordance with Executive Order 12612 (52 FR 41685, October 30, 1987), regarding Federalism. This Order requires that agencies, to the extent possible, refrain from limiting state policy options, consult with states prior to taking any actions which would restrict state policy options, and take such actions only when there is clear constitutional authority and the presence of a problem of national scope. The Order provides for preemption of state law only if there is a clear Congressional intent for the Agency to do so. Any such preemption is to be limited to the extent possible.

Section 18 of the Occupational Safety and Health Act (OSH Act) expresses Congress' clear intent to preempt state laws relating to issues on which Federal OSHA has promulgated occupational safety and health standards. Under the OSH Act, a state can avoid preemption only if it submits, and obtains Federal approval of, a plan for the development of such standards and their enforcement. Occupational safety and health standards developed by such Plan-States must, among other things, be at least as effective in providing safe and healthful employment and places of employment as the Federal standards. Where such standards are applicable to products distributed or used in interstate commerce, they may not unduly burden commerce and must be justified by compelling local conditions (see OSH Act, Section 18(c)).

The final Federal standard on respiratory protection addresses hazards which are not unique to any one state or region of the country. Nonetheless, states with occupational safety and health plans approved under Section 18 of the OSH Act will be able to develop their own state standards to deal with any special problems which might be encountered in a particular state. Moreover, because this standard is written in general, performance-oriented terms, there is considerable flexibility for state plans to require, and for affected employers to use, methods of compliance which are appropriate to the working conditions covered by the standard.

In brief, this final standard addresses a clear national problem related to occupational safety and health in general industry, construction, and maritime employment. Those states which have elected to participate under Section 18 of the OSH Act are not preempted by this standard, and will be able to address any special conditions within the framework of the Federal Act while ensuring that the state standards are at least as effective as that standard.

3. State Plans

The 25 states and territories with their own OSHA-approved occupational safety and health plans must adopt a comparable standard within six months of the publication date of a final standard. These 25 states are: Alaska, Arizona, California, Connecticut, New York (for state and local government employees only), Hawaii, Indiana, Iowa, Kentucky, Maryland, Michigan, Minnesota, Nevada, New Mexico, North Carolina, Oregon, Puerto Rico, South Carolina, Tennessee, Utah, Vermont, Virginia, Virgin Islands, Washington, and Wyoming. Until such time as a state standard is promulgated, Federal OSHA will provide interim enforcement assistance, as appropriate, in these states.

4. Unfunded Mandates

The final respiratory protection rule has been reviewed in accordance with the Unfunded Mandates Reform Act of 1995 (UMRA) (2 U.S.C. 1501 *et seq.*) and Executive Order 12875. As discussed below in the Summary of the Final Economic Analysis (FEA) (Section VI of this document), OSHA estimates that compliance with the revised respiratory protection standard will require the expenditure of more than $100 million each year by employers in the private sector. Therefore, the final rule establishes a Federal private sector mandate and is a significant regulatory action, within the meaning of section 202 of UMRA (2 U.S.C. 1532). OSHA has included this statement to address the anticipated effects of the final respiratory protection rule pursuant to section 202.

OSHA standards do not apply to state and local governments, except in states that have voluntarily elected to adopt an OSHA State Plan. Consequently, the respiratory protection standard does not meet the definition of a ''Federal intergovernmental mandate'' (Section 421(5) of UMRA (2 U.S.C. 658(5)). Thus, the final respiratory protection standard does not impose unfunded mandates on state or local governments.

The anticipated benefits and costs of this final standard, and other issues raised in section 202 of the UMRA, are addressed in the Summary of the FEA (Section VI of this preamble), below, and in the FEA (Ex. 196). In addition, pursuant to section 205 of the UMRA (2 U.S.C. 1535), having considered a reasonable number of alternatives as outlined in the preambles to the proposal and the final rule and in the FEA (Ex. 196), the Agency has concluded that the final rule is the most cost-effective alternative for implementation of OSHA's statutory objective of reducing significant risk to the extent feasible. This is discussed in the FEA (Ex. 196) and in the Summary and Explanation (Section VII of this preamble) for the various provisions of the final standard.

5. Executive Order 13045—Protection of Children From Environmental Health and Safety Risks

Executive Order 13045, signed by the President on April 21, 1997, requires that for certain Federal agency ''regulatory actions submitted to OMB's Office of Information and Regulatory Affairs (OIRA) for review pursuant to Executive Order 12866, the issuing agency shall provide to OIRA the following information developed as part of the Agency's decisionmaking process, unless prohibited by law:

(a) An evaluation of the environmental health or safety effects of the planned regulation on children; and

(b) An explanation of why the planned regulation is preferable to other potentially effective and reasonably feasible alternatives considered by the agency.''

''Covered Regulatory Actions'' under this Order are rules that may:

(a) Be ''economically significant'' under Executive Order 12866 (a rulemaking that has an annual effect on the economy of $100 million or more or would adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities); and

(b) Concern an environmental health risk or safety risk that an agency has reason to believe may disproportionately affect children.

''Environmental health risks and safety risks' mean risks to health or to safety that are attributable to products or substances that the child is likely to come in contact with or ingest (such as the air we breathe, the food we eat, the water we drink or use for recreation, the soil we live on, and the products we use or are exposed to).

The final standard on respiratory protection does not concern ''Environmental health risks and safety risks'' to children as defined under the Executive order. The respirator standard is only concerned with means of limiting employee exposures to toxic substances. The Agency believes, therefore, that the requirement noted above to provide OIRA with certain information does not apply since the respiratory protection standard is not a

''covered regulatory action'' under Executive Order 13045.

Section 6(b) (8) of the OSH Act requires OSHA to explain ''why a rule promulgated by the Secretary differs substantially from an existing national consensus standard,'' by publishing ''a statement of the reasons why the rule as adopted will better effectuate the purposes of the Act than the national consensus standard.'' In compliance with the requirement, the Agency has reviewed the standards proposed through this rulemaking with reference to the ANSI Z88.2–1992 standard for Respiratory Protection. OSHA has discussed the relationship between individual regulatory provisions and the corresponding consensus standards in the Summary and Explanation of the final rule.

6. Reasons Why the Revised Rule Will Better Effectuate the Purposes of the Act Than the Existing Consensus Standard

This process was facilitated by the fact that the previous OSHA standards on respiratory protection were start-up standards adopted directly from the ANSI Z88.2–1969 standard, ''Practices for Respiratory Protection'' under section 6(a) of the OSH Act, 29 U.S.C. 655(a). Therefore, even with subsequent revisions to the ANSI standards and the Agency's consideration of a widely varied and substantial body of information in the rulemaking record, the requirements of the OSHA final rule would tend to resemble the corresponding provisions of the current ANSI standards. In a number of instances, OSHA has utilized language identical to that in the current ANSI standard. These instances are noted in the Summary and Explanation. Where the Agency has determined that the pertinent ANSI language is not appropriate for this OSHA standard, the Summary and Explanation provides the basis for that decision.

I. General

The preamble accompanying this final standard discusses events leading to the final rule, the types of respiratory hazards experienced by employees, the degree and significance of the risk presented by failure to comply with this revised standard, the Final Economic Analysis, and the rationale behind the specific provisions set forth in the final standard. The discussion follows this outline:

I. General
II. Pertinent Legal Authority
III. Events Leading to the Final Standard
  A. Regulatory History
  B. Justification for Revising the Previous Standard
    1. Purpose of Revision
    2. Respirator Use and Hazards
  C. Responses to Advisory Committee
  D. Assigned Protection Factors
  E. Small Business Considerations
IV. Certification/Approval Procedures
V. Significance of Risk
VI. Summary of the Final Economic Analysis And Environmental Impact Assessment
VII. Summary And Explanation of the Final Standard
  A. Permissible Practice
  B. Definitions
  C. Respiratory Protection Program
  D. Selection of Respirators
  E. Medical Evaluation
  F. Fit Testing Procedures
  G. Use of Respirators
  H. Maintenance and Care of Respirators
  I. Breathing Air Quality and Use
  J. Identification of Filters, Cartridges, and Canisters
  K. Training
  L. Respiratory Protection Program Evaluation
  M. Recordkeeping and Access to Records
  N. Dates
  O. Appendices
  P. Revisions to Specific Standards
VIII. Authority And Signature
IX. Amended Standards

II. Pertinent Legal Authority

The purpose of the Occupational Safety and Health Act, 29 U.S.C. 651 *et seq.* (''the Act'') is to ''assure so far as possible every working man and woman in the nation safe and healthful working conditions and to preserve our human resources.'' 29 U.S.C. 651(b). To achieve this goal, Congress authorized the Secretary of Labor to promulgate and enforce occupational safety and health standards. U.S.C. 655(a) (authorizing summary adoption of existing consensus and Federal standards within two years of Act's enactment), 655(b) (authorizing promulgation of standards pursuant to notice and comment), 654(b) (requiring employers to comply with OSHA standards).

A safety or health standard is a standard ''which requires conditions, or the adoption or use of one or more practices, means, methods, operations, or processes, reasonably necessary or appropriate to provide safe or healthful employment or places of employment.'' 29 U.S.C. 652(8).

A standard is reasonably necessary or appropriate within the meaning of section 652(8) if it substantially reduces or eliminates significant risk or prevents it from developing, and is economically feasible, technologically feasible, cost effective, consistent with prior Agency action or supported by a reasoned justification for departing from prior Agency actions, supported by substantial evidence, and is better able to effectuate the Act's purposes than any national consensus standard it supersedes. See 58 FR 16612–16616 (March 30, 1993).

A standard is technologically feasible if the protective measures it requires already exist, can be brought into existence with available technology, or can be created with technology that can reasonably be expected to be developed. *American Textile Mfrs. Institute* v. *OSHA*, 452 U.S. 490, 513 (1981) (''ATMI''), *American Iron and Steel Institute* v. *OSHA*, 939 F.2d 975, 980 (D.C. Cir. 1991)(''AISI'').

A standard is economically feasible if industry can absorb or pass on the cost of compliance without threatening its long term profitability or competitive structure. See *ATMI*, 452 U.S. at 530 n. 55; *AISI*, 939 F. 2d at 980.

A standard is cost effective if the protective measures it requires are the least costly of the available alternatives that achieve the same level of protection. *ATMI*, 453 U.S. at 514 n. 32; *International Union, UAW* v. *OSHA*, 37 F.3d 665, 668 (D.C. Cir. 1994)(''LOTO III'').

All standards must be highly protective. See 58 FR 16614–16615; LOTO III, 37 F.3d at 668. However, standards regulating exposure to toxic substances or hazardous physical agents must also meet the ''feasibility mandate'' of Section 6(b)(5) of the Act, 29 U.S.C. 655(b)(5). Section 6(b)(5) requires OSHA to select ''the most protective standard consistent with feasibility'' that is needed to reduce significant risk when regulating these hazards. *ATMI*, 452 U.S. at 509.

Section 6(b)(5) also directs OSHA to base health standards on ''the best available evidence,'' including research, demonstrations, and experiments, 29 U.S.C. 655(b)(5). OSHA shall consider ''in addition to the attainment of the highest degree of health and safety protection * * * the latest scientific data * * * feasibility and experience gained under this and other health and safety laws.'' Id.

Section 6(b)(7) of the Act authorizes OSHA to include among a standard's requirements labeling, monitoring, medical testing and other information gathering and transmittal provisions. 29 U.S.C. 655(b)(7).

Finally, whenever practical, standards shall ''be expressed in terms of objective criteria and of the performance desired.'' Id.

Respiratory protection is a backup method which is used to protect employees from toxic materials in the workplace in those situations where feasible engineering controls and work practices are not available, have not yet been implemented, are not in themselves sufficient to protect

employee health, or in emergencies. The revisions to the respirator standard made in this rulemaking are intended to ensure that, when employers require employees to wear respirators to be protected from significant risk, protective respirators will be selected and those respirators will be used effectively to meet their design capabilities. Otherwise respirators will not reduce significant risk. The standard's provisions are designed to be feasible and cost effective, and are expressed in terms of objective criteria and the performance desired.

Further authority is provided by section 8(c)of the Act, which authorizes OSHA to require employers to maintain certain records. Section 8(g)(2) authorizes OSHA ''to prescribe such rules and regulations as (it) may deem necessary to carry out its responsibilities under the Act.''

III. Events Leading to the Final Standard

A. Regulatory History

Congress created the Occupational Safety and Health Administration (OSHA) in 1970, and gave it the responsibility for promulgating standards to protect the health and safety of American workers. As directed by Congress in the Occupational Safety and Health Act of 1970 (OSH Act; 29 U.S.C. 651 *et seq.*), OSHA adopted existing Federal standards and national consensus standards developed by various organizations such as the American Conference of Governmental Industrial Hygienists (ACGIH), the National Fire Protection Association (NFPA), and the American National Standards Institute (ANSI). The ANSI standard Z88.2–1969, ''Practices for Respiratory Protection,'' is the basis of the first six sections of OSHA's previous standard, 29 CFR 1910.134, ''Respiratory Protection.'' The seventh section was a direct, complete incorporation of ANSI Standard K13.1–1969, ''Identification of Gas Mask Canisters.'' OSHA's previous construction industry standard for respiratory protection, 29 CFR 1926.103, was promulgated in April 1971. On February 9, 1979, 29 CFR 1910.134 was formally recognized as also being applicable to the construction industry (44 FR 8577). Until the adoption of these standards by OSHA, most guidance on respiratory protective device use in hazardous environments was advisory rather than mandatory.

OSHA's maritime standards were originally promulgated in the 1960s by agencies that preceded OSHA. The original OSHA code designations of these standards and their promulgation dates are: Shipyards—29 CFR 1915.82, February 20, 1960 (25 FR 1543); Marine Terminals—29 CFR 1917.82, March 27, 1964 (29 FR 4052); and Longshoring—29 CFR 1918.102, February 20, 1960 (25 FR 1565). Section 1910.134 was incorporated by reference into OSHA's Marine Terminals standard (part 1917) on July 5, 1983 (48 FR 30909). OSHA has recently updated and strengthened its Longshoring and Marine Terminal standards, and both standards incorporate 29 CFR 1910.134 by reference.

OSHA did not propose to expand coverage of 29 CFR 1910.134 to agricultural workplaces covered by 29 CFR part 1928, and this final Respiratory Protection standard, like the proposal, does not apply to agricultural operations. The prior standard likewise did not apply to agricultural operations. (See 29 CFR 1928.21.) OSHA received no public comment requesting a change in coverage. Accordingly, the issue of respirator use during agricultural operations was not a part of this rulemaking. OSHA notes, however, that respirator use during pesticide operations and handling is covered by EPA's Worker Protection Standard, 40 U.S.C. part 170, adopted under the authority of the Federal Insecticide, Fungicide, and Rodenticide Act, as amended (7 U.S.C. 136–136y).

Under OSHA's previous standard, employers needed to follow the guidance of the Z88.2–1969 ANSI standard to ensure proper selection of respirators (see discussion 59 FR 58887). OSHA published an Advance Notice of Proposed Rulemaking (ANPR) to revise the respirator standard on May 14, 1982 (47 FR 20803). Part of the impetus for this notice was OSHA's inclusion of new respirator requirements in comprehensive substance-specific standards promulgated under section 6(b) of the Act, e.g., fit tests; use of powered air-purifying respirators (PAPRs) upon request; change of the filter elements of a respirator whenever an increase in breathing resistance is detected; employee permission to wash faces and respirator facepieces; and referral to a physician trained in pulmonary medicine for an employee who exhibits difficulty breathing, either at fit testing or during routine respirator use (see, e.g, 29 CFR 1910.1025 (lead standard)). The respirator provisions in these substance-specific standards took account of advances in respirator technology and changes in related guidance documents, particularly the recognition that standardized fit testing protocols greatly increase the effectiveness of respirators.

OSHA's 1982 ANPR sought information on the effectiveness of the current respiratory protection provisions, the need for revision of those provisions, and the substance of the revisions. Responses were received from 81 interested parties. The commenters generally supported revising OSHA's respiratory protection provisions and provided suggestions for approaches the Agency might take (Ex. 15).

On September 17, 1985, OSHA announced the availability of a preliminary draft of the proposed Respiratory Protection standard. The preproposal draft standard reflected the public comments received on the May 1982 ANPR, and OSHA's own analysis of changes needed in the standard to take into account the current state-of-the-art for respiratory protection. Responses were received from 56 interested parties (Ex. 36), and their comments were reviewed in preparing the proposal.

On November 15, 1994, OSHA published the proposed rule to revise 29 CFR 1910.134, and announced its intention to convene an informal public hearing on the proposal (59 FR 58884). The informal public hearing was convened on June 6, 1995, pursuant to notice and in accordance with Section 6(b) of the OSH Act, 29 U.S.C. 655(b)(3). Post-hearing submissions of data from parties at the hearing were received through September 20, 1995.

On November 7, 1995, OSHA reopened the record (60 FR 56127) and requested additional comment on a study performed for OSHA by Dr. Mark Nicas titled ''The Analysis of Workplace Protection Factor Data and Derivation of Assigned Protection Factors.'' That study, which was placed in the rulemaking docket on September 20, 1995, addressed the use of statistical modeling for determining respirator APFs. Comments on the Nicas study were received through the end of January 1996. The Nicas report, and comments received in response to the November 1995 notice, have convinced OSHA to deliberate further on the complex issues surrounding the establishment of APFs.

The entire record including 200 exhibits, more than 3,000 individual items, and approximately 2,300 transcript pages, was certified by the presiding administrative law judge on June 30, 1997, in accordance with 29 CFR 1911.17. Copies of materials contained in the record may be obtained from the OSHA Docket Office, Room N–2439, U.S. Department of Labor, 200 Constitution Avenue, N.W.,

Washington, D.C. 20210; (202) 219–7894.

The final revisions to 29 CFR 1910.134 are based on consideration of the entire record of this proceeding, including materials discussed or relied upon in the proposal, the record of the informal hearing, and all written comments and exhibits received.

B. Justification for Revising the Previous Standard

1. Purpose of the Revision

The intent of this revision is to enhance the protection of worker health, promote more effective use of respirators, provide greater compliance flexibility, and clarify the policies and procedures employers must follow when implementing a respiratory protection program. Evidence in the record, including case reports and studies of respirator use among workers, indicates that selecting or using respirators improperly can result in employee illness and even death. (See discussion below.) The revised standard is therefore expected to reduce the number of occupational illnesses and deaths among workers who wear respirators. OSHA is also consolidating many of its respirator-related provisions in other substance-specific health standards into one standard to make these provisions easier for employers to administer. Through consolidation, repetitive and duplicative respirator requirements have been deleted from many existing OSHA health standards, and future health standards will reference the revised final rule for many respirator requirements.

Advances in technology also made the previous standard out-of-date in many areas. Nearly all rulemaking participants, including representatives of private industry, other Federal agencies, respirator manufacturers, and unions, agreed that revision is necessary to address these advances (e.g., NIOSH, Ex. 28; Eastman Chemical Co., Ex. 54–245; 3M, Ex. 54–218A; AFL–CIO, Ex. 54–315; Building and Construction Trades Department/AFL–CIO, Ex. 29; American Petroleum Institute, Ex. 37; ISEA, Ex. 54–363). (See also 59 FR 58889.) Other agencies and committees have already updated their guidance on respirator use. For example, the ANSI standard has been revised twice (Exs. 10, 50), and NIOSH has revised its certification standard (42 CFR part 84; 60 FR 30336; 6/8/95), as well as developed a Respiratory Decision Logic (1987) to provide guidance to employers on the selection of respirators.

OSHA's experience in enforcing the previous standard also indicated that some of that standard's requirements were not understood clearly by the regulated community, and so were not adequately effective in protecting workers. The clarifications in this new standard will contribute to enhanced compliance by reducing misinterpretations and inconsistencies. A review of OSHA enforcement data for 1994 and 1995 revealed that failure to comply with the previous standard was a critical factor in at least 47 fatalities and 126 catastrophic injuries. The most frequently cited deficiencies included failure to provide respirators at all or to have standard operating procedures governing respirator use, and failure to train or fit test respirator users adequately [Source: OSHA's Federal Inspection Compliance Data (IMIS; 10/92 to 12/95)].

In addition, considerable research has been performed to determine the extent to which respirators used in workplaces actually reduce the quantity of contaminant breathed by the respirator user. Researchers have compared the in-mask concentrations of contaminants to the concentration levels outside the masks. This work was begun by NIOSH during the mid-seventies to assess respirator effectiveness in coal mines and abrasive blasting operations (Ex. 64–5) and spray paint operations (Ex. 64–68). The studies assessed the effectiveness of respirators under various conditions, and measured employee exposure in situations when respirators were not worn. The effectiveness ratings obtained in these studies are usually termed ''Effective Protection Factors'' (EPF).

More recent studies by NIOSH and private researchers have monitored respirator use even more closely to isolate variables that may affect the levels of respirator performance. Many of these studies concerned the performance of powered air-purifying respirators (PAPRs), which were not achieving in workplaces the levels of performance that had been predicted based on laboratory tests (see, e.g., Exs. 64–46, 64–42, and 64–47).

A third group of studies, ''workplace protection factor studies,'' conducted mostly by manufacturers and other private interests, was designed to determine the optimum performance of respirators by eliminating the impact of program defects under very tightly supervised workplace conditions. The results of these studies may overstate the degree of respirator effectiveness most employers can expect under conditions of workplace use because study conditions are rarely replicated in the field; nevertheless, these studies show the potential for respirators to reduce employee exposure to workplace contaminants (see, e.g., Exs. 64–25, 64–42, 64–47, 64–513).

This revised standard is intended to take account of up-to-date knowledge and technology and to make the requirements in the standard easier to understand. The standard now reflects current technology and research, as well as the findings and guidance of other expert bodies. OSHA has also included a new definitions section to enhance clarity. The revised standard includes detailed protocols for performing fit tests and lists the topics in which respirator users must be trained. It also contains provisions addressing skin and eye irritation, both of which must be considered in respirator selection. Wherever possible, OSHA has used performance-oriented language to allow for flexibility in accommodating future changes in respirator technology and to address the needs of small businesses and unusual operations. Through these improvements, OSHA expects to reduce the number of respirator-related illnesses, fatalities, and catastrophic injuries occurring among respirator wearers in U.S. workplaces.

2. Respirator Use and Hazards

The purpose of a respirator is to prevent the inhalation of harmful airborne substances or oxygen-deficient air. Basically, a respirator is an enclosure that covers the nose and mouth or the entire face or head. Respirators are of two general ''fit'' types: (1) Tight-fitting (quarter masks, which cover the mouth and nose; half masks, which fit over the nose and under the chin; and full facepiece, which cover the face from the hairline to below the chin); and (2) loose-fitting (hoods, helmets, blouses, or full suits which cover the head completely). There are also two major classes of respirators: air-purifying respirators (which remove contaminants from the air), and atmosphere-supplying respirators (which provide clean breathing air from an uncontaminated source). In general, atmosphere-supplying respirators are used for more hazardous exposures.

Effective respirator use can protect employees from exposure to a wide variety of toxic chemicals. In 1994, approximately 215 deaths, or five percent of all workplace fatalities, occurred as a result of exposure to harmful substances and environments [CFOI, BLS, 6/11/96; CFOI/FAX]. There are a number of workplace situations that involve toxic substances and for which engineering controls may be inadequate to control exposures, and respirators are used in these situations

as a back-up method of protection. Substances that have been associated with death or serious incidents include carbon monoxide, trichloroethylene, carbon dioxide, chromic acid, coal tar, several toxic metal fumes and dusts, sulphur dioxide, wood dust, and welding fumes; these substances cause adverse health effects ranging from transient, reversible effects such as irritation or narcosis, through disabling diseases such as silicosis and asbestosis, to death caused either by acute exposure or by a cancer resulting from chronic exposures (Rom, W., *Environmental and Occupational Medicine*, 2nd ed., Little, Brown & Co., Boston; 1992, p. 598.) Respirators are available that can provide protection against inhalation of these toxic substances.

Airborne contaminants may also be radioactive (''Radiologic Health in Occupational Medicine Practice,'' George L. Voelz, pg. 500 in *Occupational Medicine,* Carl Zenz, ed., Year Book Medical Publishers, Inc., Chicago, 1975; Jacob Shapiro, *Radiation Protection,* 3rd ed., Harvard University Press, Cambridge, MA, 1990, pg. 273). (See also 29 CFR 1910.1096.) Exposure to ionizing radiation can cause acute effects such as nausea and vomiting, malaise and fatigue, increased temperature, and blood changes. More severe delayed effects include leukemia, bone and lung cancer, sterility, chromosomal and teratogenic damage, shortened life span, cataracts, and radiodermatitis, a dry, hairless, red, atrophic skin condition which can include skin cracking and depigmentation (George L. Voelz, M.D., ''Radiologic Health in Occupational Medicine Practice'', in Zenz, *Occupational Medicine,* pp. 513–519; Herman Cember, *Introduction to Health Physics,* 2nd edition, Pergamon Press, New York, 1983, pg. 181–194). Respirators to provide protection against the inhalation of radioactive particles are commonly used by workers exposed to these hazards.

''Bioaerosols'' are airborne contaminants that are alive or were released from a living organism (OSHA Docket No. H–122; ACGIH Guidelines; Ex. 3–61C, page 1; 1994). Pulmonary effects associated with exposure to certain bioaerosols include rhinitis, asthma, allergies, hypersensitivity diseases, humidifier fever, and epidemics of infections including colds, viruses, tuberculosis, and Legionnaires Disease. Cardiovascular effects manifested as chest pain, and nervous system effects manifested as headache, blurred vision, and impaired judgment, have occurred in susceptible people following exposure to bioaerosols. Viral infections caused by the inhalation of bioaerosols can result in health effects that range in intensity from undetected or mild to more severe and even death. Bacterial infections resulting from inhalation of bacteria and their products cause a range of diseases, including tuberculosis, Legionnaires Disease, and hypersensitivity pneumonitis. Among workers in sewage treatment plants, health-related problems can be associated with occupational exposures to protozoa [Burge, H., 1990, ''Bioaerosols: Prevalence and health effects in the indoor environment,'' *J. Allergy and Clinical Immunology;* 86 (5); see also Exs. 3–61B and 3–61C in Docket No. H–122.] Allergic asthma and allergic rhinitis can be induced by chronic exposure to low levels of antigens. Hypersensitivity pneumonitis can occur when a worker inhales concentrated aerosols of particles released by bacteria, fungi, and protozoa (Exs. 3–61B and 3–61C in Docket No. H–122). In 1994, the Centers for Disease Control reported 41 deaths of workers for which there was evidence of work-related hypersensitivity pneumonitis (*Work-Related Lung Disease Surveillance Report,* 1994; USDHHS, CDC, DHHS (NIOSH) Number 94–120). Respirators to protect against the inhalation of biological agents are widely used in healthcare and other workplace settings where exposure to such agents presents a hazard to workers.

Respirators can also provide protection from oxygen-deficient atmospheres. Human beings must breathe oxygen in order to survive, and begin to suffer adverse health effects when the oxygen level of their breathing air drops below the normal atmospheric level. Below 19.5 percent oxygen by volume, air is considered oxygen-deficient. At concentrations of 16 to 19.5 percent, workers engaged in any form of exertion can rapidly become symptomatic as their tissues fail to obtain the oxygen necessary to function properly (Rom, W., *Env. Occup. Med.,* 2nd ed; Little, Brown; Boston, 1992). Increased breathing rates, accelerated heartbeat, and impaired thinking or coordination occur more quickly in an oxygen-deficient environment. Even a momentary loss of coordination may be devastating to a worker if it occurs while the worker is performing a potentially dangerous activity, such as climbing a ladder. Concentrations of 12 to 16 percent oxygen cause tachypnea (increased breathing rates), tachycardia (accelerated heartbeat), and impaired attention, thinking, and coordination (e.g., Ex. 25–4), even in people who are resting.

At oxygen levels of 10 to 14 percent, faulty judgment, intermittent respiration, and exhaustion can be expected even with minimal exertion (Exs. 25–4 and 150). Breathing air containing 6 to 10 percent oxygen results in nausea, vomiting, lethargic movements, and perhaps unconsciousness. Breathing air containing less than 6 percent oxygen produces convulsions, then apnea (cessation of breathing), followed by cardiac standstill. These symptoms occur immediately. Even if a worker survives the hypoxic insult, organs may show evidence of hypoxic damage, which may be irreversible (Exs. 25–4 and 150; also reported in: Rom, W., *Environmental and Occupational Medicine,* 2nd ed; Little, Brown; Boston, 1992).

A number of workplace conditions can lead to oxygen deficiency. Simple asphyxiants, or gases that are physiologically inert, can cause asphyxiation when present in high enough concentrations to lower the oxygen content in the air. Other toxic or chemical asphyxiants poison hemoglobin, cytochromes, or other enzyme systems (Rom, W., *Environmental and Occupational Medicine,* 2nd ed., Little, Brown, and Co., Boston, 1992). A number of asphyxiants are gases that can evolve from explosions, combustion, chemical reactions, or heating. A high-temperature electrical fire or arc welding accident causing a complete flashover in an enclosed area can temporarily eliminate oxygen from that area. Asphyxiation and the severe lung damage it can cause are major concerns for firefighters; of 30 firefighter deaths investigated by OSHA recently, five resulted from either asphyxiation, smoke inhalation, or flashovers (IMIS; 8 State plan states; 10/91–3/97). (See also mortality study of causes of death among firefighters, Guidotti, 37 *JOEM* 1348, 1995.)

In 1994, 110 employees died from oxygen deficiency [National Census of Fatal Occupational Injuries (CFOI); BLS; CFOI/FAX; 6/11/96)], i.e., about two percent of the total number of employees who died of occupational injuries. OSHA believes that many of these deaths could have been prevented if the victims' employers had realized that respirators were needed (BLS; CFOI/FAX, 6/96).

In some cases, respirator use itself can cause illness and injury to employees. There are a number of physiological burdens that are associated with the use of certain types of respirators. The

weight of the respirator, breathing resistances during both normal operation and if the air-purifying element is overloaded, and rebreathing exhaled air from respirator ''dead space'' can all increase the physiologic burden of respirator use (Exs. 113, 22–1, 64–427). Job and workplace conditions, such as the length of time a respirator must be worn, the level of physical exertion required of a respirator user, and environmental conditions, can also affect the physiological burden (Exs. 113, 64–363). In addition, workers who wear glasses or hearing aids may have problems achieving appropriate fit with some respirator facepieces.

Evidence of Adverse Health Effects From Respiratory Hazards. There is ample evidence that the previous standard was not doing an adequate job of protecting workers from these respiratory hazards, and that exposure to these hazards has continued to cause adverse health effects among exposed workers. An analysis of OSHA inspection data from 1976 through 1982, when the previous standard had been in effect for between five and eleven years (Ex. 33–5), found that in most cases (55.6%) where respirators were used to protect employees from excessive levels of air contaminants, respiratory protection programs were deficient in one or more elements, thus increasing the potential for employee exposure. Even more significant was the fact that in 72.1% of inspections in which an overexposure to a substance listed under 29 CFR 1910.1000 was cited, respirator use did not comply with the respiratory protection standard. OSHA performed a similar analysis of enforcement data for 1990–1996, and found similar levels of noncompliance. [See also *Work-Related Lung Disease Surveillance Report,* 1994; USDHHS, CDC, DHHS (NIOSH) Number 94–120.] The provisions of the new respirator standard are designed to regulate how an employer selects, maintains, fit tests, and trains employees in the proper use of respiratory equipment, and to provide employers with the tools needed to implement an effective respiratory protection program. OSHA has concluded that the new standard will eliminate many of the unnecessary illnesses and deaths described in this section.

C. Responses to Advisory Committee on Construction Safety and Health

The revised respirator standard replaces the previous respiratory protection standard in the construction industry (29 CFR 1926.103). Since this revision affects the construction industry, the September 1985 preproposal draft standard was presented to the Advisory Committee for Construction Safety and Health (ACCSH) for its comments. The ACCSH comments, combined with the other comments received, were considered in preparing a revision of the September 1985 draft proposal.

As part of the Notice of Proposed Rulemaking (NPRM) approval process, the revised NPRM was presented at the March 1987 ACCSH meeting and the Committee's comments were presented to OSHA at the August 1987 meeting (Ex. 39). OSHA responded to the Committee's comments in the NPRM, published in November, 1994. As noted in that response, OSHA modified the draft proposal to respond to the concerns of the Committee (59 FR 58931–58935).

The final standard replaces the previous construction industry standard for respiratory protection, 29 CFR 1926.103, with an amended 29 CFR 1926.103. The provisions of the previous respiratory protection standard (29 CFR 1926.103) are deleted by this action. The title, Respiratory Protection, will remain in the Code of Federal Regulations but will now be followed by the statement ''Respiratory protection for construction employment is covered by 29 CFR 1910.134.'' The full text of this new standard will be printed in the general industry standards, and the construction standard will reference the revised 29 CFR 1910.134.

The Agency's responses to the Committee's specific concerns follow:

Paragraph (a)—Permissible Practice

The Construction Advisory Committee recommended that paragraph (a)(1) of the standard be changed to require that all feasible engineering controls be used by employers and that the employer demonstrate that engineering controls are not feasible before respirators may be used. The recommended change also would have eliminated the requirement that appropriate respirators be used while engineering controls are being installed. OSHA has stated elsewhere in the summary and explanation section of this preamble that paragraph (a)(1) of the previous standard remains unchanged in the new final standard because this paragraph was not proposed for revision and was therefore not a subject of rulemaking in this proceeding. The purpose of the Respiratory Protection standard is to improve the level of protection provided to employees who use respirators to protect them from respiratory hazards, regardless of whether that use occurs in an environment where engineering controls are in place.

The Committee proposed that paragraph (a)(2) be modified to require that employers provide respirators to employees exposed to contaminant concentrations when the concentration reaches one-half the PEL or TLV, and that employees be required to wear them before the PEL is exceeded. To accompany this revision the Committee proposed a new definition establishing an ''action level'' of one-half the PEL for all regulated substances. OSHA has not adopted this ACCSH recommendation because the recommended changes are beyond the scope of this rulemaking.

Paragraph (b)—Definitions

ACCSH suggested that OSHA add a definition for ''Grade D breathing air'' to the standard. The properties of Grade D breathing air are listed in paragraph (i) of the final standard, Supplied Air Quality and Use. OSHA believes that repeating these elements in the definition section is redundant and unnecessary.

The Committee also recommended that the rule include a definition for ''competent person,'' as defined in 29 CFR 1926.32(f). The competent person would review the respiratory protection program and perform the function of the respiratory program administrator required in paragraph (c)(2) of the proposal. OSHA has not included a definition of competent person in the standard because 29 CFR 1926.32(f) already has such a definition. OSHA recognizes, however, that, in construction settings, the competent person is often also the administrator of the respirator program.

The Committee also recommended that the NIOSH Recommended Exposure Limits (RELs) be used along with the TLVs, to define a hazardous exposure level in the absence of a PEL. This point is no longer relevant because the concept of ''hazardous exposure level'' is not included in the final respiratory protection standard.

The proposal would have limited the use of air-purifying respirators for hazardous chemicals with poor or inadequate warning properties. ACCSH recommended a change to the definitions of ''inadequate warning properties'' and that OSHA add a new definition for ''odor threshold.'' Because the final standard takes a different approach to determining when air-purifying respirators are appropriate, OSHA has not adopted the changes recommended by ACCSH.

ACCSH also suggested that OSHA revise the proposed definition of maximum use concentration (MUC). In

the final standard the definition of MUC has been reserved, pending completion of a subsequent stage of this rulemaking that will concentrate on establishing OSHA Assigned Protection Factors (APFs).

The Construction Advisory Committee also recommended replacing the proposal's definition of ''respirator;'' because the final standard contains no definition of ''respirator,'' this suggestion has not been adopted. The Committee also recommened revising the proposed definition of ''service life.'' However, since OSHA's definition of this term has been broadened in the final rule and the rule contains detailed requirements for change schedules for cartridges and canisters, ACCSH's concerns have largely been addressed.

Paragraph (c)—Respirator Program

Paragraph (c)(1) of the proposal contained a requirement that the employer establish a respirator program that ''covers'' certain elements, as applicable. OSHA has followed the Commitee's recommendation that OSHA change the word ''cover'' to ''include'' but not removed the phrase ''as applicable,'' as recommended by the Committee, because not all elements of the program apply in all situations, and thus the ''as applicable'' language is appropriate.

The Committee also recommended that OSHA add an element to the written respirator program on procedures for monitoring the work environment, using monitoring results when selecting respirators, and selecting the most protective respirators in situations where monitoring cannot be performed (as is often the case in construction). OSHA considered this comment in drafting the final standard, which permits the employer to make reasonable estimates of exposure as part of the respirator selection process. In most cases, as discussed in the summary and explanation of paragraph (d), monitoring results will form the basis of a reasonable estimate. Where the employer cannot estimate exposure, the atmosphere must be considered immediately dangerous to life or health (IDLH). For IDLH atmospheres, the most protective respirators are required.

One of the elements in the written respirator program, paragraph (c)(1)(vi), states that the program shall include procedures to ensure proper air quality for atmosphere-supplying respirators. ACCSH asked OSHA to add the words ''quantity and flow'' to provide more direction for employers on what the procedures should cover. OSHA agrees and has revised the wording of this element accordingly.

ACCSH recommended that OSHA substitute the term ''competent person'' in paragraph (c)(2) for the language ''person qualified by appropriate training and/or experience.'' This recommendation has already been discussed above, in connection with ACCSH's comments on paragraph (b).

The written respiratory protection program, in paragraph (c)(3), is required to reflect current workplace conditions and respirator use. The Committee urged OSHA to add the term ''training'' to this element. OSHA has not done so because training is addressed in another program element. The Committee also recommended that OSHA add to paragraph (c) a provision allowing employees and designated representatives access to exposure and medical records maintained by the employer. Because this requirement is already included in 29 CFR 1910.1020, the medical and exposure records access standard, and referenced in this final respiratory protection standard, the Agency has not done so.

Proposed paragraph (c)(5) required employers to make the written program available to affected employees, designated representatives, and OSHA. The Committee requested that employers be required to send a copy of the program to the OSHA Special Assistant for Construction. However, the proposed requirement has been moved to paragraph (m) of the final standard, which requires that all written materials maintained under the standard be made available upon request to affected employees and the Assistant Secretary. This requirement should meet any need that may arise for copies of the written program.

The Committee further recommended that the written respirator program be maintained and made available to employees at the job site, and that the medical and monitoring results pertaining to respirator use be available at the work site as well. The final standard in paragraph (m) now requires employers to allow employees to examine and copy written programs upon request. Access to medical and monitoring records for employees exposed to toxic substances or harmful physical agents is regulated by OSHA in a separate standard, 29 CFR 1910.1020. That standard applies to construction workplaces as well as general industry workplaces and requires the employer to ensure that access to medical and monitoring records is provided in a reasonable time, place, and manner (1910.1020(e)(1)(i)). Nothing in the final respiratory protection standard is intended to alter this requirement.

Paragraph (d)—Selection of Respirators

In its review of paragraph (d) of the proposal on selection of respirators, the Committee requested OSHA to add a new provision that would require monitoring for contaminants when air-purifying respirators are used. This request is related to the recommendation for mandatory monitoring, discussed above. The final standard requires that employers make reasonable estimates of employee exposure levels when selecting all respirators, not just air-purifying ones. Even if current monitoring results are unavailable, employers must base their exposure estimates on reliable data, which might include, for example, the results of past monitoring for similar construction jobs. Extensive discussion of this issue is contained in the summary and explanation section of this preamble for paragraph (d). OSHA believes that allowing exposure estimates that may be based on past monitoring and other representative data makes sense for the construction industry, where jobs are often short-lived and current monitoring data relating to specific employees/operations may not be available when respirators must be selected. Because the final standard allows employers to rely on reasonable estimates of exposure as well as monitoring results, OSHA has not added a requirement to the standard mandating that employers ''obtain'' needed information, as recommended by the Committee.

The Committee also recommended removal of the proposed phrase ''when they exist'' to modify the requirement that employers select only NIOSH-approved respirators. Instead, the Committee recommended use of the most protective respirator available, an SCBA or supplied air respirator, in cases where no approved air-purifying respirator exists. OSHA has removed the phrase ''when they exist'' from the final standard, for reasons explained in the summary and explanation discussion relating to paragraph (d).

The Committee urged OSHA to include poor odor warning properties as a reason for prohibiting the use of air-purifying respirators, and to remove proposed paragraph (d)(6)(ii), which, under limited circumstances, would have allowed their use with substances with poor odor warning properties. Final paragraph (d)(3) modifies the proposal, and places many limitations on air-purifying respirator use with gases and vapors, regardless of the existence of warning properties.

The Committee objected to the use of air-purifying respirators in an

atmosphere with an oxygen content of 19.5 percent at altitudes of 14,000 feet or below; in the Committee's view, supplied air respirators should be required in this situation. OSHA continues to treat atmospheres at altitudes of 14,000 feet or below that have oxygen concentrations of at least 19.5% as non-oxygen-deficient, and to require atmosphere-supplying respirators in these atmospheres. OSHA's reasons for this determination are detailed in the summary and explanation section for paragraph (d).

Paragraph (e)—Medical Evaluations

The Committee recommended that a mandatory medical examination be required in accordance with ANSI Z88.2, and that the standard include a list of diseases and conditions that should be considered in determining an individual's ability to wear a respirator. The final standard allows employers to rely on a screening questionnaire to identify employees with specified conditions that will require follow-up medical examinations. The questionnaire specifies medical conditions that OSHA has determined often relate to an employee's ability to use a respirator. OSHA believes that this provision responds to the Committee's concern.

Based on the comments of ACCSH and others, OSHA has decided to eliminate the proposed exemption for employees wearing respirators for no more than 5 hours per week, for the reasons explained below in the Summary and Explanation. The final rule also reflects the Committee's recommendation that the medical opinion provided to the employer include only limitations on the employee's ability to use a respirator.

The Committee recommended that OSHA add a provision to this paragraph requiring the employer to inform the person performing the medical examination of the atmospheric contaminants to which the employee would be exposed. The final standard meets this concern by requiring that the physician or other licensed health care professional (PLHCP) receive a copy of the employer's written respirator program, and information about other environmental conditions an employee may encounter; this information will allow the medical professional to judge whether the employee is medically capable of wearing the respirator.

The final rule allows an employer who has, within the preceding 12 months, provided his or her employees with a medical evaluation that fulfills the requirements of the revised standard to rely on the results of that evaluation. OSHA believes that this provision is responsive to the Committee's concern that limitations be placed on the ''portability'' of medical evaluations.

The Committee recommended that OSHA add a new provision to paragraph (e) to require that the employer provide a powered air-purifying respirator or atmosphere-supplying respirator to any employee found medically unable to wear a negative pressure respirator but otherwise able to perform the task to be done. The final standard requires the employer to provide a PAPR to an employee when the PLHCP informs the employer that the employee has a medical condition that may place the employee's health at increased risk of material impairment if the employee uses a negative pressure respirator (paragraph (e)(6)(ii)) and is thus responsive to the Committee's concern.

Paragraph (f)—Fit Testing

With respect to fit testing procedures, the Committee recommended that proposed paragraph (f)(1) be rewritten to state that respirators must fit the employee so as to ensure that no exposure above the TLV or ceiling level occurs. OSHA agrees with the Committee's emphasis on fit testing and believes that the final rule's fit testing requirements and the fit test protocols in an appendix to the standard will ensure that employees are protected from the overexposures of concern to the Committee.

The Committee also suggested clarifying that a fit test is required whenever a different make or size respirator is used or when the facial characteristics of the employee change. The final rule addresses both of these points.

The Committee recommended limiting the fit testing requirements to tight-fitting negative pressure respirators. This issue, and OSHA's reasons for requiring fit testing of all tight-fitting respirators, is discussed in the fit testing section of the Summary and Explanation. OSHA has also deleted the proposed provision, objected to by the Committee, that would have allowed the employer to use a qualitative fit test for selecting respirators for employees who require fit factors greater than 10 in situations where outside contractors who do the quantitative fit testing are not available.

Paragraph (g)—Respirator Use

Paragraph (g)(1) of the final standard adopts the proposed provision prohibiting the use of respirators that rely on a tight facepiece fit when facial conditions such as a beard or scarring would prevent such fits. The Committee urged OSHA to extend this provision to cover loose-fitting respirators as well as tight-fitting ones. OSHA explains in the Summary and Explanation for this paragraph that conditions such as a beard or facial scarring would have no effect on the performance of loose-fitting hoods or helmets, and OSHA therefore does not regard it as appropriate to make this change.

Employees who wear glasses were required in proposed paragraph (g)(4) to wear them in a manner that does not interfere with the facepiece seal of the respirator. The final standard continues this requirement (paragraph (g)(l)(ii)). The Committee suggested an additional requirement stating that, where the employee must wear corrective lenses and the respirator requires that these be of special design, the employer provide the lenses at no cost to the employee. OSHA believes, however, that such a requirement is not necessary because, in most cases where negative pressure respirators may be worn, half-masks are acceptable, and half-masks eliminate the concern about corrective glasses interfering with facepiece seal. Because the final standard allows contact lenses to be worn, full facepiece respirators can be worn by persons needing corrective lenses; contact lenses obviously do not interfere with facepiece seal. Thus, the final rule gives employers several options for addressing this concern of the Committee's.

Paragraph (h)—Maintenance and Care of Respirators

The Committee urged OSHA to add the phrase ''on paid time'' to this paragraph to ensure that employers not require employees to clean their respirators on their own time. OSHA has decided in the final rule simply to require employers to ensure that respirators are cleaned according to mandatory procedures or their equivalents. OSHA believes that this approach is appropriate because the record demonstrates that on-site, employer-supervised cleaning is the prevalent cleaning procedure and the standard's rigorous requirements for cleaning respirators will limit off-site cleaning of respirators by employees.

Paragraph (k)—Training

The training section of the proposal would have required that employers provide a training program for employees who are required to wear respirators. The Committee urged OSHA to add language to paragraph (k)(1) to require employers to provide, conduct and document the effectiveness of the training program. The final standard takes a more integrated approach in that

it requires employers to evaluate the entire respiratory protection program rather than the training program specifically.

Paragraph (m)—Recordkeeping

OSHA has adopted the Committee's recommendation to add the phrase ''and make available'' to proposed paragraph (m)(1)(iii), which required employers to maintain records of medical evaluations in accordance with 29 CFR 1910.1020, the Access to Employee Exposure and Medical Records standard (see paragraph (n)(1) of the final rule).

Appendix B—Recommended Practices

Appendix B–1 of the standard contains practices for performing positive and negative pressure faceseal checks. Respirator wearers are required by paragraph (g)(iii) to perform a faceseal check before entering the work area either by following the mandatory faceseal check methods in Appendix B–1 or by following the respirator manufacturer's recommended method, if the employer shows that the manufacturer's method is as effective as the required methods. The Committee urged OSHA to add new fit check methods to Appendix B–1, and OSHA has responded to this recommendation by allowing the methods suggested by the Committee if they are as effective as the methods in the Appendix.

ACCSH also recommended that OSHA issue a separate respirator standard for the construction industry. OSHA has reviewed the Committee's comments to identify which construction-specific concerns call for provisions that differ from those applicable to general industry. First, many of the final standard's provisions are stated in performance language, which is flexible enough to accommodate differences in particular workplaces or industries. For example, approved fit test systems, both quantitative and qualitative, are portable and can be used on construction work sites as well as in fixed industrial facilities. Another example is the final rule's requirement for medical surveillance; the frequency of medical reevaluation is now event driven, which will greatly simplify evaluations for employees who frequently change employment, as is the case with many construction workers. Thus, OSHA believes that the final rule is responsive to the Committee's concerns about the uniqueness of the construction industry and is sufficiently flexible to be used on worksites in this sector.

D. Assigned Protection Factors

OSHA is reserving the sections of this standard addressing assigned protection factors (APFs) pending further rulemaking. OSHA is working diligently to complete the reserved portions of the standard. In the interim, OSHA expects employers to take the best available information into account in selecting respirators. As it did under the previous standard, OSHA itself will continue to refer to the NIOSH APFs in cases where it has not made a different determination in a substance-specific standard.

E. Small Business Considerations

Pursuant to 5 U.S.C. 605(b) of the Regulatory Flexibility Act, OSHA certified to the Small Business Administration that the proposed respiratory protection standard would not have a significant impact on a substantial number of small entities.

For the purposes of fulfilling the requirements of the Regulatory Flexibility Act, the Agency in its Preliminary Regulatory Impact Analysis (PRIA) [Ex. 57] examined the impact of the standard on a number of different small establishment-size classes (1–7 employees, 8–19 employees, etc). Although some economies of scale associated with the proposed standard were noted, the Agency found that, given the modest costs per establishment and the limited impact of the proposed regulatory revisions as a whole, the standard would not impose a significant economic impact on a substantial number of small entities. These findings were summarized in the NPRM (59 FR 58894). At the time that OSHA published the NPRM for this rulemaking (Nov. 15, 1994), the Agency transmitted the certification setting forth this conclusion, along with the full PRIA, to the Small Business Administration.

In developing the final standard, the Agency has conducted a screening analysis to identify any significant impacts on a substantial number of small entities. The details of the screening analysis are presented in the Final Economic Analysis, which is available in the docket; a summary of the analysis appears in section VI. Based on this screening OSHA has again determined that the final rule will not impose a significant impact on a substantial number of small entities. The costs of the standard will equal no more than 0.02 percent of revenues for small firms in any affected industry, and will therefore pose no threat of business disruption, whether these costs are absorbed by affected firms or passed on to consumers. OSHA therefore certifies that the final rule will not have a significant impact on a substantial number of small entities.

Nevertheless, the Agency has designed the standard to minimize impacts on all affected establishments, and particularly on small entities. OSHA's special consideration of small businesses is in accord with the Agency's continuing policy to remain sensitive to the needs of small entities affected by Agency regulations.

Provisions that recognize the special needs of small businesses are discussed in more detail under specific sections of the Summary and Explanation of the standard, Section VIII. Examples of provisions where consideration was given to small businesses in making regulatory decisions include:

—Reduction in the number of repeat fit tests required for quantitative fit testing;

—Allowing employers to use a questionnaire (Appendix C is an example) as a minimal medical evaluation tool to ascertain an employee's ability to use respirators, rather than requiring a hands-on physical examination;

—Allowing medical evaluations to be conducted either by a physician or by another licensed health care professional (PLHCP), which will reduce medical surveillance costs without compromising employee protection;

—Making the frequency of medical evaluations, after the initial assessment, event-related instead of time-related, e.g., only requiring such evaluations when specific conditions indicate a need for a reevaluation;

—Reducing the amount of paperwork required in connection with medical evaluations. OSHA's previous standard required a physician to determine pertinent health and physical conditions, and further required that the respirator user's medical status be reviewed periodically (for instance, annually). Historically, employers have had physicians evaluate their employees' physical conditions, and have maintained records documenting those evaluations;

—Revising the requirements for disinfecting respirators from ''after each use'' to ''as necessary to be maintained in a sanitary condition'' to allow flexibility for small businesses;

—Requiring only that tags be used to document respirator inspections, rather than requiring written records; and

—Allowing the employer to obtain a certificate of analysis of breathing gas

from the supplier rather than requiring employers to conduct gas analyses themselves.

In the Small Business Administration's *Annual Report to Congress,* a summary of SBA's comments to the respirator docket (Ex. 54–318) was provided. (Note that these comments pertain to the proposed rather than final rule.) SBA's comments have been examined alongside others with regard both to the proposal and its supporting economic analysis. As indicated, many of SBA's suggestions have been adopted; the SBA's comments on the Preliminary Regulatory Impact Analysis are discussed in detail in the economic impact chapter of the Final Economic Analysis.

Revised 29 CFR 1910.134 is intended to serve as a ''building block'' standard with respect to future standards that may contain respiratory protection requirements; that is, future standards that regulate respirator use in controlling employee exposure to hazardous conditions will refer to provisions in the final respiratory protection standard. Further, OSHA has found that the respirator provisions of existing substance-specific standards (Asbestos, Cadmium, Lead, etc.) were especially in need of revision in view of newly revised § 1910.134. Except for a limited number of respirator provisions unique to each substance-specific standard, the remaining regulatory text on respirators now reads virtually the same for each of these standards. For example, all provisions addressing respirator use, selection, and fit testing were deleted from the substance-specific standards, making these standards consistent with the final respiratory protection standard with respect to these requirements. The Agency believes that the revisions being made to 29 CFR 1910.134 are sufficiently comprehensive to allow deletion of those provisions in the substance-specific standards that duplicated provisions in the revised final rule. A provision was retained only when it addressed conditions (for example, medical evaluation) that were unique and/or integral to the substance-specific standard.

The Agency concludes that deletion of duplicative provisions from the substance-specific standards will enhance compliance, especially for small businesses, and will thus will improve the protection afforded to employees who use respirators.

IV. Certification/Approval Procedures

Section 1910.134(b)(8) of the previous standard required that only those respirators approved jointly by NIOSH and MSHA be used by the employer. The current respirator testing and approval regulation, 30 CFR 11, which authorized the Bureau of Mines and NIOSH to jointly approve respiratory protection devices, was promulgated on March 25, 1972 at 37 FR 6244. On November 5, 1974 the Mine Enforcement Safety Administration (MESA) succeeded the Bureau of Mines and joined NIOSH in jointly approving respirators. Following the transfer of MESA to the Department of Labor, where it became the Mine Safety and Health Administration (MSHA), authority was transferred on March 24, 1978 to MSHA for joint approval with NIOSH of respirators. Most of the Bureau's respiratory testing methods, developed in the 1950s or earlier, were changed in the 1970s to reflect changes in testing technology.

NIOSH initiated revision of 30 CFR 11 in 1980. A public meeting was held in July 1980 to address the certification program. On August 27, 1987, NIOSH published a notice of proposed rulemaking (52 FR 32402) that would have allowed NIOSH to certify respirators under the new 42 CFR part 84 regulations, replacing the current joint NIOSH/MSHA 30 CFR 11 certification regulations. The proposed NIOSH certification regulations contained new and revised requirements for testing and certification of respirators, and included a set of assigned protection factors for various classes of respirators. Public hearings on the first draft of the NIOSH proposal were held in January 1988. On the basis of the comments received, NIOSH prepared a revised proposal for further public comment. On June 8, 1995 NIOSH published revised respirator certification procedures for particulate respirators (60 FR 30336) and recodified the previous certification standards for the other respirator classes as 42 CFR Part 84. These certification procedures address N, P and R class particulate respirators at 95%, 99%, and 99.7% levels of effectiveness. Additional public comment was sought at public meetings convened in June 1996 to assist NIOSH in preparation of future rulemakings that will continue the revision of the certification procedures for other classes of respirators. In October 1997, NIOSH announced the intended priority order for these future rulemakings. Relevant aspects of these proceedings are discussed in the Summary and Explanation.

V. Significance of Risk

Respirators are used by American workers as a means of protection against a multitude of respiratory hazards that include chemical, biological, and radiological agents. Situations in which respirators are relied upon to provide protection from these hazards include those that involve immediately life-threatening situations as well as routine operations where engineering controls and work practices are not able to provide sufficient protection from these hazards. In these situations, respirators must ''seal off'' and isolate the worker's respiratory system from the contaminated environment. The risk that a worker will experience an adverse health outcome when relying on respiratory protection is a function of the toxicity or hazardous nature of the air contaminants present, the concentrations of the contaminants in the air, the duration of exposure, and the degree of isolation provided by the respirator. When respirators fail or do not provide the degree of protection expected by the user, the user is placed at an increased risk of any adverse health effects that are associated with exposure to the respiratory hazards present. Therefore, it is critical that respirators perform as they are designed to do to ensure that users are not at an increased risk of experiencing adverse effects caused by exposure to respiratory hazards.

OSHA has discussed the nature of adverse health effects caused by exposure to airborne chemical hazards many times in previous rulemaking efforts (see, for example, Appendix A of the Hazard Communication standard, 29 CFR 1910.1200 and the preambles to any of OSHA's single substance standards codified in 29 CFR 1910.1001 to 1910.1052). In all instances where OSHA has promulgated new or revised PELs for chemical air contaminants, OSHA has determined that the health effects associated with exposure to the contaminants represent material impairment of health because the effects are life-threatening, cause permanent damage, or significantly impair the worker's ability to perform his or her job in a safe manner. As discussed in Section VI of this preamble, OSHA expects that thousands of illnesses and hundreds of fatalities that are presently being caused by exposure to hazardous substances will be avoided annually among respirator wearers as a result of improvements and clarifications made to the earlier standard by this final rule.

Evidence on current workplace exposure levels confirms that respirators are needed in many work situations to protect workers against serious work-related illness. To illustrate, OSHA identified several substances that represent a range of adverse effects and

for which OSHA's Integrated Management Information System (IMIS) database has documented workplace exposures that exceed the current PELs for these substances. The effects represented by this subset of the IMIS and the associated substances for which there are documented overexposures include:

—Sudden death/asphyxiation—carbon monoxide, carbon dioxide;
—Loss of lung function—wood dust, welding fume, manganese fume, copper fume, cobalt metal fume, silica;
—Central nervous system disturbances—carbon monoxide, trichloroethylene;
—Cancer—chromic acid, wood dust, silica; and
—Cardiovascular effects—carbon monoxide.

When respirators are used during operations where exposures exceed OSHA's PEL, OSHA believes that there is little or no margin that would protect the worker in the event that the respirator does not perform as well as designed or expected. For all of the substances for which OSHA has promulgated a comprehensive health standard (i.e., Arsenic, 29 CFR 1910.1018; Asbestos, 29 CFR 1910.1001; Benzene, 29 CFR 1910.1028; Lead, 29 CFR 1910.1025; Ethylene Oxide, 29 CFR 1910.1047), OSHA has determined that exposure above the PEL is associated with a significant risk of material impairment of health, and believes as a matter of policy that exposures below the PEL may be associated with risk levels that are significant. That is, there is no exposure level near or somewhat above the PEL that can be considered to be at a low or insignificant risk level. Therefore, where workers perform jobs that result in exposures above the PEL for any of these substances, use of properly functioning respirators is essential to ensure that workers are not placed at significant risk of material impairment of health.

Throughout this preamble, OSHA has demonstrated that adequate fit testing, proper respirator selection, worker training, and thorough inspection and maintenance are essential elements of a respirator program. Without these requirements, OSHA believes that there is a greater chance that a respirator user will inhale potentially dangerous air contaminants, either by improper selection of equipment, excessive respirator leakage, improper use of the respirator, or any combination of these. This section presents an analysis conducted by OSHA to evaluate the improved protection to workers who use respiratory protection equipment by the type of effective respirator program required by the final rule.

In the context of a respiratory protection program, the health risk presented to workers can be represented as the risk that a respirator will fail to provide some minimum expected level of protection, which increases the possibility that the user of the respirator will be overexposed to a harmful air contaminant. This presumes that respirators will be selected and used in work settings where exposure to ambient concentrations of air contaminants poses an unacceptable health risk, and, if the respirator performs as expected, the wearer will be protected from that risk. For example, an employer who provides a half-mask, chemical cartridge respirator for employee use might typically assume that the respirator will filter out 90 percent of the contaminant and base his or her choice of respirator on that assumption. If the respirator performs less effectively than expected, the employer's expectation that the respirator will provide effective protection will not be fulfilled.

This concept of risk differs from that used by OSHA in its substance-specific health standards, in which the Agency typically defines risk as the probability that a worker will acquire a specific work-related illness. Quantifying that kind of risk requires the analysis of data that relates the magnitude or intensity of exposure to the incidence or prevalence of adverse effects seen among exposed populations or experimental animals. In contrast, the kinds of hazardous situations covered by the final respiratory protection standard are varied in terms of the nature of the hazard present (i.e., acute, chronic, or both), the frequency and magnitude of exposure, and the types of illnesses associated with exposure to those hazards. As a consequence, the health risks addressed by the final rule cannot be described in terms of an illness-specific risk, but instead relate to the more general probability that a respirator will provide insufficient protection causing the wearer to be exposed to a dangerous level of one or more air contaminants.

Certain studies, referred to as ''workplace protection factor'' (WPF) studies, have attempted to measure the effectiveness of respirators under actual conditions of use in the workplace. The WPF is a measure of the reduction in exposure achieved by using respiratory protection and is represented by an estimate of the ratio of the concentration of a contaminant found in the workplace air to the concentration found inside the respirator facepiece while the respirator is being worn. As the degree of protection afforded by the respirator increases, the WPF increases. Alternatively, the degree of protection provided by a respirator can be expressed as a penetration value, which is the reciprocal of the WPF and reflects the ratio of the concentration of contaminant inside the facepiece to the concentration outside. For example, a WPF of 50 equates to a penetration value of 0.02 and means that the concentration inside the respirator facepiece is one-fiftieth of the ambient level.

Because WPF studies are designed to evaluate the field effectiveness of respiratory protection equipment, study protocols usually have been designed to minimize factors that can reduce respirator performance. Such factors include selecting the wrong type of respirator for the working conditions under which the study is being conducted, use of poorly fitting respirator facepieces (i.e., testing of respirator fit is routinely done in well-conducted WPF studies), inadequate training of wearers in proper respirator adjustment and use, or excessive leakage caused by malfunctioning or dirty respirator parts. Typically, WPF study protocols include procedures for properly selecting respirators and ensuring that they are in good working order, assigning respirators to workers on the basis of valid qualitative or quantitative fit tests, training wearers on how to adjust strap tension properly and use the respirator, and ensuring that neither facial hair nor other personal protective equipment is likely to interfere with respirator fit. In addition, workers included in WPF studies are usually monitored throughout the period that respirators are worn to verify that the equipment is being properly used. All of these conditions reflect the principal elements of a strong respirator program in which respirator performance is optimized; therefore, the results from a good WPF study can mirror the results obtained by an employer who implements a well-run respiratory protection program.

To quantitatively evaluate the impact of implementing a good respirator program on respirator performance, OSHA identified several WPF studies that were conducted using methods that reflect a comprehensive program, and compared these results to other workplace studies that did not employ all of the elements of a good program. Quantitative approaches are used to develop (1) aggregate estimates of respirator effectiveness in both the presence and absence of a good

respiratory protection program, and (2) estimates of the frequency with which workers are likely to achieve inadequate protection while using a respirator, given the presence or absence of a good underlying program. All of the studies used in this analysis pertain to the effectiveness of half-mask, negative-pressure respirators, and all are contained in OSHA's rulemaking docket (H–049).

Many of the well monitored WPF studies conducted were reviewed by Nelson et al. in 1995 (Ex. 64–514); these authors selected data from seven such studies to evaluate the overall field effectiveness of half-mask, negative-pressure respirators. Each of the studies described by Nelson et al. ensured selection of properly fitted respirators either by an accepted qualitative fit test (QLFT) (i.e., isoamyl acetate or saccharin) or by a quantitative fit test (QNFT) where only respirators that provided a minimum protection factor to the wearer of at least 100 were selected. Each of these studies provided for worker instruction in proper respirator use, and workers were monitored during each study to ensure proper use. An additional six studies were reviewed by Nelson et al. but were rejected either because they allegedly used biased sampling methods to determine ambient and in-facepiece contaminant concentrations or because the authors believed that improper or invalidated fit test procedures were employed.

In the studies selected by Nelson *et al.* for analysis, workers used elastomeric or disposable respirators equipped with dust-mist, dust-mist-fume, or high-efficiency particulate (HEPA) filters, and the collection of studies represented a range of workplace exposure situations, including pigment production, metals refining, asbestos exposure during brake-repair work, welding, and spray painting. Geometric Mean (GM) WPF values from these studies ranged from 47 to 3,360, with an overall GM WPF of 290. The 5th percentile WPF from the data set was estimated to be 13, with a 95% confidence interval of 10–18. Nelson et al. concluded from the analysis of the overall data set that the assigned protection factor of 10 for half-mask, negative-pressure respirators was reasonable given that a WPF of less than 10 would not likely occur more than 5 percent of the time. In addition, Nelson et al. found no significant difference in the field performance of disposable respirators compared to elastomeric models. OSHA has not conducted a detailed comparative evaluation of WPF values obtained from disposable vs. elastomeric respirators; if, in fact, disposable respirators provide less protection than elastomeric respirators, the WPFs that can be achieved under a good respirator program will be overstated in this analysis since Nelson et al.'s compiled data reflect the use of both types of respirators.

Each of the studies reviewed by Nelson involved worker exposures to dusts. OSHA could identify only one WPF study, by Galvin et al. in 1990 (Ex. 64–22), that examined respirator effectiveness against exposure to a vapor-phase contaminant rather than a particulate. In this study, WPF measurements were taken on a group of 13 styrene workers who used half-mask, air-purifying respirators equipped with chemical cartridge filters. All employees were assigned respirators based on passing an irritant smoke fit test, and all were trained on how to properly don the respirator and conduct fit checks. In-mask and ambient styrene concentrations were measured over one-hour periods, during which employees were instructed not to readjust the facepiece. Chemical cartridges were changed with each new sampling period to ensure that there was no breakthrough. In-mask styrene concentrations were adjusted upwards by 40 percent to account for pulmonary retention, which avoided potentially overestimating the WPF. The GM WPF for the overall cohort was reported to be 79, with a geometric standard deviation (GSD) of 3.51. There was no significant difference in WPF values between those workers engaged in relatively physical operations, such as spraying, compared to those performing less physical work tasks. The GM WPF found by Galvin et al. for styrene-exposed workers lies within the range of GM WPF values reported in the studies reviewed by Nelson for worker cohorts exposed to particulate-contaminated environments.

Nelson in his 1995 report (Ex. 64–514) excluded the Galvin *et al.* study from his analysis because fit tests were performed using the irritant smoke protocol. As discussed in the Summary and Explanation section of this preamble, OSHA has determined that the irritant smoke qualitative fit test provides a valid, effective test of respirator facepiece fit. The procedures used by Galvin et al. to ensure adequate worker training and respirator use are consistent with the elements of a permissible respirator program, and OSHA, therefore, finds it appropriate to include this study in the set of WPF studies that are representative of effective respiratory program practices.

In contrast, OSHA has identified three studies where investigators also determined WPF values for half-mask, negative-pressure respirators, but where few steps were taken to ensure maximum respirator performance. OSHA believes that these studies illustrate the relative lack of protection afforded by respirators when certain critical elements of the respiratory protection program are missing or inadequate. The studies identified by OSHA are those by Toney and Barnhart in 1972 (Ex. 64–68), Moore and Smith in 1976 (Ex. 64–49), and Harris *et al.* in 1974 (Ex. 27–11).

Toney and Barnhart (Ex. 64–68) conducted a WPF study to evaluate the effectiveness of half-mask, chemical-cartridge respirators on reducing exposures of spray painters to solvent vapors and aerosols. Data were obtained from painters working at 39 different sites and included both in-mask and ambient concentrations. WPFs were found to be low; from the raw data presented in the study, OSHA calculated a GM WPF of 3.8 for solvent exposure (GSD=2.28, N=39) and a GM WPF of 11.4 for aerosol exposure (GSD=4.12, N=40). Penetration tests performed on unused respirator cartridges of the same types used in the field indicated that the poor WPFs achieved in the field tests were caused by poor respirator fit and a lack of respirator maintenance, and were not due to any inherent defect in the cartridges. The authors concluded that respirators being used by painters were not effective and cited several reasons, all pointing to the lack of a respiratory protection program at the facilities tested. For example, 28 percent of respirators used by the painters were poorly maintained. Some of the conditions found by the investigators included deteriorating rubber on the facepieces, the presence of stuck or warped valves, missing head straps, and evidence of leakage around the cartridge seal. In addition, it was apparent that some of the cartridges had not been changed for extended periods of time. Many of the facilities studied supplied non-approved respiratory protective devices (respirators were approved by the Bureau of Mines at the time of the study), and most had no formal training or maintenance program in place. The authors found that ''* * * management and workers are extremely uninformed on the subject of selection, use, and care of respiratory protective devices.'' (Ex. 64–68, p. 93).

The second study, conducted by Moore and Smith in 1976 (Ex. 64–49), measured WPF values obtained by workers exposed to sulfur dioxide (SO_2) during a furnace charging operation at a copper smelter. Three models of half-mask, chemical cartridge respirators

were tested on each of nine workers; in-mask and ambient SO_2 concentrations were measured during the furnace charging operation while the respirators were worn. There is no indication in the study that qualitative or quantitative fit testing was performed to verify adequate facepiece fit. A total of 81 samples were collected, 5 of which were excluded from the analysis because the subjects removed or lifted the respirator facepiece during the sampling period. Average ambient SO_2 concentrations varied in the range of 53 to 61 mg/m^3 (20.4 to 23.5 ppm) during the sampling period. Geometric mean WPF values reported for each of the three models of respirator were 22.1 (SD=22.6), 18.4 (SD=14.2), and 12.9 (SD = 11.0). Moore and Smith concluded that the overall protection afforded by the respirators was poor, and that between one-third and one-half of the protection factors achieved would be below 10, the accepted minimum protection factor for that type of respirator. Reasons given by the authors for the poor fits observed among the subject workers included the possibility that strap tension was not properly adjusted (the authors did not control or monitor strap tension), variation in facial hair (despite the lack of beards or wide sideburns), and normal work activities that caused head motion and deep breathing associated with heavy work.

The third study is that of Harris *et al.* in 1974 (Ex. 27–11), who evaluated the performance of five half-mask dust respirators among 37 miners working in 4 coal mines. In-mask and ambient dust measurements were made throughout the workshifts, during which miners intermittently used respiratory protection. Thus, this study differs from the others described above in that the ratio of in-mask to outside concentrations included periods of time where the respirator was not worn, in contrast to the typical WPF study. The ratio of in-mask to outside concentration determined during periods of intermittent respirator use, termed the ''effective protection factor'' (EPF), is not directly comparable to WPF values because, to the extent that workers spend time in contaminated atmospheres without respiratory protection, the WPF will tend to understate the actual protection obtained while the respirator is being worn. However, according to Poppendorf in 1995 (Ex. 54–512), it is possible to use EPF data to estimate the WPF that was likely to have been achieved during periods of respirator use if both of the following are known or can be estimated: (1) The fraction of time during which the respirator was not worn by the subject, and (2) the ratio of contaminant concentration in areas where the respirator was worn to that in areas where the respirator was not worn. Poppendorf (Ex. 54–512) described the mathematical relationship between the EPF and WPF and suggested that the likely range of average WPF values achieved by the miners during periods of respirator use was 3.6 to 5.7. This estimate of WPF is based on an observation by Harris et al. that miners wore their respirators about half of the time during the sampling periods, and an assumption by Poppendorf (Ex. 54–512) that the dust levels in the air while respirators were worn were at least 5 times higher than airborne dust levels during periods of respirator non-use. OSHA believes that the latter assumption is reasonable given that Harris et al. reported that, for the most part, miners wore their respirators only when visible airborne dust was present. Harris et al. noted that the hard hats worn by the miners interfered with proper respirator strap positioning and adjustment; OSHA believes that this factor, as well as the apparent lack of fit testing, is likely to have contributed to the low protection factors experienced by the miners.

OSHA believes that the studies described above demonstrate that improved respirator performance can be achieved under actual workplace conditions if fit testing is used to select respirators, if respirators are clean and in good working order, and if employees are properly trained and supervised in their use. This is evident when the summary statistics from aggregate protection factor data obtained from field studies on groups of employees using respirators in the absence of a strong respirator program (i.e., Moore and Smith, Toney and Barnhart, Harris *et al.*) are compared with those obtained from cohorts using respirators under the condition of a strong program (i.e., the studies reviewed by Nelson and the study by Galvin *et al.*). Summary protection factor data from these studies are presented in Table V–1 as geometric mean and mean WPF values, and the geometric standard deviation (GSD) of the distribution of WPF values. From these summary statistics, OSHA computed a weighted geometric mean WPF across cohorts exposed to particulate contaminants to compare the central tendency in protection factors achieved both with and without an adequate underlying respirator program (see footnote on Table V–1).

In general, groups of employees using respirators against particulate exposures under a strong program achieved an overall GM protection factor about 25-fold higher than groups using respirators without the elements of a strong respiratory protection program. In studies that did not implement all of these elements, mean WPF values among the particulate-exposed worker cohorts tested ranged from about 6 to 22. Mean WPF values for particulate-exposed worker cohorts included in the WPF studies where elements of a good program were implemented ranged from 72 to 2,400, with the mean WPF from one study estimated to be 11,500. The results from studies that examined respirator effectiveness against gas or vapor, also included in Table V–1, show an 8-fold difference in overall GM WPF values. With only one exception, the 95 percent confidence intervals around the GM WPF values computed from the studies reflecting inadequate program practices do not overlap with those computed from the studies reflecting strong program elements (see Table V–1); thus, the hypothesis that there are no differences in the GM WPF values between the two groups of studies is rejected. This analysis suggests that implementation of a good respiratory protection program containing the elements described by the final rule can contribute to a substantial increase in the overall performance of respirators used in actual workplace settings, as measured by the mean WPF across groups of workers.

TABLE V–1.—SUMMARY RESULTS FROM WORKPLACE PROTECTION FACTOR (WPF) STUDIES AND ESTIMATED FREQUENCIES OF RESPIRATOR FAILURE, BASED ON A ONE-FACTOR ANOVA ANALYSIS OF DATA FROM WORKPLACE PROTECTION FACTOR (WPF) STUDIES

Study	Geometric mean WPF (95% C.I.[1])	Geometric standard deviation	Mean WPF	Estimated percent of workers with:			
				Mean WPF ≤10[2]	Mean WPF ≤2[2]	WPF ≤10 at least 5% of the time[3]	WPF ≤2 at least 5% of the time[3]
Studies Reflecting Inadequate Program Elements							
Particulate Exposure							
Toney and Barnhart [1972] (Ex. 64–68)	[4]11.4 (3.2–39.6)	[4]4.12	31.1	76.8	9.0	100	60.4
Harris et al. [1974] (Ex. 27–11)							
Low Estimate	[5]3.6 (1–17.9)	[5]2–93	6.4	99.7	38.8	100	96.4
High Estimate	[5]5.7 (1.6–20.4)	[5]2.93	10.2	97.0	12.5	100	82.3
Weighted Geometric Mean	[6]5.6						
Gas/Vapor Exposure							
Moore and Smith [1976] (Ex. 64–69)							
Respirator A	15.29 (8.3–28.1)	[7]2.36	22.1	36.2	<0.01	98.9	1.9
Respirator B	13.72 (7.7–24.4)	[7]2.15	18.4	41.3	<0.01	99.7	0.5
Respirator C	9.59 (4.8–19.2)	[7]2.16	12.9	83.1	<0.01	100	9.0
Toney and Barnhart [1972] (Ex. 64–68)	[4]3.8 (1.2–11.9)	[4]2.28	5.3	100	14.7	100	95.7
Weighted Geometric Mean	[6]9.4						
Studies Reflecting Good Program Elements							
Particulate Exposure							
Dixon and Nelson [1984][8]	3360 (3101–3640)	4.8	11,498	<0.01	<0.01	<0.01	<0.01
Gaboury and Burd [1989][8]	47 (31–72)	2.5	72	0.2	<0.01	30.1	<0.01
Lenhart and Campbell [1984][8]	166 (120–228)	3.8	405	0.1	<0.01	9.0	0.02
Nelson and Dixon [1985][8]	258 (192–347)	5.2	1004	0.7	<0.01	14.5	0.3
Gosselink et al. [1986][8]	96 (75–123)	2.3	136	<0.01	<0.01	0.1	<0.01
Colton and Mullins [1992][8]	147 (117–185)	2.5	224	<0.01	<0.01	0.1	<0.01
Myers [1990][8]	346 (256–468)	7.2	2,428	2.8	0.1	22.2	1.7
Weighted Geometric Mean	[6]142						
Gas/Vapor Exposure							
Galvin et al. [1990] (Ex. 64–22)	79 (54–115)	3.5	173	1.1	<0.01	31.7	0.2

[1] 95% confidence interval of the geometric mean WPF calculated as follows for simultaneous confidence intervals: $\tilde{y} \pm SD \div \sqrt{n}\ t_{n-1,1-\alpha/2}$, $\alpha = 1-(1-0.05)^{1/N}$

where n is the number of WPF measurements in each study and N is the number of studies being compared (i.e., 10 for particulate studies and 5 for gas/vapor studies).

[2] Calculated from equation 9 as described in the text; $\delta = 0.1$ for WPF = 10, $\delta = 0.5$ for WPF = 2.

[3] Calculated from equation 10 as described in the text; $\kappa = 0.1$ for WPF = 10, $\kappa = 0.5$ for WPF = 2.

[4] Calculated by OSHA from raw data presented by the authors.

[5] Range of WPF values estimated by Popendorf [1995] (Ex. 54–512), from effective protection factor values (EPF) reported by Harris et al. GSDs calculated by OSHA from median and mean EPF values reported by Harris et al.

[6] Calculated as a weighted geometric mean as follows: $\exp[(\sum \ln GM/(\ln GSD)^2)/\sum(1/(\ln GSD)^2)]$.

[7] Calculated by OSHA from median and mean WPF values reported by Moore and Smith.

[8] Studies reviewed by Nelson [1995] (Ex. 64–514).

The three WPF studies representing deficient program practices were all conducted 10 to 20 years earlier than the WPF studies reflecting good program elements. Thus, differences between the two groups of studies in working conditions, processes and exposures, or respirator equipment and technology could confound the comparison of respirator effectiveness measures. OSHA is not aware of any recent studies that have been conducted that were designed to evaluate the impact of respirator program elements on respirator effectiveness, nor are recent studies available that have attempted to measure respirator effectiveness under conditions of a poor respiratory protection program. OSHA believes that this analysis of program impacts on respirator performance is based on the best available data. However, OSHA has considered whether confounding factors related to the elements of a good respirator program may also have contributed to the differences in respirator performance reported by the two groups of WPF studies. For example, respirator fit can be adversely affected by vigorous work activity requiring head motion and deep breathing. Heavy work loads also contribute to respirator discomfort, which may cause a worker to wear a respirator too loosely. The nature of the air contaminant affects respirator performance in that different types of respirator filters have different capabilities in purifying contaminated air and gas-phase contaminants and small-particulate aerosols pass more readily through leak points than do aerosols comprised mostly of larger particles.

OSHA does not believe that any systematic differences in working conditions or respirator technology contribute substantially to the differences in respirator effectiveness found between the two groups of studies included in the analysis. For example, both groups of studies represent a range of workplace situations that involve strenuous and non-strenuous work. In the studies that do not reflect good program practices, workers were engaged in active, strenuous work (smelter operations and coal mining) as well as less active work (spray painting). Similarly, studies that reflect good program practices have also been conducted on worker cohorts engaged in both active work (metals refining) and less active work (spray painting, brake repair). Both groups of studies also involve a range of contaminants, including both gas-phase and various kinds of particulate. Some of the studies reviewed by Nelson included information on the size distribution of

particulates to which workers were exposed, with the range across these studies including both respirable and non-respirable particles. Other studies included in the Nelson analysis reported that workers were exposed to both dust and fume. Therefore, the differences in WPFs found between the two groups of studies cannot be explained by differences in particulate sizes or characteristics. Both groups of studies also represent a variety of half-mask respirator designs and filters, including single-use respirators and respirators equipped with dust/mist (i.e., non-HEPA) filters. OSHA believes it unlikely that the 14-fold difference in overall WPFs between the two groups of studies can be primarily attributed to any fundamental differences in respirator equipment or technology. Therefore, OSHA finds that the differences in WPF values obtained from the two groups of studies are more likely to reflect differences in how well the respirators fit the subject workers, the condition of the respiratory equipment used, and the extent to which the equipment was used properly, rather than any confounding caused by systematic differences in work settings, the nature of the exposures, or the age of the WPF studies.

The kinds of summary statistics presented in Table V–1 have been used by several investigators to demonstrate how poorly or how well respirators can protect workers under actual conditions of use (see, for example, Moore and Smith (Ex. 64–69), Nelson et al. (Ex. 64–514)). However, such descriptive measures can only provide information on the aggregate frequency distribution of protection factor values in a group of workers. Although it is useful to rely on summary statistics from aggregate protection factor data to make general statements about the effectiveness of respirators, such measures do not adequately convey information on the number or proportion of workers who remain at risk of overexposure to air contaminants despite the use of respiratory protection, or how frequently an individual worker might experience poor fits.

Nicas (Ex. 156) and Nicas and Spear in 1992 (Ex. 64–425) have suggested that using statistics from aggregate protection factor data does not adequately describe the true risk of overexposure to workers using respirators because the approach fails to recognize that there are two different sources of variability that account for the overall variation in protection factor values measured from a given cohort of workers. One source of variability in protection factors is the variation typically experienced by a single worker from one day to the next; this is termed within-worker variability. The second source of variability reflects the observation that different workers within a group will achieve different average protection factors over a given period of time; this is termed between-worker variability. In a peer-reviewed article, Nicas and Spear (Ex. 64–425) have described a statistical model that accounts for both sources of variability. This model has been used by OSHA to estimate the following from the protection factor studies described above to better characterize risks to workers who use respirators both in the absence of and under a strong respiratory protection program:

(1) The proportion of workers who fail to achieve a long-term average protection factor at or above some specified target level, exposing the worker to an increased risk of a chronic health hazard (i.e., a health hazard that is typically associated with long-term cumulative exposure); and

(2) The proportion of workers who achieve a protection factor below some specified target level at least 5 percent of the time that the respirator is worn, thus increasing the frequency with which a worker may be exposed above an effect concentration associated with an acute health hazard.

The Nicas and Spear model (Exs. 64–425, 156) used by OSHA in this analysis is a one-factor analysis of variance and is described briefly as follows. Let P denote a penetration value experienced by the wearer of a respirator during a randomly selected wearing time (P is defined as the reciprocal of the protection factor PF measured in the workplace, or 1/PF). For example, a P value of 0.1 for a respirator wearer reflects that a protection factor of 10 was achieved in the workplace for that individual. If one were to measure the penetration values among members of a group of workers over time and aggregate the results, the total distribution of P values can be described by the following parameters:

$$P = \mu_p \times B \times W \quad (1)$$

$$GM[P] = \mu_p \times GM[B] \times GM[W] \quad (2)$$

$$GSD[P] = \exp\left(\sqrt{\ln^2 GSD[B] + \ln^2 GSD[W]}\right) \quad (3)$$

Where:

P = the penetration value for a worker for a particular wearing period,

μ_p = the arithmetic mean penetration value for the population,

B = a lognormally distributed factor that transforms μ_p to the arithmetic mean penetration value for the individual worker, and

W = a lognormally distributed factor that transforms $\mu_p \times B$ to the P value experienced by the individual worker for a particular wearing time.

The factors W and B describe within-worker variability and between-worker variability, respectively.

Since workplace protection factor studies typically report the geometric mean and geometric standard deviation of protection factor values obtained from a cohort of respirator wearers (i.e., GM[P] and GSD[P]), the parameters described above for within-worker and between worker variability can be estimated as follows if the relationship between GSD[B] and GSD[W] are known or assumed. Let R represent the ratio of GSD[W]/GSD[B]; then GSD[B] can be estimated from GSD[P] and R by the relationship

$$GSD[B] = \exp\left(\left[-\frac{1}{2}\ln R\right] + \frac{1}{2}\left[\sqrt{\ln^2 R + 2\left(\ln^2 GSD(P) - \ln^2 R\right)}\right]\right). \quad (4)$$

GSD[W], GM[B], and GM[W] are estimated by:

$$(5) \qquad GSD[W] = GSD[B] * R$$

$$(6) \qquad GM[W] = 1/\exp\left(0.5 * \ln^2\left(GSD[W]\right)\right), \text{and}$$

$$(7) \qquad GM[B] = 1/\exp\left(0.5 * \ln^2\left(GSD[B]\right)\right).$$

The arithmetic mean of the total distribution of penetration values across the whole cohort, μ_p, is estimated by:

$$(8) \qquad \mu_p = \frac{GM[P]}{(GM[B] * GM[W])}$$

Nicas (Ex. 156) defines two additional values, δ and κ, that are based on the parameters described above. The value δ represents the 95th percentile of the between-wearer distribution of average penetration values among a cohort of respirator wearers; thus, there is a 5 percent chance that a respirator wearer in the cohort could have an average penetration value of δ or higher. If δ is set to some penetration value reflecting some minimum acceptable value of protection, the probability that a respirator wearer would fail, on average, to achieve the minimum acceptable penetration value is Pr(Z>z), where

$$(9) \qquad z = \frac{\left(\ln \delta - \left(\ln \mu_p + \ln GM[B]\right)\right)}{\ln GSD[B]}$$

and Z is the standard normal deviate. By estimating the parameters μ_p, GM[B], and GSD[B] from WPF data, one can estimate the probability that a respirator wearer could have an average penetration value greater than some specified value δ.

The value κ is defined by Nicas (Ex. 154) based on the distribution of each worker's 95th percentile P value and represented the P value experienced at least 5 percent of the time by 95 percent of workers in the cohort. If κ is set to some minimum acceptable P value, the estimated probability that a respirator wearer could fail to achieve the minimum P value at least 5% of the time is Pr(Z>z), where

$$(10) \qquad z = \frac{\ln \kappa - \left[\ln \mu_p + \ln GM[B] + (1.645 \ln GSD[W]) - \left(0.5 \ln^2 GSD[W]\right)\right]}{\ln GSD[B]}$$

and Z is the standard normal deviate. Thus, the proportion of workers who fail to achieve a P value of κ at least 5 percent of the time can be determined by estimating the parameters μ_p, GM[B], and GSD[W] from WPF data.

The following hypothetical example illustrates OSHA's use of the model to estimate the risk to workers of experiencing an overexposure while using respiratory protection. Suppose that the WPF values obtained from a group of workers using half-mask, negative-pressure respirators are found to have a geometric mean of 50 (i.e., GM[P] = 1/50 = 0.02) and a geometric standard deviation of 3.0 (GSD[P] = 3.0). Furthermore, from one of the WPF studies reviewed by OSHA (Galvin et al.) (Ex. 64–22), it was reported that within-worker variability exceeded between-worker variability in workplace protection factors, with the ratio GSD[W]/GSD[B] = 1.5. From equations 4 through 7 above, and assuming that R = 1.5, then GSD[B] = 1.73, GSD[W] = 2.60, GM[W] = 0.63, and GM[B] = 0.86. The arithmetic average of the cohort's P values, μ_p, is estimated from equation 8 to be 0.037. If a protection factor of less than 10 (the NIOSH minimum assigned PF for half-mask respirators) is considered to place the worker at risk of an overexposure, then equation 9 predicts a probability of 1.8 percent that a worker in the group would be expected to have an average WPF value of 10 or less (i.e., δ is set to 0.1 in equation 9); that is, 1.8 percent of the group of respirator wearers would frequently encounter situations where they are working in a hazardous environment without the minimum protection expected from the respirators being used. By equation 10, there is a substantial probability (47 percent) that a worker in the cohort would not achieve a minimum protection factor of 10 at least 5 percent of the time that respirators are used (i.e., κ is set to 0.1 in equation 10).

OSHA used the Nicas and Spear model, the summary data from the WPF studies reviewed above, and the method outlined in the example described above to estimate the probability that a respirator wearer would fail to receive adequate protection from their respirator; the detailed results of this analysis appear in Table V–1, and summary findings are listed in Table V–2. From the studies that reflect the lack of an adequate respiratory protection program, the Nicas and Spear model predicts a high probability (between 36 and 100 percent) that a wearer would

not achieve an average protection factor of 10. Data from two of these studies by Toney and Barnhart (Ex. 64–68), and Harris *et al.* (Ex. 27–11), when used in the model, suggest a probability of between 13 and 39 percent that the average WPF for a respirator wearer could be 2 or less, which may be considered equivalent to receiving no long-term protection at all. In contrast, workers included in the studies reflecting good respirator program elements would be expected to experience low WPFs much less frequently. The probability that a wearer would attain an average WPF of 10 or less is estimated to be between <0.01 and 3 percent. Results from the studies that reflect good respiratory program practices also indicate that long-term average WPF values at or below 2 would rarely occur. The results from this analysis demonstrate that deficiencies in implementing a good respirator program can greatly increase the chance that the wearer of a negative-pressure respirator will receive less than the minimum expected average protection from the respirator over the long-term, thus increasing the chance that the worker will be exposed to a higher chronic health risk.

TABLE V–2.—SUMMARY ESTIMATES OF THE PROBABILITY OF ACHIEVING INADEQUATE FITS FOR HALF-MASK, NEGATIVE-PRESSURE RESPIRATORS UNDER DEFICIENT AND GOOD RESPIRATORY PROTECTION PROGRAMS

Quality of respirator program	Percent probability that wearer will achieve	
	Average workplace fit factor of less than 10	Workplace fit factor of less than 10 at least 5 percent of time that respirator is worn
Deficient	36–100	99–100
Good	<0.01–3	<0.01–32

OSHA's analysis (Tables V–1 and V–2) also demonstrates that workers using respiratory protection under a deficient program will be exposed more frequently to higher concentrations of airborne contaminants, which may increase the risk that the worker will experience acute health effects. The Nicas and Spear model applied to the studies that reflect inadequate respirator programs predicts nearly a 100 percent chance that a protection factor of less than or equal to 10 would be experienced at least 5 percent of the time. Under conditions of a good respirator program, use of the model suggests no more than a 32 percent chance that WPFs of less than or equal to 10 will occur more than 5 percent of the time.

OSHA finds that, without an adequate respiratory protection program in place, a substantial fraction of respirator users are at risk of being overexposed to hazardous air contaminants due to poor respirator performance. The studies conducted under conditions of a poor respirator program, when analyzed using the Nicas and Spear model, suggest a greater than 50 percent probability that the wearer of a half-mask, negative-pressure respirator will regularly fail to attain the expected minimum level of protection, and that the chance of receiving essentially no protection is substantial. OSHA considers these risks of overexposure to be significant. The studies reviewed by Nelson and the Galvin study indicate that these risks are considerably lower in situations where respirators are used in conjunction with the implementation of strong respiratory protection program elements such as appropriate fit testing, adequate employee training, use of clean respirators in good working order, and regular monitoring of employees to ensure proper respirator use. Thus, OSHA finds that implementation of a comprehensive respiratory protection program, such as the one prescribed by the final rule, will substantially reduce the risk of overexposure that is due to respirator failure. Because such overexposures can place workers at a significant risk of health impairment, as described earlier in this section, OSHA also finds that promulgation of the final rule will substantially reduce the significant health risks associated with those overexposures.

VI. Summary of the Final Economic Analysis

In the Final Economic Analysis, OSHA addresses the significant issues related to technological and economic feasibility and small business impacts raised in the rulemaking process. This analysis also explains in detail the Agency's findings and conclusions concerning pre-standard (baseline) conditions, such as respirator program practices, in establishments in the regulated community, and discusses how and why the requirements of the standard are expected to reduce employee exposures. The preamble to the revised rule and the Final Economic Analysis are integrally related and together present the fullest statement of OSHA's reasoning concerning this standard. The Final Economic Analysis has been placed in the rulemaking docket.

This analysis of OSHA's revised Respiratory Protection standard (29 CFR 1910.134) has been conducted in accordance with Executive Orders (EOs) 12866 and 12875, the Regulatory Flexibility Act (as amended in 1996), the Small Business Regulatory Enforcement Fairness Act (SBREFA), the Unfunded Mandates Reform Act (UMRA) and the Occupational Safety and Health Act. The standard is a ''significant'' rule as defined by EO 12866, a ''major'' rule as defined by Sec. 804 of SBREFA, and a ''significant'' rule as defined by UMRA.

The purposes of this Final Economic Analysis are to:

- Describe the need for a revised standard governing the use of respirators;
- Identify the establishments, industries and employees potentially affected by the standard;
- Evaluate the costs, benefits, economic impacts and small business impacts of the standard on affected firms;
- Assess the technological and economic feasibility of the standard for affected establishments, industries, and small businesses; and
- Identify the availability of effective non-regulatory and alternative regulatory approaches.

OSHA's final Respiratory Protection standard covers the use of respiratory protection in general industry, construction and shipyard employment, as well as marine terminals and longshoring. In all, about 5 million

employees are estimated to use respirators.[1] Workers use respirators to protect themselves from a wide variety of occupational exposures. Respirators are used, at least to some extent, in virtually every industry, although the extent of respirator use varies by industry. Manufacturing and construction have relatively heavy respirator use; in contrast, use in many service industries is very limited.

Chapter II of the economic analysis describes the pattern of respirator use within each affected industry. To develop this profile, the Agency analyzed the results of several OSHA-sponsored nationwide surveys. The results of OSHA's analysis appear in Table VI–1. The Agency estimates that approximately five percent of workers wear respirators at some time, and that approximately 1.3 million establishments, or about 20 percent of all establishments, have employees who use respirators. Approximately 900,000 of these establishments are very small, i.e., have fewer than 20 employees. For a discussion of the number of firms identified by the Small Business Administration (SBA) as small, see Chapter V.

TABLE VI–1.—NUMBER OF RESPIRATOR USERS AND THEIR EMPLOYERS BY INDUSTRY

SIC and industry	Total employment	Number of respirator wearers	Total number of establishments	Number of establishments with respirator wearers
07 Agricultural services	555,686	48,262	95,956	25,464
08 Forestry	17,716	2,764	2,251	950
13 Oil and gas extraction	257,694	46,180	18,502	3,313
15 General contractors and operative builders	1,096,289	202,284	180,998	70,835
16 Heavy construction, except building	679,578	99,668	34,332	13,403
17 Special trade contractors	2,731,774	491,928	382,528	115,380
20 Food and kindred products	1,498,078	87,589	21,049	8,899
21 Tobacco products	37,189	2,022	119	47
22 Textile mill products	615,683	66,989	6,245	1,937
23 Apparel and other textile products	972,060	26,431	24,293	5,238
24 Lumber and wood products	675,081	89,970	37,087	15,922
25 Furniture and fixtures	476,488	56,141	11,515	7,675
26 Paper and allied products	627,746	41,313	6,478	2,616
27 Printing and publishing	1,500,580	19,185	65,416	6,393
28 Chemicals and allied products	851,720	230,405	12,371	10,744
29 Petroleum and coal products	112,984	29,647	2,117	1,398
30 Rubbber and miscellaneous plastics products	915,166	53,800	16,048	6,805
31 Leather and leather products	104,747	4,406	2,025	324
32 Stone, clay, and glass products	471,639	69,904	16,208	8,798
33 Primary metal industries	655,556	133,012	6,726	4,105
34 Fabricated metal products	1,371,072	124,289	36,416	17,134
35 Industrial machinery and equipment	1,749,735	96,161	54,436	25,545
36 Electronic and other electronic equipment	1,424,351	65,930	17,073	6,895
37 Transportation equipment	1,601,554	185,783	11,420	7,649
38 Instruments and related products	878,379	35,188	11,419	4,207
39 Miscellaneous manufacturing industries	375,501	22,751	17,183	6,793
40 Railroad transportation	49,200	1,790	1,000	225
41 Local and interurban passenger transit	366,657	13,337	18,603	4,194
42 Trucking and warehousing	1,633,543	59,497	115,531	26,049
44 Water transportation	162,478	7,458	8,412	605
45 Transportation by air	344,822	12,543	11,436	822
46 Pipelines, except natural gas	17,143	2,808	811	521
47 Transportation services	363,103	22,428	47,858	3,441
48 Communication	1,299,658	15,176	40,399	3,457
49 Electric, gas, and sanitary services	924,373	187,298	21,040	10,148
50 Wholesale trade—durable goods	3,414,441	373,644	317,418	118,387
51 Wholesale trade—nondurable goods	2,504,260	289,619	185,908	70,196
52 Building materials and garden supplies	696,228	95,688	69,965	19,822
53 General merchandise stores	2,141,964	21,420	35,646	3,565
54 Food stores	3,027,828	30,278	181,850	18,185
55 Automotive dealers and service stations	1,992,774	245,662	198,905	80,121
56 Apparel and accessory stores	1,194,121	15,788	143,526	14,353
57 Furniture and homefurnishings stores	754,024	12,348	112,254	11,225
58 Eating and drinking places	6,727,618	67,276	441,512	44,151
59 Miscellaneous retail	2,422,923	38,734	352,129	35,213
60 Depository institutions	2,095,049	20,950	102,622	10,262
61 Nondepository institutions	483,133	4,831	41,869	4,187
62 Security and commodity brokers	449,826	4,498	34,325	3,433
63 Insurance carriers	1,570,356	15,704	43,784	4,378
64 Insurance agents, brokers, and service	656,007	13,452	122,292	12,229
65 Real estate	1,335,048	25,846	234,961	23,496
67 Holding and other investment offices	254,172	3,016	27,420	2,742
70 Hotels and other lodging places	1,527,126	15,271	52,874	5,287

[1] Approximately 5% of these respirator-using employees would be subject to OSHA's substance-specific health standards rather than to this standard.

TABLE VI–1.—NUMBER OF RESPIRATOR USERS AND THEIR EMPLOYERS BY INDUSTRY—Continued

SIC and industry	Total employment	Number of respirator wearers	Total number of establishments	Number of establishments with respirator wearers
72 Personal services	1,252,777	45,854	200,520	23,848
73 Business services	5,832,261	255,034	322,668	38,375
75 Auto repair, services, and parking	903,806	110,528	174,635	70,345
76 Miscellaneous repair services	439,495	5,103	72,763	3,810
78 Motion pictures	500,889	5,009	42,457	4,246
79 Amusements and recreation services	1,201,248	12,012	88,077	8,808
80 Health services	10,403,118	217,118	471,873	108,337
81 Legal services	962,374	17,417	158,335	15,834
82 Educational services	1,967,024	19,670	42,867	4,287
83 Social services	2,028,694	20,287	145,998	14,600
84 Museums, botanical, zoological gardens	73,874	739	3,607	361
86 Membership organizations	2,062,501	26,275	238,868	23,887
87 Engineering and management services	2,589,839	27,483	249,846	24,985
89 Services, n.e.c.	84,960	1,607	14,606	1,461
92 Fire Departments (State Plan States)	126,500	126,500	9,283	9,283
Other public sector (State Plan States)	7,677,000	114,570	203,158	20,316
Total	98,768,281	4,953,568	6,494,122	1,281,945

Sources: DOL, OSHA Office of Regulatory Analysis; County Business Patterns, 1993; OSHA's respirator, PEL, PPE, and Construction PEL surveys.

The new standard is programmatic in nature, reflects current practice at many facilities, and does not require the use of new technology. Thus, OSHA finds that the standard is clearly technologically feasible for affected firms of all sizes.

The benefits that will accrue to respirator users and their employers are substantial and take a number of forms. Chapter IV of the analysis describes these benefits, both in quantitative and qualitative forms. The standard will benefit workers by reducing their exposures to respiratory hazards. Improved respirator selection procedures, better fit test procedures, and improved training, all areas strengthened by the revised standard, will contribute substantially to greater worker protection. Estimates of the benefits of the standard are complicated by uncertainties about the effectiveness of the standard and the number of covered work-related illnesses. The Agency estimates that the standard will avert between 843 and 9,282 work-related injuries and illnesses annually, with a best estimate (expected value)[2] of 4,046 averted illnesses and injuries annually. In addition, the standard is estimated to prevent between 351 and 1,626 deaths annually from cancer and many other chronic diseases, including cardiovascular disease, with a best estimate (expected value) of 932 averted deaths from these causes.[3]

The annual costs employers in the affected establishments are estimated to incur to comply with the revised respirator standard total $111 million.[4] These costs, which are presented in detail in Chapter III of the full economic analysis, are annualized over a 10-year horizon at a discount rate of 7 percent; Table VI–2 shows annualized costs by provision of the standard. The most costly provisions are those requiring annual fit testing of respirators and annual refresher training. These two provisions together account for approximately 90 percent of the standard's compliance costs. As a rule, costs are largely determined by the extensiveness of respirator use in affected establishments. This analysis did not attempt to factor in the offsetting value of cost savings from regulatory changes, such as dropping the existing standard's prohibition against contact lens use, providing for greater uniformity for substance-specific health standard respirator provisions, or allowing employers to use licensed health care providers in addition to physicians to perform medical evaluations.

[2] OSHA believes that, for the purposes of this rulemaking, the most reasonable way to summarize the uncertainties in benefits estimates via a single numerical estimate is to use the expected value; that is, the average of all plausible values weighted by their relative probabilities. For simplicity's sake, OSHA will refer to this point estimate as the ''best estimate.''

[3] Because this regulation will not directly affect the benefits for the estimated 5% of employees who wear respirators as a result of OSHA's substance-specific health standards (except to the extent that uniformity of provisions improve compliance), and these respirator-wearing employees are included in the benefits estimates presented here, the benefits of the revised respiratory protection standard are somewhat overestimated. In particular, deaths and illnesses caused by exposures to such OSHA-regulated substances as asbestos and lead may in fact account for a disproportionate share (more than 5%) of the occupational illnesses and deaths attributed by this analysis to the respirator standard. This means that OSHA's benefits estimates are likely to be overstated by more than 5%. Nevertheless, OSHA believes that the substantial majority of the benefits resulting from appropriate respirator use can be properly attributed to the respirator standard.

[4] Because this regulation does not directly affect the costs for the estimated 5% of employees who wear respirators as a result of OSHA's substance-specific health standards, and these respirator users are included in the cost estimates, the costs are somewhat overestimated. Because costs are approximately proportional to the number of employees affected, the magnitude of this overestimate is likely to be about 5%.

TABLE VI–2.—ANNUAL COST OF RESPIRATOR STANDARD REVISIONS FOR RESPIRATOR-USING ESTABLISHMENTS, BY PROVISION

SIC and industry	Revision written plans	Annual fit testing	Annual training	Certification for emergency respirator inspections	Labeling for sorbent bed changes	Record-keeping	Total
07 Agricultural services	$31,755	$441,836	$298,047	$0	$0	$35,858	$807,497
08 Forestry	1,228	25,475	13,849	0	0	2,054	42,606
13 Oil and gas extraction	8,769	734,048	315,180	41,551	0	34,312	1,133,860
15 General contractors and operative builders	141,534	2,992,402	1,909,631	0	479	150,297	5,194,342
16 Heavy construction, except building	32,027	1,534,132	736,976	0	2,109	74,053	2,379,297
17 Special trade contractors	256,681	7,820,459	4,340,977	0	1,344	365,502	12,784,963
20 Food and kindred products	21,109	1,006,778	428,004	86,371	0	65,078	1,607,339
21 Tobacco products	210	37,254	16,252	0	0	1,502	55,218
22 Textile mill products	4,349	728,823	286,222	9,703	0	49,773	1,078,870
23 Apparel and other textile products	7,864	226,658	101,380	0	0	19,638	355,540
24 Lumber and wood products	27,997	972,293	489,510	16,750	0	66,848	1,573,397
25 Furniture and fixtures	13,119	623,774	289,781	53,627	0	41,712	1,022,013
26 Paper and allied products	8,373	877,037	280,715	66,279	105	30,696	1,263,205
27 Printing and publishing	15,217	221,275	139,295	0	0	14,255	390,041
28 Chemicals and allied products	33,159	4,194,240	1,656,678	741,170	763	171,191	6,797,201
29 Petroleum and coal products	4,699	646,431	277,684	108,927	16	22,028	1,059,785
30 Rubber and miscellaneous plastics products	14,100	676,734	284,187	2,068	0	39,974	1,017,063
31 Leather and leather products	456	37,208	15,800	1,502	0	3,274	58,239
32 Stone, clay, and glass products	20,743	1,018,192	464,833	28,365	11	51,939	1,584,083
33 Primary metal industries	14,028	2,263,416	951,396	44,664	28	98,828	3,372,360
34 Fabricated metal products	41,510	1,663,770	765,562	178,892	0	92,346	2,742,081
35 Industrial machinery and equipment	64,626	1,498,968	786,251	0	868	71,447	2,422,161
36 Electronic and other electronic equipment	17,103	917,414	388,929	24,483	657	48,986	1,397,572
37 Transportation equipment	23,876	3,413,486	1,568,463	100,401	8,775	138,037	5,253,038
38 Instruments and related products	10,299	516,278	230,813	1,626	333	26,145	785,493
39 Miscellaneous manufacturing industries	12,007	250,490	136,104	0	176	16,904	415,682
40 Railroad transportation	937	37,818	16,134	0	0	1,330	56,219
41 Local and interurban passenger transit	9,002	167,510	86,710	0	0	9,910	273,131
42 Trucking and warehousing	64,666	791,301	511,259	570	0	44,206	1,412,003
44 Water transportation	1,588	136,318	65,312	0	0	5,541	208,760
45 Transportation by air	2,015	199,061	85,196	0	0	9,320	295,592
46 Pipelines, except natural gas	1,637	87,121	31,182	0	15	2,086	122,041
47 Transportation services	6,150	256,532	135,948	0	0	16,664	415,294
48 Communication	9,141	282,097	141,518	0	0	11,276	444,032
49 Electric, gas, and sanitary services	32,542	3,736,483	1,662,243	359,209	4,581	139,162	5,934,220
50 Wholesale trade—durable goods	241,074	5,545,911	2,737,719	6,687	0	277,618	8,809,008
51 Wholesale trade—nondurable goods	134,760	3,979,336	1,728,752	126,854	0	215,187	6,184,888
52 Building materials and garden supplies	24,193	922,814	418,187	0	0	71,096	1,436,291
53 General merchandise stores	5,369	135,056	56,819	0	0	15,915	213,160
54 Food stores	27,336	208,820	154,036	0	0	22,497	412,689
55 Automotive dealers and service stations	112,276	1,920,333	1,281,723	0	0	182,527	3,496,858
56 Apparel and accessory stores	19,022	91,801	92,713	0	0	11,730	215,266
57 Furniture and homefurnishings stores	20,225	111,532	106,953	0	0	9,175	247,884
58 Eating and drinking places	47,123	257,557	214,860	0	0	49,986	569,526
59 Miscellaneous retail	53,098	275,565	269,808	0	0	28,780	627,250
60 Depository institutions	20,271	207,313	135,320	0	0	15,566	378,470
61 Nondepository institutions	10,608	51,626	53,951	0	0	3,590	119,776
62 Security and commodity brokers	10,508	64,998	58,550	0	0	3,342	137,397
63 Insurance carriers	13,360	226,063	123,889	0	0	11,668	374,979
64 Insurance agents, brokers, and service	36,394	200,209	199,277	0	0	9,995	445,875
65 Real estate	70,079	348,877	368,891	0	0	19,203	807,051
67 Holding and other investment offices	8,272	43,583	43,970	0	0	2,241	98,066
70 Hotels and other lodging places	8,119	101,853	57,381	0	0	11,347	178,699
72 Personal services	26,015	552,641	270,488	0	0	34,069	883,214
73 Business services	58,974	3,325,952	1,172,726	0	0	189,490	4,747,142
75 Auto repair, services, and parking	93,387	970,308	881,030	0	0	82,122	2,026,846
76 Miscellaneous repair services	5,735	61,214	54,759	0	0	3,791	125,499
78 Motion pictures	11,425	62,923	61,091	0	0	3,722	139,160
79 Amusement and recreation services	14,128	93,683	76,484	0	0	8,925	193,220
80 Health services	183,206	2,510,780	1,948,071	0	0	161,319	4,803,376
81 Legal services	47,661	253,320	256,703	0	0	12,941	570,625
82 Educational services	10,933	259,816	125,365	0	0	14,615	410,729
83 Social services	23,601	166,510	130,949	0	0	15,073	336,133
84 Museums, botanical, zoological gardens	891	8,995	6,036	0	0	549	16,471
86 Membership organizations	57,115	316,483	304,939	0	0	19,523	698,060
87 Engineering and management services	74,480	380,740	390,356	0	0	20,420	865,997
89 Services, n.e.c.	4,082	28,754	22,201	0	0	1,194	56,231

TABLE VI–2.—ANNUAL COST OF RESPIRATOR STANDARD REVISIONS FOR RESPIRATOR-USING ESTABLISHMENTS, BY PROVISION—Continued

SIC and industry	Revision written plans	Annual fit testing	Annual training	Certification for emergency respirator inspections	Labeling for sorbent bed changes	Record-keeping	Total
92 Fire Departments	24,723	2,265,377	1,005,792	0	0	93,990	3,389,882
Other public sector	48,361	49,739	1,147,899	0	0	85,126	1,331,125
Total	2,501,319	67,033,593	35,865,707	1,999,699	20,259	3,680,501	111,101,079

Source: Department of Labor, Safety and Health Administration, Office of Regulatory Analysis.

Chapter V of the economic analysis analyzes the impact of these compliance costs on establishments in affected industries. The standard is clearly economically feasible: the cost in the average affected establishment is 0.002 percent of sales and 0.03 percent of profits; in the most heavily impacted industry—business services, SIC 73—annualized compliance costs amount to only 0.1 percent of estimated sales and 1.22 percent of profits. In the next most heavily impacted industry—Special Trade Contractors, SIC 17—costs amount only to 0.02 percent of sales and 0.46 percent of profits. These results are shown in Table VI–3.

TABLE VI–3.—ANNUAL COST OF FINAL RESPIRATORY PROTECTION STANDARD AS A PERCENT OF SALES AND PROFITS OF RESPIRATOR-USING ESTABLISHMENTS

SIC and industry	Average compliance cost/establishment	Average sales/establishment	Average profit/establishment	Compliance cost as a percent of sales	Compliance cost as a percent of profits
07 Agricultural services	$32	$269,290	17,425	0.01	0.18
08 Forestry	45	897,908	69,720	0.00	0.06
13 Oil and gas extraction	364	11,234,630	1,021,330	0.00	0.04
15 General contractors and operative builders	73	1,131,765	52,585	0.01	0.14
16 Heavy construction, except building	178	2,709,660	146,028	0.01	0.12
17 Special trade contractors	111	476,348	24,098	0.02	0.46
20 Food and kindred products	192	20,620,629	999,788	0.00	0.02
21 Tobacco products	1,169	869,935,367	204,319,114	0.00	0.00
22 Textile mill products	578	7,611,245	438,223	0.01	0.13
23 Apparel and other textile products	68	3,228,588	194,177	0.00	0.03
24 Lumber and wood products	99	2,539,729	146,588	0.00	0.07
25 Furniture and fixtures	140	3,571,798	216,729	0.00	0.06
26 Paper and allied products	551	22,478,383	1,260,152	0.00	0.04
27 Printing and publishing	61	2,096,632	152,975	0.00	0.04
28 Chemicals and allied products	909	29,454,052	2,231,368	0.00	0.04
29 Petroleum and coal products	1,053	143,210,471	6,292,581	0.00	0.02
30 Rubber and miscellaneous plastics products	150	8,202,235	584,099	0.00	0.03
31 Leather and leather products	187	7,267,252	429,429	0.00	0.04
32 Stone, clay, and glass products	183	4,184,931	228,219	0.00	0.08
33 Primary metal industries	864	18,123,180	1,015,996	0.00	0.08
34 Fabricated metal products	170	4,348,383	266,070	0.00	0.06
35 Industrial machinery and equipment	95	6,924,099	482,589	0.00	0.02
36 Electronic and other electronic equipment	207	11,591,397	684,946	0.00	0.03
37 Transportation equipment	724	44,334,058	1,948,012	0.00	0.04
38 Instruments and related products	187	10,720,444	763,426	0.00	0.02
39 Miscellaneous manufacturing industries	61	1,568,937	111,245	0.00	0.06
40 Railroad transportation	249	NA	NA	NA	NA
41 Local and interurban passenger transit	65	1,014,732	43,699	0.01	0.15
42 Trucking and warehousing	54	1,286,872	58,437	0.00	0.09
44 Water transportation	345	NA	NA	NA	NA
45 Transportation by air	359	3,106,975	197,717	0.01	0.18
46 Pipelines, except natural gas	234	13,802,633	585,566	0.00	0.04
47 Transportation services	121	23,585,180	8,076,137	0.00	0.00
48 Communication	128	1,894,095	82,755	0.01	0.16
49 Electric, gas, and sanitary services	677	15,622,527	2,485,402	0.00	0.03
50 Wholesale trade—durable goods	74	14,371,043	1,350,007	0.00	0.01
51 Wholesale trade—nondurable goods	89	2,282,652	102,134	0.00	0.09
52 Building materials and garden supplies	72	4,447,849	172,734	0.00	0.04
53 General merchandise stores	60	1,075,912	36,708	0.01	0.16
54 Food stores	23	8,648,964	471,762	0.00	0.00
55 Automotive dealers and service stations	44	2,179,673	61,031	0.00	0.07
56 Apparel and accessory stores	15	2,010,075	47,296	0.00	0.03
57 Furniture and homefurnishings stores	22	737,603	47,246	0.00	0.05
58 Eating and drinking places	13	672,234	34,798	0.00	0.04

TABLE VI–3.—ANNUAL COST OF FINAL RESPIRATORY PROTECTION STANDARD AS A PERCENT OF SALES AND PROFITS OF RESPIRATOR-USING ESTABLISHMENTS—Continued

SIC and industry	Average compliance cost/establishment	Average sales/establishment	Average profit/establishment	Compliance cost as a percent of sales	Compliance cost as a percent of profits
59 Miscellaneous retail	18	734,358	34,558	0.00	0.05
60 Depository institutions	37	547,141	30,254	0.01	0.12
61 Nondepository institutions	29	8,651,403	NA	0.00	NA
62 Security and commodity brokers	40	9,094,686	1,419,322	0.00	0.00
63 Insurance carriers	86	6,131,429	631,723	0.00	0.01
64 Insurance agents, brokers, and service	36	65,412,387	NA	0.00	NA
65 Real estate	34	674,913	NA	0.01	NA
67 Holding and other investment offices	36	500,929	46,869	0.01	0.08
70 Hotels and other lodging places	34	5,183,873	573,368	0.00	0.01
72 Personal services	37	1,243,240	97,027	0.00	0.04
73 Business services	124	128,952	10,164	0.10	1.22
75 Auto repair, services, and parking	29	975,693	74,455	0.00	0.04
76 Miscellaneous repair services	33	358,494	22,775	0.01	0.14
78 Motion pictures	33	181,478	11,743	0.02	0.28
79 Amusement and recreation services	22	1,597,336	142,792	0.00	0.02
80 Health services	44	631,398	31,198	0.01	0.14
81 Legal services	36	1,167,682	71,435	0.00	0.05
82 Educational services	96	421,539	67,758	0.02	0.14
83 Social services	23	2,613,764	174,383	0.00	0.01
84 Museums, botanical, zoological gardens	46	351,713	16,137	0.01	0.28
86 Membership organizations	29	560,217	40,331	0.01	0.07
87 Engineering and management services	35	320,236	15,070	0.01	0.23
89 Services, n.e.c.	38	1,030,962	81,876	0.00	0.05
92 Fire Departments	365	NA	NA	NA	NA
other public sector	66	NA	NA	NA	NA

Source: Department of Labor, Occupational Safety and Health Administration, Office of Regulatory Analysis.

In the Preliminary Regulatory Impact Analysis developed in support of OSHA's 1994 Respiratory Protection proposal [Ex. 57], the Agency examined the impact of the proposal on different sizes of establishments. Based on that analysis, the Agency certified that the proposed standard would not have a significant economic impact on a substantial number of small entities. Upon review of comments and other data submitted to the record of this rulemaking, the Agency has analyzed the final rule's impact on small entities, as defined by the Small Business Administration (SBA) and in accordance with the Regulatory Flexibility Act. In addition, in order to ensure that even the smallest entities are not significantly impacted, the Agency performed an analysis of impacts on the smallest establishments, i.e., those with fewer than 20 employees.

The impacts of the standard on sales and profits did not exceed 1 percent for small firms in any covered industry, whether the analysis used the SBA's definitions or the fewer-than-20-employee size class definition. Because the incremental costs of the final rule are primarily related to the number of respirator users per establishment and because small entities do not have a higher percentage of respirator users than large establishments, the standard does not have a differential impact on small entities. If the costs of compliance were influenced by economies of scale, such effects would have been demonstrated by OSHA's analysis of the smallest firms, i.e., those with fewer than 20 employees. However, no such effects were seen, even among firms in this smallest size-class. Therefore, the Agency has no reason to believe that establishments or firms in intermediate size groupings, i.e., those in the range between 20 employees and the employment size cutoff for the applicable SBA definition, would experience larger impacts. Finding this, the Agency certifies that the final Respiratory Protection standard will not have a significant adverse economic impact on a substantial number of small entities. The results of OSHA's analysis of small business impacts on firms [5] within the SBA's size classifications are shown in Table VI–4.

TABLE VI–4.—ANNUAL COST OF THE RESPIRATORY PROTECTION STANDARD AS A PERCENT OF SALES FOR RESPIRATOR-USING SMALL FIRMS [1]

SIC and industry	Small business definition [1]	Number of affected firms	Average compliance cost per firm	Average sales per firm	Compliance cost as a percent of sales	Average profit per firm	Compliance cost as a percent of profits
07 Agricultural services	$5 million [2]	23,313	$36	$223,567	0.02	$14,466	0.25
08 Forestry	$5 million	860	41	470,247	0.01	36,513	0.11
13 Oil and gas extraction	500 employees	2,565	222	2,017,392	0.00	226,361	0.10

[5] The Agency also examined the impact of the costs of compliance on governmental entities serving communities with fewer than 50,000 people, and also found small impacts.

TABLE VI–4.—ANNUAL COST OF THE RESPIRATORY PROTECTION STANDARD AS A PERCENT OF SALES FOR RESPIRATOR-USING SMALL FIRMS [1]—Continued

SIC and industry	Small business definition [1]	Number of affected firms	Average compliance cost per firm	Average sales per firm	Compliance cost as a percent of sales	Average profit per firm	Compliance cost as a percent of profits
15 General contractors and operative builders	$17 million	70,232	75	954,486	0.01	43,794	0.17
16 Heavy construction, except building	$17 million	12,628	135	1,611,092	0.00	72,025	0.19
17 Special trade contractors	$7 million	114,097	117	490,343	0.02	24,806	0.47
20 Food and kindred products	500 employees	5,583	143	7,070,622	0.00	288,666	0.05
21 Tobacco products	500 employees	27	434	419,423,746	0.00	98,271,892	0.00
22 Textile mill products	500 employees	1,306	243	4,485,467	0.00	236,814	0.10
23 Apparel and other textile products	500 employees	4,227	49	1,717,339	0.00	84,857	0.06
24 Lumber and wood products	500 employees	13,854	96	1,520,435	0.00	80,494	0.12
25 Furniture and fixtures	500 employees	5,860	135	2,063,881	0.00	101,980	0.13
26 Paper and allied products	500 employees	1,082	364	7,356,895	0.00	389,269	0.09
27 Printing and publishing	500 employees	4,612	63	1,349,101	0.00	82,533	0.08
28 Chemicals and allied products	500 employees	3,794	388	7,758,606	0.00	573,110	0.07
29 Petroleum and coal products	500 employees	373	505	11,906,004	0.00	523,143	0.10
30 Rubber and miscellaneous plastics products	500 employees	3,926	192	4,132,970	0.00	252,124	0.08
31 Leather and leather products	500 employees	224	246	2,312,572	0.00	106,106	0.23
32 Stone, clay, and glass products	500 employees	5,529	209	2,337,003	0.00	101,728	0.21
33 Primary metal industries	500 employees	2,260	530	6,447,895	0.00	359,703	0.15
34 Fabricated metal products	500 employees	12,435	167	2,782,599	0.00	138,568	0.12
35 Industrial machinery and equipment	500 employees	18,625	152	2,001,196	0.00	118,786	0.13
36 Electronic and other electronic equipment	500 employees	4,356	237	3,836,835	0.00	184,646	0.13
37 Transportation equipment	500 employees	5,999	281	3,362,262	0.00	120,155	0.23
38 Instruments and related products	500 employees	3,266	163	3,239,263	0.00	211,242	0.08
39 Miscellaneous manufacturing industries	500 employees	5,149	102	1,539,311	0.00	95,981	0.11
40 Railroad transportation	1500 employees	NA	NA	NA	NA	NA	NA
41 Local and interurban passenger transit	$5 million	2,582	106	417,934	0.01	17,701	0.60
42 Trucking and warehousing	$18.5 million	15,626	79	670,885	0.01	29,993	0.26
44 Water transportation	500 employees	187	243	1,781,166	0.01	90,917	0.27
45 Transportation by air	1500 employees	157	449	2,031,762	0.00	70,300	0.64
46 Pipelines, except natural gas	1500 employees	11	888	15,403,556	0.00	5,274,551	0.02
47 Transportation services	$5 million	879	55	377,507	0.02	15,544	0.35
48 Communication	1500 employees	1,279	172	2,132,980	0.01	335,309	0.05
49 Electric, gas, and sanitary services	$5 million	3,809	65	883,319	0.01	72,099	0.09
50 Wholesale trade—durable goods	100 employees	52,553	43	1,828,263	0.00	73,131	0.06
51 Wholesale trade—nondurable goods	100 employees	30,785	44	2,682,104	0.00	85,196	0.05
52 Building materials and garden supplies	$5 million	13,619	19	712,058	0.01	24,294	0.08
53 General merchandise stores	$5 million	482	14	398,828	0.01	16,892	0.08
54 Food stores	$5 million	6,419	140	763,042	0.00	20,647	0.68
55 Automotive dealers and service stations	$5 million	38,985	26	774,574	0.01	18,225	0.14
56 Apparel and accessory stores	$5 million	289	41	1,346,240	0.00	85,526	0.05
57 Furniture and homefurnishings stores	$5 milion	438	71	1,685,231	0.00	87,235	0.08
58 Eating and drinking places	$5 million	16,852	24	374,691	0.00	17,633	0.14
59 Miscellaneous retail	$5 million	12,619	18	406,958	0.01	22,502	0.08
60 Depository institutions	$5 million	788	123	1,060,910	0.00	NA	NA
61 Nondepository institutions	$5 million	840	25	728,626	0.00	106,401	0.02
62 Security and commodity brokers	$5 million	921	33	631,139	0.01	55,488	0.06
63 Insurance carriers	$5 million	365	92	740,731	0.01	NA	NA
64 Insurance agents, brokers, and service	$5 million	5,583	54	335,823	0.01	NA	NA
65 Real estate	$5 million	10,714	56	533,940	0.01	48,369	0.12
67 Holding and other investment offices	$5 million	1,036	36	889,373	0.00	95,534	0.04
70 Hotels and other lodging places	$5 million	2,163	41	472,311	0.00	32,784	0.13
72 Personal services	$5 million	9,786	80	190,546	0.02	15,019	0.53
73 Business services	$5 million	14,343	160	517,986	0.01	37,783	0.42
75 Auto repair, services, and parking	$5 million	43,985	47	342,341	0.01	21,749	0.22
76 Miscellaneous repair services	$5 million	2,631	34	340,605	0.01	22,039	0.15
78 Motion pictures	$5 million	1,494	29	350,142	0.01	24,304	0.12
79 Amusement and recreation services	$5 million	4,052	46	469,977	0.00	23,222	0.20
80 Health services	$5 million	39,536	82	521,074	0.01	31,877	0.26
81 Legal services	$5 million	7,288	41	314,988	0.01	48,175	0.09
82 Educational services	$5 million	1,739	99	649,462	0.01	35,911	0.28
83 Social services	$5 million	5,194	43	354,060	0.01	16,245	0.26
84 Museums, botanical, zoological gardens	$5 million	158	80	492,341	0.01	35,333	0.23
86 Membership organizations	$5 million	11,589	55	296,761	0.01	13,965	0.39
87 Engineering and management services	$5 million	11,383	62	457,931	0.01	34,480	0.18
89 Services, n.e.c	$5 million	679	58	423,854	0.01	36,402	0.16

[1] As defined by the Small Business Administration, 61 FR 3289.
[2] Annual receipts.

Source: Department of Labor, Occupational Safety and Health Administration, Office of Regulatory Analysis.

Unfunded Mandates Analysis

The final Respiratory Protection standard has been reviewed by OSHA in accordance with the Unfunded Mandates Reform Act of 1995 (UMRA) (2 USC 1501 et seq.) and Executive Order 12875. As discussed in Chapter V, OSHA estimates that compliance with the revised Respiratory Protection standard will require expenditures of more than $100 million each year by employers in the private sector. Therefore, the Respiratory Protection final rule establishes a Federal private sector mandate and is a significant regulatory action within the meaning of Section 202 of UMRA (2 U.S.C. 1532). OSHA has included this statement to address the anticipated effects of the final rule pursuant to Section 202.

OSHA standards do not apply to state and local governments except in states that have voluntarily elected to adopt an OSHA State plan and have then adopted the specific standard in question or one that has been deemed by OSHA to be equally effective. Consequently, the Respiratory Protection standard does not impose a ''federal intergovernmental mandate'' as defined by Section 421(5) of UMRA (2 USC 658 (5)). The revised Respiratory Protection standard therefore does not impose an unfunded mandate on state and local governments.

Further, OSHA has found that the costs incurred by state and local governments in those states that choose to adopt the standard will be small compared to corresponding state and local government expenditures. If State-plan states adopt the standard, the greatest impact in some states would be on public fire departments. Bureau of the Census data on the amount of revenue dedicated to fire protection by local governments indicate that $14.4 billion was spent on this service in 1992, the latest year for which such data are available [*Government Finances*]. NFPA data indicate that 75.3 percent of the U.S. population is served by fire departments that employ at least some career firemen [NFPA, p. 15]. This means that approximately 37.7 percent of the population (approximately half of all state and local government employees work in State-plan states) is served by at least partly career fire departments in State-plan states. Assuming the expenditures for fire protection are spread fairly evenly across the population, approximately $5.3 billion is spent on fire protection annually by affected fire departments. As indicated in the cost analysis (see Table VI–2), the total annual cost of the standard for public fire departments in State-plan states is approximately $3.5 million, which means that the costs of compliance constitute less than 0.1 percent of the revenue devoted by these states to fire protection. Costs of this magnitude are clearly an insignificant portion of the total fire protection budget.

The remainder of this section summarizes OSHA's findings, as required by Section 202 of UMRA (2 USC 1532):

This standard is issued under Section 6(b) of the OSH Act.

This standard has annualized costs estimated at $111 million, primarily in the private sector, and is estimated to save hundreds of lives per year from cancer and cardiovascular disease. Compliance will also prevent thousands of illnesses annually that would have been caused by acute and chronic overexposures. The standard will impose no more than minimal costs on state, local or tribal governments, substantially less than $100 million. OSHA pays 50 percent of State plan costs, although the Agency does not provide funding for state, local or tribal governments to comply with its rules as employers.

OSHA does not anticipate any disproportionate budgetary effects upon any particular region of the nation or particular state, local, or tribal governments, or urban or rural or other types of communities. The principal costs of this standard are to control worker exposures associated with programmatic provisions such as annual fit testing and training, activities that are engaged in by thousands of establishments in hundreds of SIC codes that are widely distributed throughout the country. Chapters III and V have provided detailed analyses of the costs and impacts of the standard on particular segments of the private sector. OSHA has analyzed the economic impacts of the standard on the industries affected and found that compliance costs are no more than 0.1 percent of sales for establishments in any industry, and consequently that no plant closures or job losses are anticipated in the affected industries. As a result, impacts on the national economy would be too small to be measurable by economic models.

Pursuant to Section 205 of the UMRA (2 USC 1535), after having considered a variety of alternatives outlined in the Preamble and in the Regulatory Flexibility Analysis, the Agency has concluded that the final rule is the most cost-effective alternative for implementation of OSHA's statutory objective of reducing significant risk to the extent feasible.

Environmental Impact Analysis

The final Respiratory Protection standard has been reviewed in accordance with the requirements of the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 et seq.), the regulations of the Council of Environmental Quality (CEQ) (40 CFR part 1500), and DOL NEPA procedures (29 CFR part 11). As a result of this review, OSHA has concluded that the rule will have no significant environmental impact.

References

Bureau of the Census, *Government Finances*, Series GF, No. 5, annual, as reported in the *Statistical Abstract of the United States, 1995*. GPO, 1995.

VII. Summary and Explanation

This section of the preamble summarizes and explains the provisions of the final respiratory protection standard. It describes changes made to the rule since the proposal was issued, discusses the comments received by the Agency on the proposal, and presents OSHA's rationale for making these changes. The record evidence supporting each of the requirements of the final rule is also described in detail in this section.

This final rule clarifies, updates, and strengthens OSHA's previous respiratory protection standard, which was adopted by the Agency in 1971 and has remained essentially unchanged since that time. This rulemaking is thus the first major revision to OSHA's respiratory protection standard in more than 25 years. As discussed in connection with several of the individual paragraphs of the revised standard, not all of the provisions of the standard have been revised; in some cases, OSHA found, and the record supported, leaving individual provisions unchanged.

The final respiratory protection standard applies to respirator use in general industry, construction, shipyards, marine terminals, and longshoring operations. When used properly, respirators can help to protect employees from the acute and chronic effects of exposure to hazardous airborne contaminants, whether in the form of particulates, vapors, or gases. Generally, OSHA requires respirators to be used to protect employee health in

situations where engineering controls and work practices are not feasible, where such controls have not yet been instituted, in emergencies, or where such controls are not sufficient, by themselves, to protect the health of employees.

As noted above, this final standard applies to respirator use in general industry, construction, shipyards, marine terminals, and longshoring operations. In the 1994 proposal, OSHA proposed to cover general industry, shipyards and construction. The longshoring and marine terminals final rule (48 FR 30908) already made this standard applicable to those industries as well. To provide clarity, the final respiratory standard explicitly contains a note setting forth the scope of the respirator standard.

The preamble to the proposed rule asked for comments about the appropriateness of applying the final rule to construction and maritime workplaces. In the case of the construction industry, OSHA specifically provided the Advisory Committee for Construction Safety and Health (ACCSH) with a copy of the proposal for review and comment, and ACCSH recommended that the revised standard apply to construction industry workplaces. OSHA's responses to these comments are discussed above in the introduction to this preamble.

In response to the question raised about the applicability of the standard to the construction and shipyard industries, OSHA received several comments from participants concerned about the rule's impact on the construction industry (Exs. 54–102, 54–231, 54–288). These commenters noted that the costs of the standard for construction employers may be higher than for their counterparts in general industry because of the higher turnover, decentralization of workplaces, and multi-employer work arrangements typical of construction sites. However, as reported in the Final Economic Analysis (Ex. 196), OSHA has determined that the final rule is both technologically and economically feasible for employers in the construction industry. There is no question that many workers in this industry need respiratory protection to prevent material impairment of their health; in fact, some of the most hazardous exposures occur in this industry. For example, workers engaged in the abrasive blasting of bridges are often exposed to high concentrations of silica and other hazardous substances (contained in the abrasive blasting media), as well as to lead, chromates, and other toxic materials (contained in the paints, coatings, or preservatives covering the substrate). Welders, demolition workers, tunnel workers, and painters are other examples of construction trades that often involve overexposure to toxic substances and require respirators for control. In fact, respirators may be even more necessary in construction than in general industry because the transient and constantly changing nature of many construction worksites makes the use of engineering controls more difficult in these environments. Finally, OSHA's previous respiratory protection standard has applied to the construction industry since 1971 (it is codified at 29 CFR 1926.103); removing this protection for construction workers would thus decrease existing safety and health protections despite the significant risk confronting construction workers in many situations. Decreasing feasible worker protections in the face of significant risk of material impairment of health would clearly be contrary to the Agency's mandate.

OSHA received no comments on the applicability of the final rule to shipyard employment. Like construction workers, shipyard workers have been covered by the Agency's previous standard since 1971. In addition, employees in shipyards engage in many of the same highly hazardous operations as construction workers, including abrasive blasting, welding, painting, and drilling. The Final Economic Analysis (Ex. 196) has determined that it is both technologically and economically feasible for employers in shipyard operations to achieve compliance with the final rule.

OSHA has recently issued a revised final rule for the Longshoring (shipboard) portion of marine cargo-handling operations, along with revisions to the Agency's Marine Terminals (dockside) marine cargo-handling standard. The scope and application sections of both final maritime rules specifically incorporate OSHA's respiratory protection standard (29 CFR 1910.134) by reference. Thus, consistent with the proposal, this final respiratory protection standard will apply to workplaces in general industry and in the construction, shipyards, longshoring, and marine terminals industries.

At the public hearing, the Brotherhood of Maintenance of Way Employees (BMWE) submitted testimony on the issue of OSHA's respiratory protection standard's coverage of railroad construction and maintenance employees (Ex. 122). The BMWE stated:

> * * * the BMWE respectfully requests that * * * formal recognition of the applicability of OSHA 1910.134 for railroad employees be published in the **Federal Register** to remove any lingering questions regarding the applicability of OSHA's respiratory protection standards to working conditions which, although located within the railroad industry, are in fact similar to those of any industrial workplace.

In response to this comment, OSHA notes that both the prior respiratory protection standard and the final revised standard being published will apply to railway workers unless the Federal Railroad Administration (FRA) exercises statutory authority to issue a separate respirator standard for those workers. To date, the FRA has not issued a respiratory protection standard applicable to railway workers. Unless and until it does, this standard will apply to those workers.

This Summary and Explanation section follows the order of the final rule. The abbreviation ''Ex.'' denotes exhibits in the docket for this rulemaking, Docket H–049. The abbreviation ''Tr.'' denotes the transcripts of the hearings conducted in connection with this rulemaking.

Paragraph (a)—Permissible practice

Paragraphs (a)(1) and (a)(2) of the final rule are essentially unchanged from the corresponding paragraphs of the prior rule and the proposed rule. Indeed, in the proposal OSHA explained that this rulemaking was not intended to address the substantive portion of paragraph (a)(12). The only changes proposed by OSHA to the regulatory language of paragraph (a) were non-substantive: (1) In the proposal, the Agency titled this paragraph ''Scope and Application'' rather than ''Permissible Practice,'' which had been the title of this paragraph since 1971; and (2) a cross-reference to paragraph (b) in the prior standard was proposed to be changed to paragraph (c), because a new paragraph (b), ''Definitions,'' was proposed to be added to the final rule. In the final rule, OSHA has determined that the original title of paragraph (a), ''Permissible Practice,'' better describes paragraph (a), and thus this continues to be the title of this paragraph. The proposed cross-reference to paragraph (c) is retained in the final rule.

Paragraph (a)(1) requires the use of appropriate respiratory protection when ''effective engineering controls are not feasible, or while they are being instituted.'' This paragraph also stipulates that the prevention of atmospheric contamination caused by ''harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors'' shall

be accomplished, to the extent feasible, by the use of engineering control measures.

As stated in the preamble of the proposed rule (59 FR 58895), OSHA did not in this rulemaking open the record on the issue of the hierarchy of industrial hygiene controls; the hierarchy language is merely brought forward, verbatim, from this paragraph of the prior rule. Paragraph (a)(1), which was adopted by OSHA in 1971 from the 1969 American National Standards Institute (ANSI) standard, Z88.2–1969, established that a hierarchy of controls is to be used to protect employees from hazardous airborne contaminants. According to this hierarchy, engineering controls are the preferred method of compliance for protecting employees from airborne contaminants and are to be implemented first, before respiratory protection is used. According to paragraph (a)(1), respirators are permitted to be used only where engineering controls are not feasible or during an interim period while such controls are being implemented.

Paragraph (a)(2) requires employers to provide employees with respirators ''when such equipment is necessary to protect the health of the employee.'' In addition, this paragraph specifies that the employer must provide employees with respirators that are ''applicable and suitable'' for the purpose intended, i.e., for the protection of employee health. This paragraph thus clearly recognizes that, when properly selected, used, and maintained, respiratory protection can play an essential role in preventing adverse effects on the health of employees exposed to hazardous airborne contaminants.

By leaving paragraphs (a)(1) and (a)(2) of the final rule unchanged from the corresponding paragraphs of the respiratory protection standard that has been in effect since 1971, OSHA accomplishes several objectives. First, it continues the protection that employees have relied on throughout OSHA's history. Second, it retains the language that employers are familiar with and thus will not require them to become familiar with new regulatory language. Third, leaving the regulatory text of paragraphs (a)(1) and (a)(2) unchanged allows OSHA and the affected public to continue to rely on OSHA interpretations, decisions, and case law that have developed over the years.

As noted above, this standard is a respiratory protection standard. OSHA has enforced this standard when employers fail to provide respirators, when the respirators that are provided are inappropriate for the form of the contaminant or for the atmospheric concentration of the contaminant, when they are inappropriately used, and when they are improperly maintained.

Although OSHA clearly stated in the preamble to the proposal that the hierarchy of controls was not an issue in this rulemaking, the Agency did receive comment on this provision. For example, one commenter stated that, in its opinion, OSHA has ''a legal obligation to provide interested parties with an opportunity to comment on the methods of compliance provisions'' (Ex. 54–307). In the opinion of this commenter, the American Iron and Steel Institute (AISI), ''Section 6(b)(2) of the OSH Act requires that OSHA provide interested persons an opportunity to submit written data and comments on a proposed rule *in total*'' [emphasis added].

The unchanged language of paragraph (a)(1) was included in the proposed rule only to enable interested parties to view the rule as it would ultimately appear in the Code of Federal Regulations in its entirety. Since OSHA neither proposed nor adopted modifications to paragraph (a)(1), the Agency believes that it is not legally required to reconsider this issue at this time. OSHA has the authority to identify which regulatory requirements it is proposing to revise and which issues are to receive regulatory priority. Limiting this rulemaking to issues concerning respirator programs is appropriate because such programs are the exclusive focus of this rulemaking and to collect comments and data on additional issues would divert resources from the task at hand.

The preference for engineering controls has been reaffirmed in each substance-specific health standard OSHA has published, most recently in the Methylene Chloride standard (29 CFR 1910.1052). OSHA does not believe that it is necessary or appropriate, in a rulemaking dealing with respiratory protection, to reconsider its long-established policy with regard to the hierarchy of controls.

A number of commenters raised another issue in connection with paragraph (a)(1), and that is whether biological hazards, such as the hazard posed by exposure to *Mycobacterium tuberculosis,* the infectious agent that causes tuberculosis (TB), are covered by this paragraph (Exs. 54–213, 54–239, 54–249). In response, OSHA emphasizes that this respiratory protection standard does apply to biological hazards (see *Mahone Grain Corp.,* 10 OSHRC 1275, 1981). However, specifically with regard to the use of respirators to protect employees from the risk of occupational exposure to *M. tuberculosis,* OSHA stated at the public hearing on this respiratory protection standard (Tr. 16–17), that the Agency's tuberculosis standard, which has just been proposed (62 FR 54160) would contain specific requirements covering all aspects of respirator use in environments where occupational transmission of tuberculosis is possible. As explained in the preamble to that standard, OSHA is committed to ensuring consistency between the respirator requirements in the two standards.

As stated at the hearing, ''until the final tuberculosis standard is promulgated, we will continue to enforce respirator usage for TB under the current, unrevised respirator standard, 1910.134.'' (Tr. 18). There was little comment on this issue during the rulemaking. The entire previous respiratory protection standard is being redesignated as 29 CFR 1910.139. It will be published in the next edition of the Code of Federal Regulations under that designation. OSHA's enforcement policy concerning required respirator use for TB is set out in OSHA's Compliance Directive, ''Enforcement Procedures and Scheduling for Occupational Exposure to Tuberculosis'' (OSHA Instruction CPL 2.106). These enforcement procedures are based, in part, on the Centers for Disease Control and Prevention's (CDC) ''Guidelines for Preventing the Transmission of *Mycobacterium Tuberculosis* in Health-Care Settings, 1994.'' Like the CDC recommendations, OSHA's directive clarifies that respiratory protection for employees exposed to TB is required when: (1) Workers enter rooms housing individuals with suspected or confirmed infectious TB; (2) workers are present during the performance of high-hazard procedures on individuals who have suspected or confirmed infectious TB; and (3) emergency medical response personnel or others transport, in enclosed vehicles, an individual with suspected or confirmed infectious TB. Under the directive, OSHA also enforces the performance criteria recommended by CDC for selecting a respirator suitable for use against TB. OSHA's directive further specifies that where respirator use is required against TB, the program elements of OSHA's respiratory protection standard apply. A copy of OSHA's Compliance Directive can be obtained from OSHA's Office of Publications (Telephone Number, 202–219–4667). Copies of the CDC Guidelines can be obtained by calling CDC (Telephone Number, 1–800–342–2437).

As noted above, paragraph (a)(2) of the final rule is identical both to the corresponding paragraph of the respiratory protection standard in place

since 1971 and to proposed paragraph (a)(2). It specifies that respirators must be provided by the employer ''when such equipment is necessary to protect the health of the employee.'' OSHA considers respirators to be necessary to protect the health of the employee whenever feasible engineering and work practice controls are not available, are not sufficient to protect employee health, have not yet been instituted, in emergencies, and where the health of an employee is at risk (e.g., whenever employee exposure exceeds an OSHA permissible exposure limit (PEL)).

A violation of paragraph (a)(2) could exist, for example, if it can be shown that exposure to an airborne contaminant could result in illness or injury to the employee's health and that this could be prevented by the appropriate selection and use of a respirator. An OSHA Review Commission case illustrates such a situation: an employer was held to have violated paragraph (a)(2) because his employees either did not use respirators when working in an atmosphere contaminated with grain dust or used respirators that were ''so caked with dust that employees could not breathe through them'' and contracted a potentially fatal disease caused by the inhalation of grain dust contaminated with *Histoplasma capsulatum* spores (*Mahone Grain Corporation,* 10 OSHRC 1275, 1981). Paragraph (a)(2) was cited in this case even though OSHA has no specific PEL for grain dust or for *H. capsulatum* spores.

In the past 5 years, OSHA has issued 99 citations for violations of paragraph (a)(2) in conjunction with a citation of the General Duty Clause (i.e., Sec. 5(a)(1) of the Act). These citations concerned various situations involving the failure of the employer: (1) To control exposures in emergencies; (2) to control exposure to unknown concentrations of a toxic substance; (3) to control exposure to a contaminant that was clearly a recognized hazard even though no OSHA PEL existed; (4) to provide and require the use of a respirator for a confined space entry; or (5) to ensure the proper use of a respirator in a situation involving the improper storage of a chemical(s). OSHA will continue to view these situations as citable under this standard because they involve failure to implement the appropriate exposure control necessary to protect the health of the employee from adverse effects.

As proposed, paragraph (a)(3) of OSHA's prior standard does not appear in the final rule. This paragraph, which was adopted by OSHA in 1971 from the ANSI Z88.2–1969 standard, stated that employees must use the respiratory protection provided in accordance with instructions and training they have received.

Several commenters (Exs. 54–79, 54–181, 54–226, 54–234, 54–295, 54–307, 54–334) urged OSHA to retain this paragraph in the final rule. According to these commenters, this paragraph is necessary to ensure that employees take responsibility for their actions and that employees are actively involved in the respirator program and conform to program procedures. OSHA agrees that active employee involvement in the respirator program is essential to program effectiveness but does not believe that this principle should be stated in the standard, for a number of reasons. First, the OSH Act itself, at Sec. 5(b), states that ''Each employee shall comply with occupational safety and health standards and all rules, regulations, and orders issued pursuant to the OSH Act which are applicable to his own actions and conduct.'' In addition, the courts have repeatedly held that employers are responsible under Section 5(a)(2) of the Act (29 U.S.C. 654(a)(2)) for ensuring worker protection (see, e.g., *Brock v. City Oil Well Service Co.,* 795 F.2d 507, 511 (5th Cir. 1986)). In this case, the court held, ''it is the employer's responsibility to ensure that the employees are protected. It may accomplish this objective through others if it chooses, but the duty to provide the protection remains the employer's.'' Accordingly, the final rule does not contain this paragraph.

An issue raised by OSHA in connection with paragraph (a) of the proposal, the use of respirators by employees when such use is required by an individual employer or is chosen voluntarily by employees but not mandated by OSHA in this final rule, is addressed below in connection with paragraph (c) of this Summary and Explanation.

Paragraph (b)—Definitions

The final standard includes definitions of important terms used in the regulatory text of the final rule. The previous and proposed respiratory protection standards contained no definitions; however, OSHA is adding a number of definitions to the final rule because the Agency believes that employers and employees will benefit from this additional information. This is consistent with the Agency's desire to clarify its respiratory protection requirements, including those that are not being substantively changed in this rulemaking.

A number of the definitions relate to specific types of respiratory protection devices or to components or design characteristics of those devices. For example, the terms ''air-purifying respirator,'' ''filter or air-purifying element,'' and ''positive pressure respirator'' are defined in the final rule. These definitions, which are derived from generally recognized sources such as the current ANSI Z88.2–1992 respiratory protection standard, the NIOSH requirements for particulate respirators in 42 CFR part 84, and the 1987 NIOSH Respirator Decision Logic (Ex. 38–20), have been revised for clarity, consistency with compliance interpretations of the Agency's respiratory protection standard, and to respond to comments received during the rulemaking.

A number of commenters (Exs. 54–208, 54–218, 54–219, 54–410, 54–424) suggested that OSHA adopt several of the definitions in the ANSI Z88.2–1992 respiratory protection standard. The regulated community is already familiar with the ANSI definitions of these terms, and OSHA agrees that the potential for confusion will be reduced if terms mean the same thing in both the OSHA and ANSI standards. Therefore, the ANSI definitions of ''airline respirator (supplied-air respirator or airline respirator),'' ''canister or cartridge,'' ''demand respirator,'' ''end-of-service-life indicator,'' ''escape-only respirator,'' ''filter,'' ''fit check (user seal check),'' ''fit test,'' ''helmet,'' ''hood,'' ''loose-fitting facepiece,'' ''negative pressure respirator,'' ''pressure demand respirator,'' ''powered air-purifying respirator (PAPR),'' ''respiratory inlet covering,'' ''self contained breathing apparatus (SCBA),'' ''service life,'' and ''tight-fitting facepiece'' have all been added to the final standard, with some minor word changes to improve clarity and to recognize the mandatory nature of OSHA standards. In other cases, OSHA has substituted an ANSI definition for one the Agency originally proposed.

Several commenters urged OSHA to add other definitions to those in the proposal (Exs. 54–208, 54–218, 54–219, 54–222, 54–251 54–267, 54–283, 54–289, 54–363, 54–410, 54–437, 54–455). OSHA did not add some of the suggested definitions, such as one for ''health screening,'' because the term is no longer used in the standard. Other terms, such as ''medical evaluation,'' are defined where they appear in the regulatory text.

The following discussion addresses changes made since the proposed standard.

Adequate warning properties. The proposed definition of ''adequate warning properties'' has not been

retained in the final standard because the term is no longer used in the regulatory text. OSHA deleted the term after concluding that the two major warning properties, odor and irritation, are unreliable or inappropriate to use as indicators of sorbent exhaustion. This issue is discussed further in this Summary and Explanation in connection with paragraph (d).

Air-purifying respirator. The final standard defines the term ''air-purifying respirator'' as ''a respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.'' Marc Evans of Baxter Diagnostics, Inc. (Ex. 54–38) stated that the proposed definition, ''a respirator which is designed to remove air contaminants [i.e., dust, fumes, mists, gases, vapors, or aerosols] from the ambient air or air surrounding the respirator,'' was inaccurate since filter elements can only remove air contaminants when air passes through the filters; he stated that the ANSI definition was more accurate in this regard.

Another commenter wanted to add the term ''biologicals'' to the list of air contaminants removed by air-purifying respirators (Ex. 54–249). In response, the definition has been revised to state more clearly that an air-purifying respirator removes specific contaminants from the ambient air by drawing air through appropriate filters, cartridges, or canisters. Deleting the proposed definition's examples of air contaminants makes clear that no type of air contaminant, including biological agents, is excluded from the definition. Also, the term ''filter'' has been changed to ''filter or air-purifying element,'' which is also defined in the standard, and includes the broad range of filters, cartridges, canisters and other air-purifying elements used with respirators.

Assigned protection factor. The definition of ''assigned protection factor'' has been reserved as part of OSHA's decision to address the entire Assigned Protection Factor (APF) issue in a subsequent phase of this rulemaking. OSHA proposed to reference the NIOSH assigned protection factors from the 1987 NIOSH Respirator Decision Logic in the respiratory protection standard and then to adopt new APF values issued by NIOSH after that Agency had conducted rulemaking on APFs. In the course of this rulemaking, OSHA has concluded that it should instead develop its own set of assigned protection factors based on a thorough review and analysis of all relevant evidence. Both the NIOSH and the ANSI APFs, as well as all relevant data and information, will be considered by OSHA at that time.

Atmosphere-supplying respirator. This term means ''a respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere, and includes supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.'' As it has done in many of the definitions in this section, OSHA has substituted the term ''breathing air'' for a number of synonymous, but confusingly diverse, terms used in the proposal and in the ANSI Z88.2–1992 standard. The minor changes from the proposed definition have been made solely to enhance clarity.

Canister or cartridge. The final standard adopts the ANSI Z88.2–1992 standard's definition: ''a container with a filter, sorbent, or catalyst, or combination of these items, which removes specific contaminants from the air passed through the container.'' Several commenters suggested that this definition be added to the final rule (Exs. 54–208, 54–218, 54–219, 54–410, 54–424).

Demand respirator is defined as ''an atmosphere-supplying respirator that admits breathing air to the facepiece only when a negative pressure is created inside the facepiece by inhalation.'' This term was not defined in the proposal but is defined by ANSI, and several commenters (Exs. 54–208, 54–218, 54–219, 54–410, 54–424) urged that it be included in the final rule. As in other definitions, the phrase ''breathing air'' has been substituted for ''respirable gas'' for clarity.

The proposal's definition of ''demand'' has been deleted from the final standard because the addition of a definition for ''demand respirator'' makes its inclusion unnecessary. (See the definition of pressure demand respirator below for the distinction between the two types of respirator.)

Dust mask. See the definition for ''filtering facepiece'' below.

Emergency situation. In the final rule, OSHA is adding this term to paragraph (b) to clarify its use in the regulatory text. ''Emergency situation'' is defined as ''any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment that may or does result in an uncontrolled substantial release of an airborne contaminant.'' Under this definition, OSHA intends that a potential release, and not just an actual release, be considered an emergency situation requiring appropriate respiratory protection. This definition is the same or similar to those used to define emergency situations in other OSHA health standards (e.g., 1910.1051, Butadiene; 1910.1028, Benzene; 1910.1048, Formaldehyde).

Employee Exposure. OSHA has added this term to paragraph (b) of the final rule and has defined it to mean ''exposure to a concentration of an airborne contaminant that would occur if the employee were not using respiratory protection.'' This is the same definition that has been used in many of OSHA's substance-specific health standards. It is included to clarify that employee exposure is measured outside any respiratory protection worn.

End-of-service-life indicator (ESLI) means ''a system that warns the respirator user of the approach of the end of adequate respiratory protection, for example, that the sorbent is approaching saturation or is no longer effective.'' This definition was not in the proposal, but has been derived from the definition in the ANSI Z88.2–1992 standard, as requested by several commenters (Exs. 54–208, 54–218, 54–219, 54–410, 54–424). OSHA has included the example at the end of the definition to clarify the function of an ESLI.

Escape-only respirator. This term was not defined in the proposal, but the final standard defines an escape-only respirator as ''a respirator intended to be used only for emergency exit.'' The Dow Chemical Company (Ex. 54–278) and the Chlorine Institute (Ex. 54–439) recommended adding definitions for an ''escape'' respirator and an ''emergency'' respirator. Partially in response to these comments, and to clarify OSHA's intent, OSHA has described in paragraph (d) the narrow function of an ''escape-only respirator,'' and has added a definition for ''escape-only respirator'' to this paragraph (b). The definition of ''escape-only respirator'' derives from the ANSI Z88.2–1992 standard, with the phrase ''egress from a hazardous atmosphere'' replaced by the word ''exit.''

Filter or air-purifying element. The final standard's definition of this term is ''a component used in respirators to remove solid or liquid aerosols from the inspired air.'' The parallel definition in the proposal used ''filter'' instead of ''filter or air-purifying element'' and has been changed in response to comments (Exs. 54–208, 54–218, 54–219, 54–410, 54–424). The phrase ''or air-purifying element'' has been added to clarify that this definition applies to all filtration mechanisms, not only to mechanical or electrostatic filtration of particulates. The new definition derives from the definition of ''filter'' in the ANSI Z88.2–1992 standard.

Filtering facepiece (dust mask). The definition of ''filtering facepiece'' in the final rule is ''a negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium.'' This new definition is derived from the definition of ''filtering facepiece'' in the NIOSH Respirator Decision Logic (Ex. 38–20). As described in the discussion of paragraph (c) below, employers who allow the use of these respirators when such use is not required need to comply with only paragraph (c)(2) of this standard, which requires that the employer provide the employee with the information contained in Appendix D.

Fit factor. The definition of ''fit factor'' in the final rule is a quantitative estimate of the fit of a particular respirator to a specific individual, and typically estimates the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn. In the proposal, OSHA's definition included the terms ''challenge agent'' and ''test chamber.'' Several commenters (Baxter Diagnostics, Ex. 54–38; American Subcontractors Association, Ex. 54–293) stated that using these terms would have the unintended effect of prohibiting the use of several existing QNFT test methods, such as the TSI Portacount,™ and recommended that OSHA rely on the ANSI definition of ''fit factor'' instead. OSHA agrees with this point, and the final standard's definition derives primarily from the ANSI Z88.2–1992 standard's definition, as commenters suggested (Exs. 54–208, 54–218, 54–219, 54–410, 54–424). The final definition uses the word ''estimate'' instead of the ANSI definition's word ''measure'' because fit factors estimate, rather than measure, the fit obtained during use. The phrase ''specific individual'' has been substituted for ''particular individual'' for clarity.

Fit test. A definition of ''fit test'' has been added to the final rule and is defined as ''the use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual.'' (See also QLFT and QNFT.) This definition has been added because OSHA is of the opinion, based on comments to the record, that such a definition is needed (Exs. 54–208, 54–218, 54–219, 54–410, 54–424). ANSI also has a definition of fit test, but OSHA's definition differs from that in the ANSI Z88.2–1992 standard in that the term ''challenge agent'' has been eliminated and replaced by the phrase ''protocol to quantitatively or qualitatively evaluate.'' The use of the term ''challenge agent'' would limit the development of future fit test technologies that do not involve a test agent (Exs. 54–208, 54–250, 54–330, 54–424).

Hazardous exposure level. Because the final standard does not use the term ''hazardous exposure level,'' it is not defined. The proposal defined such levels as including the Permissible Exposure Limits (PELs) contained in OSHA's Tables Z–1, Z–2, and Z–3 of 29 CFR 1910.1000; the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs), as published in the latest edition of that organization's ''Threshold Limit Values for Chemical Substances and Physical Agents,'' for those substances without an OSHA PEL; the NIOSH Recommended Exposure Limits (RELs) for those hazardous chemicals without either an OSHA PEL or ACGIH TLV; and any exposure level based on available scientific information, including Material Safety Data Sheets, for those hazardous chemicals for which no OSHA PEL, ACGIH TLV, or NIOSH REL has yet been published.

The proposed rule would have required employers to identify the ''hazardous exposure level'' applicable to each hazardous chemical in the workplace and then to use this information in selecting the appropriate respirator to provide protection against exposure to that chemical. The final rule takes a different and much simpler approach to assisting employers in the selection of appropriately protective respirators in those cases where OSHA has not yet promulgated a PEL for a hazardous chemical. OSHA has taken the approach reflected in the final standard because there was widespread objection to the proposed approach (Exs. 54–94, 54–175, 54–212, 54–226, 54–232, 54–275x, 54–283, 54–293, 54–306, 54–312, 54–324, 54–334, 54–347, 54–352, 54–361, 54–397, 54–443, 54–445). Some commenters (Exs. 54–91, 54–165, 54–181, 54–291, 54–316, 54–347, 54–397, 54–445) interpreted the proposed approach as an attempt by OSHA to expand the number of hazardous chemicals with OSHA-enforceable exposure limits, while others believed that implementing the proposed approach would require employers to have risk assessment expertise or to perform complex analyses, and pointed out that many employers lacked such expertise (Exs. 54–106, 54–175, 54–210). In general, rulemaking participants stated that OSHA's approach to this problem should rely on the professional judgment of employers, based on readily available information (Exs. 54–206, 54–210).

OSHA has decided, after a thorough review of the record, to follow these recommendations, and in the final rule has adopted an approach that requires employers to select appropriately protective respirators on the basis of informed professional judgment. Accordingly, the final rule does not identify the ACGIH TLVs or the NIOSH RELs as references that would trigger required respirator use. The approach taken in the final rule provides employers with the flexibility to rely on professional judgment and available data sources when selecting respirators for protection against hazardous chemicals that have no OSHA PEL.

OSHA believes that it is prudent in such cases for employers to select more rather than less protective respirators, i.e., to select a respirator that will reduce employee exposure to a level below the concentration indicated as hazardous by the scientific literature. OSHA also believes that many employers will choose to rely on the ACGIH TLV or NIOSH REL in those cases where OSHA has no PEL at the present time. However, whatever approach employers choose to take, the respirator selected must ''be applicable and suitable for the purpose intended,'' as required by paragraph (a).

Helmet. The final standard defines a helmet as ''a rigid respiratory inlet covering that also provides head protection against impact and penetration.'' This definition, which was not in the proposal, has been added to the final standard at the request of several commenters (Exs. 54–208, 54–218, 54–219, 54–410, and 54–424). The OSHA definition uses the term ''respiratory inlet covering'' instead of the word ''hood'' used in the ANSI definition in order to include helmet-style powered air-purifying respirators (PAPRs).

High efficiency particulate air (HEPA) filter is defined as ''a filter that is at least 99.97% efficient in removing monodisperse particles of 0.3 micrometers in diameter. The equivalent NIOSH 42 CFR 84 particulate filters are the N100, R100, and P100 filters.'' Although NIOSH has revised the particulate filter descriptions under the new 42 CFR Part 84 respirator certification regulation, and no longer uses the term HEPA, this definition is included because ''HEPA filter'' is used in many of OSHA's substance-specific standards. The definition, which is similar to that used by ANSI, lists the NIOSH 42 CFR part 84 particulate filters that are equivalent, in terms of

efficiency, to the HEPA filter, i.e., the N100, R100, and P100 filters.

Hood. The final standard includes the following definition of ''hood'': ''a respiratory inlet covering that completely covers the head and neck and may also cover portions of the shoulders and torso.'' This definition has been added to the final standard in response to commenters (Exs. 54–208, 54–218, 54–219, 54–410, and 54–424). The definition derives from the ANSI Z88.2–1992 standard; the word ''also'' has been added for clarity.

Immediately dangerous to life or health (IDLH). The final standard defines IDLH as ''an atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere.'' In the proposal, the definition of IDLH was ''an atmospheric concentration of any toxic, corrosive, or asphyxiant substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere.'' In the final rule, OSHA has decided that including all atmospheres capable of causing the listed health effects is more consistent with OSHA's intent than limiting the definition to toxic, corrosive, and asphyxiant atmospheres and has also deleted the word ''delayed'' from the definition because including it caused considerable confusion among commenters.

Under the final standard's definition, atmospheres where a short, one-time exposure (i.e., an acute exposure) may cause death or irreversible adverse health effects immediately, within a few hours, or within a few days or weeks are considered IDLH atmospheres. The severity of the adverse effects and the certainty that health impairment will occur following an acute exposure are more important considerations in defining a potential IDLH situation than is the time course of the health effect. For example, an atmosphere containing life-threatening or health-impairing concentrations of fluorides, cadmium fumes, or radioactive substances would be considered IDLH even though a single exposure might not cause death or permanent impairment for as long as days or even weeks after the exposure. On the other hand, many situations involving atmospheres exceeding short-term or ceiling exposure limits are not IDLH atmospheres; most short-term or ceiling limits are designed to reduce the risk of less serious effects, such as sensory irritation. Thus, only those situations where the acute exposure would threaten life, initiate an irreversible process that threatens life or health, or impede the ability of the worker to escape from the atmosphere would constitute IDLH conditions. In contrast, if chronic exposure to a toxic atmosphere is required to produce health impairment or cause death, the atmosphere is not IDLH. Thus, the relatively low atmospheric concentrations of carcinogenic substances that cause work-related cancers are not considered IDLH atmospheres, even though the effect of long-term exposure at such concentrations is death or serious illness.

Paragraphs (d) and (g) of the final standard require employers whose employees are exposed to an IDLH atmosphere to provide them with the most protective and reliable respiratory protection, i.e., a full facepiece pressure demand SCBA certified by NIOSH for a minimum of a 30-minute service life, or a combination full facepiece pressure demand supplied-air respirator with auxiliary self-contained air supply, and to implement specific rescue precautions and communication procedures. Although OSHA's prior Respiratory Protection standard does not explicitly use the term ''IDLH,'' it does require that respirators used in ''immediately dangerous'' atmospheres keep inward leakage to a minimum and be highly reliable (See paragraph (c) of prior 29 CFR 1910.134, which incorporates this language from the ANSI Z88.2–1969 standard by reference).

Commenters raised a number of issues specifically related to the proposed definition of IDLH and to the IDLH concept in general. These comments addressed the following points:

- Whether the term IDLH should apply to all delayed effects, some delayed effects, or be restricted to immediate effects;
- How OSHA's definition of IDLH differs from those of other organizations and how it relates to the definition of IDLH used in other OSHA standards;
- How the presence of an IDLH or potential IDLH atmosphere affects respirator selection.

The following discussion addresses each of these points in turn.

The proposed definition of IDLH included the phrase ''delayed adverse health effects.'' OSHA has omitted this phrase from the final standard to respond to comments received and to remove a source of confusion. Many commenters argued that the term IDLH should cover only immediate, severe adverse health effects, such as those resulting from exposures to hydrogen fluoride or oxides of nitrogen (e.g., Exs. 54–208, 54–219; 54–316), while others favored taking chronic, delayed effects into consideration when making an IDLH decision (See, e.g., Exs. 54–202 and 54–437). For example, OCAW stated that ''OSHA's IDLH and acute hazard-based framework * * * does not properly emphasize the need to consider long-term and cumulative health effects.''

Most participants, however, argued against including chronic health effects in the IDLH definition because it would make the definition too broad. These participants feared that including this term would mean that exposures typically associated with chronic effects, such as cancer, would be designated IDLH (Exs. 54–67; 54–153; 54–175; 54–208; 54–218; 54–219; 54–232; 54–266; 54–278; 54–307; 54–314; 54–316; 54–326). Typical of these comments is one from the American Iron and Steel Institute: ''The proposed definition, which includes ''delayed health effects,'' is so broad that it goes far beyond the accepted IDLH concept, and would expand it beyond its intended purpose'' (Ex. 54–307). Arguing along the same lines, the Exxon Corporation stated that ''the phrase 'delayed health effects' could include chronic toxins like asbestos * * *'' (Ex. 54–266).

Other commenters urged OSHA to narrow the definition of IDLH by adding the word ''acute'' before ''adverse'' in the phrase ''delayed adverse health effects'' or by making other language changes that would achieve the same effect (Exs. 54–67, 54–278, 54–326, 54–208A). For example, the American Industrial Hygiene Association (Ex. 54–208A) stated that the only atmospheric contaminants with delayed effects that should be included in the definition are those, such as the oxides of nitrogen, that cause delayed-onset severe adverse health effects (such as pulmonary edema). Representatives of Pennzoil suggested that ''* * * the phrase 'immediate or delayed irreversible debilitating health effects', be used'' to achieve the same end (Ex. 54–287).

These commenters objected to the inclusion of ''delayed health effects'' in the proposed definition because the language suggested that effects typically associated with long-term exposures, such as cancer, would be included. The definition in the final standard recognizes that the effects of concern must be the result of an acute overexposure but does not specifically limit the length of time between that overexposure and the resulting effect.

Where very serious health effects may arise from a single acute exposure, even if such effects become apparent only after a relatively long latency period, e.g., hours, days, or even weeks, the atmosphere associated with the effect must be designated IDLH. OSHA is confident that deleting the word ''delayed'' from the IDLH definition in the final rule will reduce confusion but will not affect the level of employee protection provided by the standard.

Many commenters urged OSHA to adopt an IDLH definition developed by another organization, agency, or by OSHA itself in other standards. Some commenters (Exs. 54–153, 54–214, 54–234, 54–251, 54–266, 54–278, 54–290, 54–330, 54–361, 54–363, 54–424, 54–439) urged OSHA to adopt the ANSI Z88.2–1992 standard's definition of IDLH: ''any atmosphere that poses an immediate hazard to life or poses immediate irreversible debilitating effects on health'' (clause 3.33). For example, Bell Atlantic (Ex. 54–361) suggested that the ANSI definition be used to ensure that ''chronic toxins like asbestos would not be considered IDLH.'' However, OSHA believes that adopting the definition contained in the current ANSI standard could reduce employee protection because it states that atmospheres are IDLH only in cases where the adverse effects of exposure occur immediately. An example of an atmosphere that OSHA believes must be considered IDLH but arguably would not be so designated under the ANSI definition is one containing high concentrations of cadmium fume, which may result in fatal collapse as long as 48–72 hours after an acute overexposure.

The Exxon Corporation (Ex. 54–266) objected to the phrase ''ability to escape'' in OSHA's proposed definition, and suggested that OSHA instead adopt the ANSI definition, which does not refer to impairment of the ability to escape. OSHA wishes to clarify that the proposed terminology, ''interfere with an individual's ability to escape'' was not meant to cover a minor or even moderate degree of interference but to address interference of a kind sufficiently serious to impair the individual's ability to escape from exposure to a dangerous concentration of an air contaminant. To address Exxon's concern, the final rule's definition has been revised to read ''impair the individual's ability to escape.'' OSHA notes that it is imperative for employees to be able to escape. There are atmospheres, for example one contaminated with a severe eye irritant, that can effectively incapacitate an individual in the short term and prevent the individual from escaping in time to avoid more serious health consequences. OSHA has therefore retained in the IDLH definition language that addresses the need to protect workers escaping from dangerous atmospheres.

One commenter, Monsanto (Ex. 54–219), expressed concern about the consistency of IDLH definitions in different OSHA standards. In response, OSHA has reviewed the definitions of IDLH used in its standards and believes that the final standard's definition is largely consistent with those in the two OSHA safety standards that use the term: 29 CFR 1910.146, the Permit-Required Confined Space standard (''Confined Spaces standard'') and 29 CFR 1910.120, the Hazardous Waste Operations and Emergency Response (HAZWOPER) standard.

Some commenters (Exs. 54–439, 54–330, 54–278) asked which IDLH values OSHA endorses or pointed to the limitations of the available information on IDLH concentrations. For example, OCAW noted that ''only a handful of IDLH limits have been determined. In most worker exposure, the IDLH limit is unknown. Even when [an] IDLH limit exists, workers do not have access to this information. MSDSs rarely include IDLH information'' (Ex. 54–202).

The final rule does not contain a prescribed list of IDLH values or require employers to rely on any particular list. Some commenters (Exs. 54–278, 54–330, 54–361, 54–424, 54–439) criticized the IDLH values listed in the 1994 NIOSH Pocket Guide to Chemical Hazards (Ex. 54–278) or recommended that the Emergency Response Planning Guidelines (ERPGs) developed under the auspices of the American Industrial Hygiene Association be used instead. OSHA is aware that published IDLH values are not available for many industrial contaminants and that employers must therefore rely on their own knowledge and judgment, and that of safety and health professionals, when deciding that a given atmosphere has the potential to cause health effects of the kind envisioned by OSHA's IDLH definition. During enforcement inspections, OSHA will continue to accept any published IDLH value that is based on sound scientific evidence; those published by NIOSH and the AIHA would clearly meet this test.

OSHA's final IDLH definition does not separately mention ''potential'' IDLH atmospheres. Many OSHA enforcement cases have involved the failure of employers to provide respirators in situations that were not IDLH at the time workers entered the area but became so thereafter. OSHA intends employers to interpret the respirator selection requirements in paragraph (d)(1) proactively, i.e., where employers are uncertain about the adequacy of a given respirator for a highly hazardous atmosphere, cannot identify the atmospheric concentration of a substance that poses a potentially life-threatening or health-impairing risk, or cannot maintain the concentration of such a substance below life-threatening or health-impairing levels, the employer must consider the atmosphere IDLH and select a respirator accordingly. For example, an employer in a chemical plant knows that inadvertent releases or spills of highly hazardous chemicals may occur at the facility and selects the most protective respirators available for employees who must enter a spill area because, in an emergency, there is no time to take airborne measurements to determine whether or not the concentration is IDLH. OSHA encourages this kind of proactive planning because it is protective of employee health.

Interior structural firefighting. The final respiratory protection standard uses the OSHA definition for ''interior structural firefighting'' contained in 29 CFR 1910.155, which applies to all situations covered by Subpart L—Fire Protection. The definition is as follows:

> *Interior structural firefighting* means the physical activity of fire suppression, rescue or both, inside of buildings or enclosed structures which are involved in a fire situation beyond the incipient stage.

Loose-fitting facepiece. The final standard now defines this term to mean ''a respiratory inlet covering that is designed to form a partial seal with the face.'' This definition was not in the proposal, and has been added in response to commenters such as the AIHA (Ex. 54–208), 3M (Ex. 54–218), Monsanto (Ex. 54–219), Martin Marietta Energy Systems, Inc. (Ex. 54–410), and ORC (Ex. 54–424), who recommended that OSHA adopt several of the ANSI Z88.2–1992 definitions for respirator terms. OSHA has adopted only part of the ANSI definition for loose-fitting facepiece. The phrase in the ANSI definition that states a loose-fitting facepiece ''does not cover the neck and shoulders, and may or may not offer head protection against impact and penetration'' has not been included. This phrase from the ANSI definition was not adopted as part of the OSHA definition because adding this phrase would not allow users to clearly distinguish between hoods, helmets, and loose-fitting respirators. It is important for employers to be able to distinguish loose-fitting from tight-

fitting respirators in order to correctly apply the fit testing requirements.

Maximum use concentration. OSHA is not defining this term at this time because the Agency has reserved the issue of Assigned Protection Factors, which is associated with Maximum Use Concentrations, until a subsequent phase of this rulemaking.

Negative pressure respirator (tight fitting). The final standard defines this term as ''a respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator.'' The proposed definition was revised in response to comments (Exs. 54–208, 54–218, 54–219, 54–410, and 54–424) that recommended that OSHA adopt the ANSI Z88.2–1992 standard's definition. In the final rule, OSHA has accepted the ANSI definition, with two changes: (1) The word ''facepiece'' has replaced the term ''respiratory inlet covering'' to make clear that the facepiece is the area of interest with negative pressure respirators; and (2) the phrase ''outside the respirator'' has been added after the phrase ''ambient air pressure'' to clarify that negative pressure exists only when the outside air pressure is higher than the air pressure inside the negative pressure facepiece.

Oxygen-deficient atmosphere. The proposed definition of an ''oxygen deficient atmosphere'' was ''an atmosphere with an oxygen content of less than 19.5% by volume at altitudes of 8000 feet or below.'' OSHA is retaining the 19.5% definition of an oxygen-deficient atmosphere in the final rule, but is removing the reference to altitudes. The use of a 19.5% oxygen level is well established and has even been incorporated by Congress into other safety and health legislation (See Federal Mine Safety and Health Act, 20 USC 863 (b), discussed in *National Mining Association* v. *MSHA*, 116 F.3d 520 (D.C. Cir. 1997.) Paragraph d(2)(iii) of the final rule requires employers to consider all oxygen-deficient atmospheres to be IDLH and to require the use of pressure-demand SCBA or a combination full-facepiece pressure-demand SAR with an auxiliary self-contained air supply. However, this paragraph also contains an exception that would permit employers to use any atmosphere-supplying respirator in oxygen-deficient atmospheres where the employer can demonstrate that oxygen levels cannot fall below the altitude-adjusted concentrations prescribed in Table II of paragraph (d).

The ANSI Z88.2–1992 standard, NIOSH (Ex.164), and AIHA (Ex. 2098) use an altitude-adjusted definition for oxygen deficiency. Although there are some small differences, these organizations generally define oxygen deficiency as an oxygen level of less than 19.5% at altitudes up to 5,000 or 6,000 feet, and less than 20.9% at higher elevations. OSHA chose not to adopt this approach to defining oxygen deficiency for several reason. First, as was stated in the proposal (59 FR 58905), OSHA's concern is that employees not be exposed to environments in which the oxygen partial pressure is less than 100 mm Hg; this partial pressure of oxygen is generally regarded as an appropriate IDLH level (Exs. 164, 208). OSHA believes that using an oxygen concentration of 19.5 percent as a baseline oxygen level is appropriate because exposure to such an atmosphere does not pose a serious health risk at elevations below 8,000 feet, i.e., the oxygen partial pressure in such atmospheres will remain above 100 mm Hg (Ex.164). Although OSHA realizes that the partial pressure of oxygen may be at or above 100 mm Hg even at some lower altitudes and lower oxygen concentrations, these lower-altitude, lower-concentration situations are generally unstable and can quickly deteriorate to life-threatening atmospheres. OSHA has accounted for those rare situations where the employer controls the environment to maintain a constant altitude-adjusted oxygen level through the exception in paragraph (d)(2)(iii) of the final rule. OSHA's definition of oxygen deficiency is also consistent with the Compressed Gas Association's definition of Grade D breathing air as air containing a minimum of 19.5% oxygen. OSHA finds that defining oxygen deficiency as an atmosphere with an oxygen content below 19.5% is both protective and straightforward, and is consistent with the definition that has been used by the Agency in the past.

Oxygen-deficient IDLH atmosphere. The proposal originally included a definition of oxygen-deficient IDLH atmosphere. Because the term has not been used in the regulatory text of the final rule, OSHA is deleting this term from paragraph (b).

Physician or other licensed health care professional (PLHCP) is defined as ''an individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide, or be delegated the responsibility to provide, some or all of the health care services required by paragraph (e) of this section.'' This definition has been added because paragraph (e)(2) of the final standard requires that all medical evaluation procedures be performed by a PLHCP.

OSHA has long considered the issue of whether, and if so how, to specify the qualifications of the particular professionals who are permitted to perform the medical evaluations required by its standards. The Agency has determined that any professional who is licensed by state law to perform the medical evaluation procedures required by the standard may perform these procedures under the respiratory protection standard. The Agency recognizes that this means that the personnel qualified to provide the required medical evaluation may vary from state to state, depending on state licensing laws. Under the final rule, an employer has the flexibility to retain the services of a variety of qualified licensed health care professionals, provided that these individuals are licensed to perform a given service. OSHA believes that this flexibility will reduce cost and compliance burdens for employers and increase convenience for employees. The approach taken in this final standard is consistent with the approach OSHA has taken in other recent standards (e.g., cadmium, methylene chloride).

Positive pressure respirator. This term has been redefined in the final standard to mean ''a respirator in which the pressure inside the respiratory inlet covering is positive with respect to ambient air pressure outside the respirator.'' Consistent with the recommendations of several commenters (Exs. 54–208, 54–218, 54–219, 54–410, and 54–424), the final standard's definition adopts the ANSI Z88.2–1992 definition but adds the phrase ''outside the respirator'' for clarity.

Powered air-purifying respirator. The final standard defines this term as ''an air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.'' This revision also reflects commenters' recommendations that OSHA adopt ANSI Z88.2–1992 standard definitions (Exs. 54–208, 54–218, 54–219, 54–410, and 54–424). The term ''ambient atmosphere'' in the ANSI definition has been replaced with the term ''ambient air'' for simplicity.

Pressure demand respirator. This type of respirator is defined as ''a positive pressure atmosphere-supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.'' This language has been taken verbatim from the ANSI Z88.2–1992 standard's definition, except that

the term ''breathing air'' has replaced the term ''respirable gas'' for clarity.

Qualitative fit test (QLFT). This definition has been revised to read ''a pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.'' OSHA has replaced the proposal's QLFT definition with one derived from the ANSI Z88.2–1992 standard but has added the phrase ''to assess the adequacy of respirator fit'' to emphasize the purpose of QLFT. In addition, the OSHA definition uses the phrase ''the individual's response'' instead of the ANSI definition's phrase ''subject's sensory response'' for clarity.

Quantitative fit test (QNFT). This definition has been revised and simplified to accommodate both current and yet-to-be-developed fit test technology. The final standard defines a quantitative fit test (QNFT) as ''an assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.'' Commenters generally opposed the proposed definition of QNFT, which made reference to challenge agents, because they feared that it might interfere with the development of new fit test methods (Exs. 54–5, 54–222, 54–251, 54–266, 54–275x, 54–350, 54–208, 54–218, 54–219, 54–278, 54–316, 54–424). OSHA agrees and has revised the definition accordingly. OSHA believes that the definition of QNFT must be usable, enforceable, and understandable, and accommodate evolving technology.

Respiratory inlet covering. The final standard defines this term, which is often used in descriptions of respiratory equipment, as ''that portion of a respirator that forms the protective barrier between the user's respiratory tract and an air-purifying device or breathing air source, or both. It may be a facepiece, helmet, hood, suit, or a mouthpiece respirator with nose clamp.'' This definition is adapted from that in the ANSI Z88.2–1992 standard; the phrase ''that connects the wearer's respiratory tract'' in the ANSI definition has been modified to read ''that forms the protective barrier between the user's respiratory tract'' in the OSHA definition for clarity.

Self-contained breathing apparatus (SCBA). The proposed definition of self-contained breathing apparatus (SCBA) has been revised slightly in the final standard to read ''an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.'' This revised definition was adopted from the ANSI Z88.2–1992 standard's definition of SCBA.

Service life. The final standard defines service life as ''the period of time that a respirator, filter, or sorbent, or other respiratory equipment provides adequate protection to the wearer.'' This definition eliminates a reference in the proposal to substances ''breaking through'' the cartridge or canister, and deletes a statement that respirator manufacturers are to determine service life concentrations, since this is the employer's responsibility. The new definition parallels ANSI's except that it contains additional language covering filters, sorbents, and other respiratory equipment. This definition is further explained in the discussion of paragraph (d) of the Summary and Explanation.

Supplied-air respirator (SAR) or airline respirator. OSHA has elected to retain a definition for supplied-air respirators, since the term is used by NIOSH in the 42 CFR part 84 regulations. The final standard's definition reads: ''Supplied-air respirator (SAR) or airline respirator means an atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.'' Participants (Exs. 54–208, 54–249) were more familiar with this term than with the term ''air-supplied respirator'' recommended as an alternative by some commenters (Exs. 54–218, 54–219, 54–363, 54–434). The language of this definition is derived from the ANSI Z88.2–1992 definition for ''airline respirator,'' but also applies to supplied-air respirators, a term that NIOSH uses to certify this class of respirators. OSHA believes that using both names in the definition will reduce confusion for respirator users.

Tight-fitting facepiece is defined as ''a respiratory inlet covering that forms a complete seal with the face.'' This term was not defined in the proposal, but numerous commenters requested that OSHA add this definition (Exs. 54–222, 54–283, 54–363, 54–410, 54–424, 54–428, 54–433, 54–455) to the final standard.

User seal check is defined as ''an action conducted by the respirator user to determine if the respirator is properly seated to the face.'' Such a check is performed by the user each time the respirator is donned or adjusted to ensure that the tight-fitting respirator is properly seated on the user's face, i.e., that the proper seal has been achieved. Several commenters recommended that OSHA add the definition for ''fit check'' from the ANSI Z88.2–1992 standard to replace the term ''facepiece seal check'' that was used in Appendix B of the proposal (Exs. 54–208, 54–218, 54–219, 54–410, 54–424). The term ''fit check'' has proven confusing to those respirator users who do not realize that a daily fit check is not a substitute for an annual fit test. The AIHA (Ex. 54–208) recommended that OSHA add a statement to Appendix B to the effect that: ''Fit checks are not substitutes for qualitative or quantitative fit tests,'' and OSHA has done so in this final standard. Because OSHA believes that the similarity between the terms ''fit check'' and ''fit test'' is responsible for this confusion, OSHA has used the term ''user seal check'' rather than ''fit check'' in the final standard. The definition of ''user seal check'' derives from the ANSI Z88.2-1992 standard's definition for ''fit check,'' except that the word ''action'' has been substituted for ''test'' to avoid any possible confusion among respirator users.

Paragraph (c)—Respiratory Protection Program

This paragraph of the final standard requires employers to develop and implement a written respiratory protection program, with workplace-specific procedures addressing the major elements of the program, whenever respirators are necessary to protect the health of the employee. In addition, where an employer requires an employee to wear a respirator, i.e., in a situation where the standard does not otherwise require such use, a written program must be developed and implemented. Employers who provide respirators at the request of their employees or who allow their employees to bring their own respirators into the workplace must ensure that the respirator used does not present a hazard to the health of the employee. However, if the respirator voluntarily worn is a filtering facepiece (dust mask), the employer is not required to implement a written program. Paragraph (c)(1) also requires employers to update the program when changes in the workplace or in respirator use make such updating necessary.

As in the proposed rule, the final standard requires that the respiratory protection program be written. OSHA's experience and that of the industrial hygiene community have demonstrated that health and safety programs can best be effectively implemented and evaluated when written. In addition, because workplaces differ substantially, each program must be tailored to the specific conditions of the workplace if it is to protect employee health, and developing a written program is the most efficient way of ensuring that the program reflects the unique characteristics of each workplace. Developing and writing down worksite-

specific procedures requires employers to design their respiratory protection programs to address the respiratory hazards in their particular workplace, and this process requires employers to think about and document all relevant information pertaining to the hazardous atmospheres that their employees may encounter under normal operating conditions or during reasonably foreseeable emergencies that may occur in the workplace. Finally, OSHA's enforcement data indicate that compliance with the previous standard has not been optimal, particularly in smaller workplaces, and a written program will help employers, employees, and compliance officers gauge the adequacy of a given program.

Paragraphs (c)(1)(i) through (c)(1)(ix) identify the elements that must be included in the employer's program unless the particular element does not apply to the employer's workplace. The previous OSHA respiratory protection standard also required employers to develop written standard operating procedures that covered the selection, use, cleaning, maintenance, inspection, and storage of respirators and the training and medical evaluation of respirator users (paragraphs (b)(1), (e)(1), and (e)(3), among other provisions of the previous standard). In the final standard, the general elements of the written program have been expanded, reordered and updated, and the term ''written standard operating procedures (SOP)'' used in the previous standard has been replaced with the words ''worksite-specific procedures.'' Thus, the standard identifies the basic elements of written programs for all workplaces, but the employer has the flexibility to tailor these general program elements to match the specific workplace conditions and processes that occur in that workplace. In the Agency's previous respiratory protection standard, the requirement for written standard operating procedures tended to lead to the adoption of generic procedures. Changing the terminology from ''SOPs'' to ''worksite-specific procedures'' gives employers the incentive to develop procedures that are unique and specific to the employer's workplace, to describe the particular respirator selection process used in that workplace, and to explain how employees are to use respirators in that setting.

OSHA has also revised the required program elements themselves, for several reasons. First, they have been modified to reflect those provisions of the final standard that have been added or enhanced to reflect advances in respiratory protection technology, such as the development of atmosphere-supplying respirators and the widespread use of modern methods of fit testing. Second, several of the provisions of the previous standard were vague and had caused compliance difficulties for employers over the years. OSHA wishes to provide employers with clear notice of what elements OSHA considers essential to an effective respirator program. Third, OSHA has adopted several changes suggested by commenters.

OSHA also believes that clearer program elements will improve employer compliance. According to the Minnesota Department of Labor and Industry (Ex. 54–204), for example, many employers have had difficulty complying with OSHA's previous standard because they were unsure what elements a program was required to include. Several other data sources also point to the lack of clarity in OSHA's previous standard; these include OSHA's inspection data and compliance experience, comments to the record (Ex. 54–219), and studies of workers (Ex. 64–65). As noted in the NPRM, data collected on current respirator practices and procedures in over 2300 manufacturing plants classified in 15 SIC codes were reviewed by the Agency (See Summary of the Preliminary Regulatory Impact Analysis, 59 FR 58892). This survey sample was used to produce estimates of respirator-related practices for about 123,200 manufacturing plants with regular and occasional respirator use. Only 25.5% of these plants were estimated to have written standard operating procedures, and only 7.9% had procedures that addressed all eight of the program elements required by the previous standard (selection, use, cleaning, maintenance, inspection and storage of respirators, and the training and medical evaluation of respirator users). More than 80% of the very large plants (those with 1000 or more employees) had written procedures, while in small plants (those with fewer than 50 employees), only about 22% had written procedures. This survey clearly showed that improving the clarity of the elements to be addressed in standard operating procedures would help employers to develop and implement better respiratory protection programs and thus would provide greater protection to workers as well.

Similarly, a study of OSHA citations for violations of the previous OSHA respirator standard from 1977 to 1982 showed that 13% of these citations were issued because standard operating procedures were either inadequate or missing (Rosenthal and Paull; Ex. 33–5). OSHA's latest citation data for the respiratory protection standard, for the period October 1990 to December 1995, show that the number of citations issued for inadequate or missing written respirator programs in general industry has increased to 18.4% of all respirator standard-related citations. These data indicate that the conclusions reached by Rosenthal and Paull are still valid. The citation history for the construction industry respiratory protection standard, 29 CFR 1926.103, is similar, with citations for inadequate respirator programs representing 10.5% of all respirator standard-related citations in that industry. OSHA believes that the percentages of respirator standard-related citations reported in these reviews substantially underestimate the real incidence of deficient programs because it is OSHA policy not to issue citations for an inadequate program unless an overexposure is also documented.

Paragraphs (c)(1)(i) through (c)(1)(ix) of the final standard provide additional detail about each of the required program elements but remain performance based to enable employers to adapt them to their workplaces. The program elements have been reorganized from those in the previous standard so that they track the order of the major paragraphs of the standard. OSHA believes that reordering the elements, as suggested by one commenter (Ex. 54–204), is logical and should make program development easier. OSHA also believes that the additional detail and greater clarity provided by the final rule's program elements will reduce confusion over the intent of these provisions, lead to higher compliance rates, and result in better respiratory protection for employees.

The ANSI Z88.2–1992 standard for respiratory protection also states that written procedures covering the complete respirator program must be established and implemented (Ex. 81). Thus, like OSHA, ANSI recognizes the need for a written respiratory protection program and implementing procedures to provide complete and consistent protection to employees wearing respirators. Although the ANSI standard does not contain detailed instructions on the content of these procedures, it does describe, in clause 6, the elements to be included in the program to cover routine and emergency use of respirators.

The program elements in the ANSI Z88.2–1992 standard (i.e., program administration, respirator selection, training, respirator fit, maintenance, inspection and storage) are similar to those in paragraphs (c)(1)(i) through

(c)(1)(ix) of OSHA's final standard. The specific content of each element of the written procedures is left to the employer, who can tailor them to match the conditions that occur in his/her worksite. Although many of the program elements are common to all respiratory protection programs, such as respirator selection, care, use, and program evaluation, some elements, such as the one addressing specifications for air quality for atmosphere-supplying respirators, apply only in workplaces in which those types of respirator are used.

OSHA received many comments, both on written programs in general and on specific program elements. Some commenters (Exs. 54–160, 54–187, 54–238), questioned the need for a written respirator program with worksite-specific procedures. For example, Transtar Railroads (Ex. 54–160) stated that written procedures do not guarantee an effective respiratory protection program and argued that requiring additional written program elements would not cause those companies who presently disregard OSHA's existing standard to become more conscientious. Motorola (Ex. 54–187) urged OSHA to delete the requirement for a written program and instead simply to require that employers ensure that respirators are properly selected, fitted, used, and maintained as necessary to protect employees when respirators are required. However, the requirement for a written respirator program was widely supported by many other participants in the rulemaking (Exs. 54–204, 54–219, 54–304, 54–387, 54–389, 54–428, 54–435). For example, the United Automobile Workers (Ex. 54–387) agreed that a written respiratory protection program that is site-specific and detailed (for example, that includes specific procedures for determining when a cartridge or filter needs to be changed) should be required. The American Federation of Labor and Congress of Industrial Organizations (AFL–CIO) (Ex. 54–428) strongly supported the requirement for a written respiratory program and identified such a program as the fundamental core of the standard:

> The AFL–CIO strongly supports the Agency's proposal that employers who are required to use respirators or voluntarily use respirators in the workplace establish a written respiratory protection program. The written program constitutes an employer's plan for dealing with worker protection from hazardous airborne contaminants that may be present in the workplace, and as such, we view these provisions as the fundamental core of the standard. Requiring a written program is essential in providing uniformity and consistency while supplying the maximum protection for workers who use respirators in the workplace. (Ex. 54–428)

OSHA's expert witness, James Johnson of the Lawrence Livermore National Laboratory, testified that respiratory protection programs must be written because of their complexity:

> * * * A respirator program involves many decisions. What kind of respirator do I use, what kind of concentrations were measured, what kind of contaminants were in the workplace
>
> * * * So all this information is important to provide documentation and understanding so that you can make sure the program is adequate and you can make changes to it, to improve it and to have it be a dynamic operation as the workplace changes * * * (Tr. 212)

Commenting in the same vein, the National Pest Control Association (Ex. 54–435), which represents many small businesses, agreed that requiring employers to provide a written respiratory program was sensible, and the Cambrex Corporation (Ex. 54–389) noted that ''A performance approach in defining written program requirements will provide needed flexibility to employee protection programs.'' David Lee, CIH, CSP (Ex. 54–304), strongly supported the approach OSHA has taken in the final rule; he stated that a written respiratory protection program should be required in all places where respirators are used, regardless of the circumstances, and that the program's contents should be specifically tailored to conditions of use at the place of employment.

OSHA agrees with these commenters that it is appropriate to retain the previous standard's requirement for a written program, and that the program must be flexibly tailored to worksite conditions. OSHA finds that comments to the record, and the Agency's own compliance experience, strongly suggest that many employers wish to comply but are unsure about what is required; for these employers, greater clarity and guidance will enhance compliance and enable them to provide their employees with needed protection.

Paragraph (c)(1) of the final rule requires employers to update the program as necessary to reflect changes in the workplace. This requirement has been revised somewhat from the proposal. The proposed standard stated that ''[t]he written program shall reflect current workplace conditions and respirator use'' (59 FR 58939). OSHA received several comments on this provision (Exs. 54–278, 54–213, 54–249). For example, the Dow Chemical Company (Ex. 54–278) urged OSHA to revise this language to require that the program reflect only those current workplace conditions ''significantly impacting respirator use.'' In the final rule, OSHA has moved this provision to paragraph (c)(1) and revised it to require that the program be ''updated as necessary to reflect those changes in workplace conditions that affect respirator use.'' OSHA believes that this change is responsive to Dow's point. As now written, when the workplace changes in a way that may affect respirator use, such as when new processes are introduced, changes are made in the types of chemicals used, or the types of respirators being used changes, employers must revise the program as necessary to reflect these new conditions.

One of the major issues raised in the rulemaking dealt with situations in which respirator use is not specifically required by 29 CFR 1910.134 or other OSHA statutory or regulatory requirements, but instead is required by employers as a condition of employment or is permitted by employers upon the request of employees (i.e., voluntary use). The preamble discussion for proposed paragraph (a) stated that employers who required employees to use respirators would be covered by the standard (59 FR 58895). OSHA also recommended in the NPRM that employers who permit voluntary respirator use in their workplaces implement the full respiratory protection program. In the final rule, paragraph (c)(1) requires that a respiratory protection program be developed and implemented ''wherever respirators are required by the employer,'' but has greatly reduced the obligations of employers who allow their employees to use respirators when such use is not required.

In the preamble to the proposal, OSHA discussed the reasoning behind including employer-required respirator use within the scope of the standard (59 FR 58895). OSHA stated that the requirement was appropriate both because the use of a respirator could in itself present a health hazard to the wearer, and because improper use of a respirator in environments where respiratory hazards are present would not sufficiently protect employees from those hazards. OSHA finds that these are still valid reasons for requiring that a respiratory protection program be implemented where employers require respirator use. All of the elements of a respiratory protection program apply to this situation. Employers must still select respirators that are appropriate to the workplace conditions and types of respiratory hazards present to ensure that respirators offer adequate protection. Improperly selected

respirators may afford no protection at all (for example, use of a dust mask against airborne vapors), may be so uncomfortable as to be intolerable to the wearer, or may hinder vision, communication, hearing, or movement and thus pose a risk to the wearer's safety or health.

Employees who are required by their employers to wear respirators must also be medically evaluated to determine that they are capable of tolerating the increased physiological load associated with some respirator use. Proper fit testing is necessary to ensure that discomfort is minimized and that the respirator selected is offering sufficient protection. It is also necessary that respirators required by employers be cleaned, disinfected, stored, inspected, and repaired according to the procedures contained in the final rule to ensure proper respirator functioning and protection of employees from dermatitis or exposure to hazardous contaminants that may result from using a dirty respirator. Compliance with the provisions of the standard dealing with supplied air quality and use is also essential where employers require the use of supplied-air respirators. When employers require employees to use respirators, OSHA believes it necessary that employees be properly trained in their use and care, and be informed of the limitations of using respirators. Paragraph (k) of the final rule makes clear that employers must implement the employee training requirements contained in paragraph (k) if they require their employees to use respirators.

In contrast, not all of these protections are necessary in the situation where an employer allows, but does not require, respirator use. OSHA has therefore added a new paragraph (c)(2) to the final rule, which applies when employers allow employees to use respirators when such use is not required by the employer or by the standard. This paragraph applies when employers either provide respirators to employees who request them or allow employees to use their own respirators. In both situations, paragraph (c)(2)(i) states that employers must determine that the employees that they allow to use respirators are medically able to do so, and that there are no other conditions that could cause the respirator use to create a hazard.

If the employer allows voluntary respirator use, paragraph (c)(2)(i) requires that the employer provide the employee with the information contained in Appendix D to this standard, entitled ''Information for Employees Using Respirators When Not Required Under the Standard.'' In the rare case where an employee is voluntarily using other than a filtering facepiece (dust mask) respirator (paragraph (c)(2)(ii)), the employer must implement some of the elements of a respiratory protection program, e.g., the medical evaluation component of the program and, if the respirator is to be reworn, the cleaning, maintenance, and storage components. An exception to this paragraph makes clear that, where voluntary respirator use involves only filtering facepieces (dust masks), the employer is not required to implement a written program.

Paragraph (c)(2) is necessary because the use of respirators may itself present a health hazard to employees who are not medically able to wear them, who do not have adequate information to use and care for respirators properly, and who do not understand the limitations of respirators. Paragraph (c)(2) is intended to allow employers flexibility to permit employees to use respirators in situations where the employees wish to do so, without imposing the burden of implementing an entire respirator program. At the same time, it will help ensure that such use does not create an additional hazard and that employees are provided with enough information to use and care for their respirators properly. This provision does not, of course, preclude employers from adopting additional program elements if they believe such elements are appropriate.

The great majority of voluntary use situations involve the use of dust masks, i.e., filtering facepieces, which are provided for the employee's comfort. For example, some employees who have seasonal allergies may request a mask for comfort when working outdoors, or an employee may request a dust mask for use while sweeping a dusty floor. There are no medical limitations on the use of these respirators, so employers who allow their use need only ensure that the masks are not dirty or contaminated, that their use does not interfere with employees' ability to work safely, and that they provide the employees with the information contained in Appendix D, as required by paragraph (k) of the final rule.

In rare cases where the employee requests and the employer allows the use of a negative-pressure respirator (tight-fitting), or where the employee brings such a respirator into the workplace, the employer must implement some provisions of the respirator program described in paragraph (c)(1) to ensure that such respirator use will not affect the employee's health adversely. The employer can include these elements in its existing respiratory protection program, if it is required to maintain one. Some medical evaluation is necessary to determine that the employee is physically able to use a tight-fitting negative pressure respirator. In addition, if the respirators being used voluntarily are reused, it is necessary to ensure that they are maintained in proper condition to ensure that the employee is not exposed to any contaminants that may be present in the facepiece, and to prevent skin irritation and dermatitis associated with the use of a respirator that has not been cleaned or disinfected. OSHA believes it unlikely that voluntary use situations will involve the use of supplied-air devices, but such use would also trigger these requirements of the standard.

These requirements are necessary because use of a negative pressure (tight-fitting) respirator imposes a significant physiologic burden on a respirator user, and it is crucial to determine that the user can withstand that burden without suffering adverse health consequences. Similarly, reusable tight-fitting negative pressure respirators can become contaminated if they are not cleaned, maintained, and stored properly. Thus if an employer allows use of this type of respirator, the employer must implement the program elements necessary to ensure that contamination does not harm the employee.

The hazards addressed by this requirement are the same ones that are already considered under OSHA's longstanding enforcement policy. The Agency generally does not issue citations for violations of its respirator standards unless there is also evidence of overexposure to a hazardous substance, or some other hazard caused by improper or inadequate respirator use. (OSHA Field Inspection Reference Manual (FIRM), Ch. III. Sec. C.3.c). Other hazards referenced in the FIRM include ingestion of harmful substances that may remain on improperly cleaned and maintained respirators, or dermatitis caused by the same condition. These are precisely the hazards that the requirements of paragraph (c)(2) are designed to prevent. They can occur whether respirator use is voluntary or required, and OSHA does not believe it would be consistent with the OSH Act to allow employees to expose themselves to preventable hazards, particularly where there are fairly undemanding measures available to prevent that exposure.

Requiring employers to undertake these minimal obligations when they allow voluntary respirator use is

consistent with the fact that employers control the working conditions of employees and are therefore responsible for developing procedures designed to protect the health and safety of the employees. Employers routinely develop and enforce rules and requirements for employees to follow based on considerations of safety. For example, although an employer allows employees discretion in the types of clothing that may be worn on site, the employer would prohibit the wearing of loose clothing in areas where clothing could get caught in machinery, or prohibit the use of sleeveless shirts where there is a potential for skin contact with hazardous materials. Similarly, if an employer determines that improper or inappropriate respirator use presents a hazard to the wearer, OSHA finds that the employer must exert control over such respirator use and take steps to see that respirators are safely used under an appropriate program. It has been OSHA's experience that employers will be able to determine whether employees are using their own respirators in the workplace, just as they are able to determine that employees are adhering to all other procedures and requirements established by the employer.

Concomitantly, OSHA's decision to impose fewer requirements on voluntary respirator use than on required use is supported by the record. Many comments addressed the issue of how the final standard should treat these two types of respirator use. Many commenters (Exs. 54–96, 54–109, 54–196, 54–222, 54–272, 54–341, 54–424, 145, 176, Tr. 2127, Tr. 2174) supported the inclusion of employer-required respirator use, but not of voluntary use, within the full scope of the standard. Many of these rulemaking participants believed that voluntary respirator use should require a minimal program designed to provide information and training to the employee, and that other elements of the program should not be made mandatory. Typical of these was the post-hearing comment of Organization Resources Counselors, Inc. (ORC):

> OSHA should not require a complete respirator program for the voluntary use of respirators by employees, when not required by an OSHA standard, or by the employer. Some employees will wish to use respirators even though they are not required to protect against overexposure to a toxic hazard. In these instances the employer should be required only to inform the employee of the safe and proper use of such respirators and any associated limitations on the particular device chosen (Ex. 145).

In addition, some of these commenters (Exs. 54–341, 176, Tr. 594, Tr. 2100) suggested that requiring employers to comply with all or most of the requirements would discourage employers from permitting voluntary respirator use in their workplaces. For example, in its post-hearing submission, the North American Insulation Manufacturers Association (NAIMA) commented as follows:

> NAIMA agrees with many other hearing participants that employers should be required to train voluntary respirator users in the proper function and use of respirators * * * OSHA should, however, tailor other aspects of the Proposed Rule to ensure that the more onerous and unnecessary additional requirements, such as comprehensive medical examinations, are not imposed in truly voluntary use situations. Applying unnecessary ancillary requirements to voluntary use situations would discourage employers from allowing workers such use (Ex. 176).

OSHA believes that the final rule provides for the kind of tailoring suggested by NAIMA's comment. Employers who permit the voluntary use of tight-fitting negative-pressure respirators must utilize the procedures necessary to address the health hazards associated with the use of such respirators, but in the vast majority of voluntary-use situations where employees are using dust masks (filtering facepieces), the standard does not require the employer to implement a written respirator program to ensure employee health. Thus, the final rule does not require employers providing dust masks (filtering facepieces) to their employees to comply with the requirements that NAIMA considers ''onerous and unnecessary'' in this situation. However, where respirators are used voluntarily by employees, and the use of a given type of respirator, e.g., a tight-fitting negative pressure respirator, is associated with an increased health risk, OSHA finds that applying relevant portions of the respiratory protection program is essential to ensure worker protection.

Other commenters (Exs. 54–214, 54–218, 54–278, 54–389) believed that application of the standard should be limited in situations where there was no exposure to a respiratory hazard, regardless of whether respirator use is required by employers in this situation or is voluntary. In discussing this issue, the 3M Company commented as follows:

> 1. Any use of respirators or masks in the workplace should trigger a requirement for at least a minimal respiratory protection program. Regardless of whether use is required or recommended by an employer or is self-imposed by an employee, the employer should be responsible for the safe use of respirators and masks in the workplace.
>
> 2. Where it is documented by an employer that no hazard exists—such as when used against non-toxic materials, exposures well below the permissible exposure limit (PEL) or hazard level, or voluntary use against such conditions as discomfort or allergies—the rule should only require an abbreviated respiratory protection program * * *. (Ex. 54–218)

In a similar argument, the Dow Chemical Company (Ex. 54–278) suggested that employers be exempt from the standard's requirements if they require employees to use respirators as a precautionary measure where exposures are below the PELs.

OSHA did not adopt this approach in the final rule because the Agency believes that, in most cases of employer-required respirator use, respirators are being used as protection against actual or potential exposure to a respiratory hazard. In these cases, OSHA finds that it is necessary and appropriate that the employer implement all elements of the respiratory protection program that apply to the worksite-specific conditions under which respirators are used. If respirators are used as protection against a real or potential risk caused by exposure to a respiratory hazard, OSHA believes it essential for the employer to provide for proper respirator selection, fit testing, medical evaluation, and care and maintenance to ensure that the respirator is providing sufficient protection against the hazard and that use of the respirator is not imposing an additional health risk. OSHA also believes that, by distinguishing between employer-required and voluntary respirator use in the final rule, it will be easier for employers to determine the extent to which the standard will apply to their specific workplaces.

Other rulemaking participants (Exs. 54–208, 177, Tr. 782, Tr. 1722) were of the opinion that voluntary respirator use should not be distinguished from employer-required use in determining how the standard should apply, or reported that some employers already implement a program for voluntary use. The AIHA, in support of full coverage of the standard for voluntary respirator use, stated in written comment:

> The position of AIHA is that all use of respiratory protection should be covered by an employer's respiratory protection program. That includes both voluntary use as well as required use. Both groups should participate in all elements of the respiratory protection program. An individual desiring to wear a respirator to obtain some level of comfort or to further reduce their exposure to

a chemical in the workplace should receive the full benefits of an established program: training to convey proper knowledge in equipment selection, maintenance, and use; medical evaluation to confirm that its use will not present a risk to the individual; and fit testing to confirm that the equipment fits properly and workplace surveillance to confirm that the equipment being utilized is suitable for the exposure level. (Ex. 54–208)

At the public hearing, Larry Janssen of the AIHA elaborated that ''* * * there should be some kind of a minimum framework to prevent the misuse of respirators in those voluntary use situations, that you don't do harm by allowing a respirator to be used where it's not really needed'' (Tr. 782). Similarly, in a post-hearing comment, the Industrial Safety Equipment Association (ISEA) stated that it was important to cover voluntary use in the standard since ''* * * [r]espirators that are not used properly could present a hazard'' (Ex. 177). This practice is already being implemented in some workplaces; Richard Holmes of Union Carbide, representing the Chemical Manufacturers Association (CMA) at the hearings (Tr. 1722), testified that ''* * * [w]e treat the voluntary user just like a mandatory user so they're in the program just as though they were required to wear the respirator and the * * * medical surveillance is all handled the same * * * [as is the training].''

As discussed above, OSHA agrees that some voluntary respirator use (e.g., that involving tight-fitting negative-pressure respirators) may present a health hazard to employees if the respirator is not properly selected, maintained, and used. Therefore, OSHA has revised the final rule to ensure that employers who permit voluntary use of such respirators in their workplaces implement those portions of the standard necessary to protect employees from any health risks associated with respirator use. The position taken in the final rule also reflects OSHA's long-standing enforcement policy with the previous respiratory protection standard, as stated in the FIRM and in several letters of interpretation issued by the Agency (See letters dated 10/2/87 from Thomas J. Shepich, 4/11/91 from Patricia K. Clark, 3/19/91 from Patricia K. Clark, 3/4/93 from Roger A. Clark (2 letters), and 3/15/95 from Ruth McCully). For example, in the letter of March 4, 1993 from Roger A. Clark, OSHA stated its policy regarding the application of 29 CFR 1910.134 to the voluntary use of respirators:

OSHA's policy is that if the respirator itself could present an adverse health condition if a specific requirement of the respiratory protection standard is not observed, then the requirement applies. Examples may include a dirty respirator that is causing dermatitis, a worker's health being jeopardized by wearing a respirator due to an inadequately evaluated medical condition, or a significant ingestion hazard created by an improperly cleaned respirator. This is so regardless of whether the employee purchased the respirator or the employer provides it.

OSHA also has determined that complete training is not required for employees using respirators voluntarily. Instead, paragraph (k) of the final rule requires employers to provide the information contained in Appendix D to ensure that employees are informed of proper respirator use and the limitations of respirators.

Paragraphs (c)(1)(i) through (c)(1)(ix) list the elements of the respirator program required by this standard. Paragraph (c)(1)(i) requires the program to contain procedures for the selection of respirators appropriate to protect employees from the respiratory hazards present in the particular workplace. This provision is unchanged from the corresponding provision in the proposal and is also similar to paragraph (b)(2) of OSHA's previous standard. Paragraph (c)(1)(ii) addresses the medical evaluation of employees required to wear respirators and is unchanged from the parallel requirement in the proposal. The AIHA (Ex. 54–208) recommended that paragraph (c)(1)(ii), which requires employers to develop procedures addressing ''medical evaluations of employees required to wear respirators,'' be changed to specify that these procedures need only cover employees who are ''authorized by the employer to wear respirators''; the AIHA wanted this word change to ensure that employers understood that these procedures must cover both voluntary and required use. However, as explained above, OSHA has decided to require medical evaluation of employees who use respirators voluntarily only when such use may present a health hazard to employees, e.g., in the case of tight-fitting negative pressure respirators. Therefore, OSHA has not included the language suggested by the AIHA in the final rule.

Paragraph (c)(1)(iii) covers the fit test element of the program and has been modified since the proposal to respond to comments. The proposal would have required the program to contain fit testing procedures ''for air-purifying respirators and tight-fitting positive pressure respirators.'' The Service Employees International Union (Ex. 54–455) commented that this provision only needed to address ''tight-fitting respirators'' because this language adequately describes the respiratory equipment to be covered. Since OSHA has revised the fit testing requirements in paragraph (f) to cover all tight-fitting respirators, the language in paragraph (c)(1)(iii) has been revised accordingly.

Paragraph (c)(1)(iv) states that employers shall include ''Procedures for proper use of respirators in routine and reasonably foreseeable emergency situations.'' In the NPRM, this requirement was addressed under paragraph (g)(1), but it has been moved into paragraph (c)(1) of the final rule to ensure that employers are aware that written workplace-specific procedures must address both routine and non-routine respirator usage, including that in reasonably foreseeable emergency situations. OSHA received no comments on this provision.

Paragraph (c)(1)(v) requires the workplace-specific procedures to cover ''procedures and schedules for cleaning, disinfecting, storing, inspecting, repairing, discarding, and otherwise maintaining respirators.'' This provision is unchanged from that proposed. The American Iron and Steel Institute (AISI) urged OSHA to remove the word ''schedules'' from paragraph (c)(1)(iv) and to substitute the word ''frequencies'' instead. AISI stated that the term ''schedules'' connotes a requirement for extensive recordkeeping and paperwork. OSHA does not agree. Since OSHA requires the respirator program to be written, as required under the prior standard and as proposed and supported by comments in this rulemaking, it is OSHA's conclusion that including the employer's schedule for cleaning, disinfecting, or otherwise maintaining respirators is not unduly burdensome. A schedule is needed to inform employees when they are to have their respirators fit tested, cleaned, and maintained. Therefore, OSHA is retaining the word ''schedule.'' Representatives of the Service Employees International Union [(SEIU) Ex. 54–455)] strongly supported the requirement for maintenance schedules as proposed under paragraph (c)(1)(v) of the NPRM for the same reason.

Paragraph (c)(1)(vi) is essentially unchanged from the proposal and requires ''Procedures to ensure adequate air quality, quantity, and flow of breathing air for atmosphere-supplying respirators.'' Representatives from SEIU (Ex. 54–455) supported OSHA's addition of ''quantity and flow'' to paragraph (c)(1)(vi) in the NPRM. Proper air quality and quantity are crucial to the use of supplied air respirators to protect worker health. The revised provision has been slightly modified from the provision in the NPRM that

read ''* * * ensure proper air quality, quantity, and flow * * *'' for atmosphere-supplying respirators. The addition of the words ''* * * for breathing air * * *'' is to clarify that under no circumstances should air for atmosphere-supplying respirators be of less than Grade D breathing air quality.

Paragraph (c)(1)(vii), as proposed, would have required employers to include ''[t]raining of employees in the respiratory and health hazards of the hazardous chemicals to which they are potentially exposed as required under the Hazard Communication standard (29 CFR 1910.1200).'' Several commenters questioned the need to cross-reference an existing OSHA standard in the respirator standard, and recommended that this provision be deleted (Exs. 54–154, 54–271, 54–278, 54–295, 54–307). OSHA agrees that the cross-reference is unnecessary, and the reference to the Hazard Communication standard has been removed from the final standard. However, the requirement that employers develop procedures that address the ''Training of employees in the respiratory hazards to which they are potentially exposed during routine and emergency situations'' remains, because there are respiratory hazards, such as biological hazards and radioactive particles, that are not covered by the Hazard Communication standard.

Paragraph (c)(1)(viii) requires employers to develop procedures for the training of employees in the proper use of respirators, including putting on and removing them, the limitations of these devices, and maintenance procedures for respirators. OSHA received no comments on this provision, which has been revised slightly since the proposal for clarity.

Paragraph (c)(1)(ix) states that the program should include ''Procedures for regularly evaluating the effectiveness of the program.'' This provision is basically the same as in the NPRM except that the word ''periodically'' has been deleted to avoid the suggestion that OSHA has a fixed interval in mind. This provision notifies employers that their written workplace procedures must include routine evaluation of the program to ensure that it is effective, up-to-date, and includes all necessary provisions. In workplaces where worksite-specific conditions are relatively stable, such as a manufacturing site, program evaluation may be conducted on a fixed schedule. In other workplaces where worksite conditions are less stable, employers must develop schedules for evaluating the program that make sense in that context.

In a general comment, the United States Enrichment Corporation (Ex. 54–283) stated that the final rule's requirements for work procedures in paragraphs (c)(1)(i) through (c)(1)(ix) implied that OSHA intended separate documents to be developed to meet each of the requirements, and asked OSHA to clarify this. It has always been OSHA's intention that the employer can address the required program elements and the development of worksite-specific procedures in a single document, the written respiratory protection program. OSHA believes that reorganizing the elements of this program to track the order of the standard will facilitate the inclusion of all worksite-specific procedures into one document.

In another general comment, Peter Hernandez of the American Iron and Steel Institute (AISI) (Ex. 54–307) urged OSHA to revise paragraph (c) and other paragraphs of the final rule to remove the term ''ensure,'' which he interpreted as imposing an impossible burden on employers. OSHA disagrees with this interpretation, however. OSHA standards use the word ''ensure'' because they impose a mandatory requirement to comply on employers and because the OSH Act and subsequent case law have made it clear that it is the employer's responsibility to compel compliance. The reasoning behind this body of case law is that it is the employer, and not the employee, who controls the conditions of work at a given workplace. OSHA believes that the word ''ensure'' is appropriate because it indicates that the employer must manage, lead by example, train, direct, and, if necessary, set up a disciplinary system so that employees understand that they must follow safe and healthful practices on the job. However, case law also makes it clear that employers are not the ''insurers'' of their employees' behavior. In other words, if an employer establishes, implements, trains employees in, and enforces safe operating procedures, and does so in a consistent manner, the employer will not be liable for an employee's unforeseeable violation of its safety rule.

Paragraph (c)(3) of the final rule requires employers to designate a person as program administrator and to ensure that this person is qualified to perform the responsibilities of this position. The person can be qualified either by appropriate training or experience or both. The administrator is also the person responsible for evaluating the program, as stated in paragraph (c)(3). This requirement is essentially unchanged from the proposal, although its language has been clarified. The ANSI Z88.2–1992 respiratory protection standard (Ex. 81) also contains a description of the responsibilities of the program administrator and a requirement that the respirator program be ''periodically audited to ensure that (a) the program procedures reflect the requirements of current applicable regulations and industry accepted standards and (b) the program as implemented reflects the written procedures'' (See clause 5.3). The ANSI standard recommends that the audit be conducted by a knowledgeable person not directly associated with the program, rather than by the program administrator. OSHA has not adopted the ANSI recommendation that periodic audits be performed by knowledgeable outside persons because the OSHA standard requires the administrator to be qualified to perform this task; thus, an additional requirement for audits to be performed by an outside party is unnecessary and may prove unduly burdensome for some employers.

The training requirements and experience level necessary for the program administrator were the subject of substantial comment. OSHA proposed that the program supervisor be a person ''qualified by appropriate training and/or experience'' to be responsible for the respirator program. Many commenters supported this performance-based requirement (Exs. 54–68, 54–80, 54–91, 54–175, 54–187, 54–208, 54–219, 54–220, 54–222, 54–252, 54–319, 54–352, 54–361, 54–435, 54–455). For example, the Service Employees International Union (Ex. 54–455) supported the proposed ''performance-oriented qualifications for the designated person (program administrator).'' Allied Signal (Ex. 54–175) stated that ''there should be no specific minimum training for program administrators. We believe the level of training for the respirator program administrator must be adequate to deal with the complexity of the program.'' Motorola (Ex. 54–187) commented that ''Training requirements for those individuals designated by the employer to administer the program should be commensurate with the type of respirator program needed at the workplace.''

Several commenters urged OSHA to add a phrase to this requirement in the final rule to require that the level of program supervisor training must be adequate to deal with the complexity of the program because the level of training appropriate for a workplace with extensive respirator use is substantially different from one with limited respirator use (Exs. 54–175, 54–

187, 54–200, 54–206, 54–214, 54–219, 54–222, 54–245, 54–265, 54–266, 54–275, 54–361). As Monsanto (Ex. 54–219) stated:

> An employer's respirator usage may be limited to dust respirators or may have a wide variety of types covering both air-purifying and atmosphere-supplying respirators. Program administrator training/qualifications would need to cover a wider range of topics in the latter case than in the former case.

However, some commenters, e.g., the Sparks Nevada Fire Department (Ex. 54–129), wanted to avoid imposing overly stringent requirements on choosing a program administrator, while others, e.g., the Grain Elevator and Processing Society (Ex. 54–226), urged OSHA to delete the phrase ''qualified by training and/or experience'' on the grounds that there are no widely accepted criteria for determining such a program administrator's qualifications. A few commenters acknowledged that since the program administrator's tasks often vary by type of workplace, it would be difficult for OSHA to establish a required minimum level of training that would be appropriate for all program supervisors in all workplaces. Michael Rehfield, Safety Officer for the Westminster, Maryland Fire Department (Ex. 54–68) stated:

> I am in total agreement that the person fulfilling this role and the ''qualifications'' should be ''performance oriented''. That language should appear in this section. It is imperative that the emergency response community be represented by performance oriented standards or regulations since the associated tasks are so diverse.

A working group from the State Universities of New York (Ex. 54–357) felt that the performance language regarding program supervisors was too vague, and suggested that a nonmandatory appendix be added to identify the types of qualifications a program supervisor would need. The United Automobile, Aerospace & Agricultural Implement Workers of America (UAW) (Ex. 54–387) wanted OSHA to define a body of knowledge necessary to carry out the duties of a qualified program administrator.

OSHA discussed these qualifications in the preamble to the NPRM at 59 FR 58898–58899. That proposal discussion reiterated many of the points that are described above: that the level of training appropriate for a workplace with limited respirator use would be quite different from another with extensive use of different respirator types, and that the program administrator can work with a workplace respirator committee, or assign responsibility for portions of the program to industrial hygienists, safety professionals, or other respirator experts while retaining overall responsibility for the program. In other words, the level of training of the program administrator must be adequate to deal with the complexity of the respirator program.

The AFL–CIO (Exs. 54–428, 255) urged OSHA to add a new definition to paragraph (b) for qualified person as follows:

> *Qualified Person:* This should be defined as, someone who is capable of identifying existing and predictable respiratory hazards in the workplace and who maintains a common knowledge of the respirator standard. This individual should possess the authority to take prompt corrective action to eliminate hazards including the measures required in subsection (c). The qualified person shall be certified by the manufacturer(s) for their ability to select and maintain the type(s) of respirator(s) that is/are used on the job site or possess the experience and knowledge needed to properly select respirators for the employees and job situation.

Instead of adopting the AFL–CIO definition for ''qualified person,'' OSHA has relied on the type of wording used in the ANSI standard, which is more performance oriented. Specifying in detail the type and extent of training required for program administrators depends upon the type of workplace and is best left to the employer, in OSHA's opinion. For example, the level of training that would be appropriate for a workplace with limited respirator use would be quite different from that required at another workplace with extensive respirator use for IDLH atmospheres, highly toxic chemicals, or other complex respirator use operations. Therefore, OSHA has adopted a definition of training and experience that uses performance language and is similar to the ANSI Z88.2–1992 standard's requirement. However, OSHA does require employers to ensure that the level of training for the respirator program administrator is adequate to deal with the complexity of the workplace.

In keeping with this approach, OSHA has not established any one training program, such as the NIOSH respirator course, as the level of training program administrators must achieve. OSHA believes that NIOSH's course is excellent, and therefore more than sufficient in most cases. However, OSHA acknowledges commenters' concerns that a general respirator training course covers a broad range of many different respirator types and uses, and provides information that is not tailored to any one particular workplace (Exs. 54–220, 54–265, 54–342, 54–435). Typical of these comments is one by the United Parcel Service (Ex. 54–220), which stated: ''An attempt to fashion uniform standards for all administrators of all respiratory programs could result in inadequate training for administrators of particularly sophisticated or specialized programs and irrelevant training for administrators of relatively simple programs.'' The North American Insulation Manufacturers Association agreed, stating (Ex. 54–342) ''A requirement that supervisors undergo a rigid minimum training regimen, which would require instruction on many issues irrelevant to the supervisor's own situation, would be excessive and beyond the rule's intended objective.'' For example, extensive training on certain types of respirators such as SCBAs would be inappropriate for program administrators with simple programs that don't use SCBAs. In other cases, respirator program administrators with highly complex respirator programs may need an even more comprehensive course than that provided by a general respirator training course. Based on the above discussion, OSHA has retained a performance-based program approach. OSHA anticipates that larger establishments will develop training requirements for respirator program administrators that fit the needs of a workplace-specific respirator program.

OSHA has prepared a Small Entity Compliance Guide setting forth how a small business owner, manager or an employee of the small business can be qualified to be a program administrator. It also sets forth a sample respirator program to guide small businesses. If the employees of a small business are only exposed to nuisance dusts and relatively non-toxic chemicals and use only a few types of relatively simple respirators, knowledge of the guide and materials supplied by the respirator manufacturer may be sufficient for the small business owner or an employee to become qualified as a program administrator. If more dangerous chemicals or high exposures are present, or sophisticated respirators are used, the program administrator must have more knowledge or experience. In these circumstances, it may be necessary for the administrator to seek out the expertise needed or to obtain appropriate training.

The need for a specific individual to be in charge of the respirator program was discussed by several commenters. One commenter argued that requiring that a specific person be selected as program administrator requires the equivalent of a full-time person to

manage the program and conduct periodic reviews of its performance (Ex. 54–160). Motorola (Ex. 54–187) stated that one overall program administrator would be a problem for decentralized workplaces. Motorola recommended that OSHA permit a committee or multiple employees to be responsible for the respirator program, thus allowing the employer to tailor the program to meet the needs of each particular workplace. Dow (Ex. 54–278) also supported the use of a committee or team with joint responsibility for the respirator program at large sites. Duke Power (Ex. 54–326) stated that at large facilities, such as nuclear stations, it is often necessary to designate more than one program administrator to address radiological and non-radiological use of respirators. The Public Service Electric and Gas Company (Ex. 54–196) said it may be more effective to have a program administrator for each ''business unit'' in a decentralized, diversified company, particularly where each unit's respiratory protection needs are different (Ex. 54–196). The AFL–CIO (Ex. 54–428) wanted to have one qualified person responsible for the program, with a ''site person'' at each work site, who would be responsible for the program at that site, but who would report to the qualified person. The Department of Defense (Ex. 54–443), specifically the Navy, urged OSHA to add language to require that each ''activity'' designate a person responsible for the respiratory protection program because a single program administrator would be a potential problem for a large, multi-tiered employer with activities throughout the world, such as the Navy.

The final standard continues to require that a person qualified by training or experience be designated to be responsible for the overall management and administration of the program to ensure that the integrity of the respiratory protection program is maintained through the continuous oversight of one responsible individual. The program administrator may serve largely in an oversight and coordination role between the various subunits or departments that perform duties in support of the respiratory program. Regardless of the number of subunits, each employer must ensure that all subunits report to one overall program administrator for coordination of the program. The program administrator can use the assistance of industrial hygienists, safety professionals, or other respirator experts to help run the respirator program. The program administrator can work with a committee or assign responsibility for portions of the program to other personnel, but the overall responsibility for the operation of the program must remain with the designated program administrator. This approach promotes coordination of all facets of the program. For large companies or multiple worksites, the program administrator can delegate to a qualified person the responsibility for the day-to-day operation of the program at a specific site or for a specific activity. However, coordination between different worksites is an important aspect of the operation of a good program; therefore, ensuring implementation of the overall respirator program remains the duty and responsibility of the program administrator. For small and moderate sized employers, OSHA believes that the duties of a program administrator will require only a small part of one employee's time.

Paragraph (c)(4) of the final rule requires employers to provide respirators at no cost to the employee. This was included in the proposal in paragraph (d)(1) and has been moved to paragraph (c) of this final standard. This provision reflects OSHA's strong orientation that the costs of complying with safety and health requirements must be borne by the employer. OSHA has a long-standing policy that employers are obligated to provide and pay for necessary personal protective equipment (PPE) such as respirators used by employees on the job. A compliance memorandum of October 18, 1994, titled ''Employer Obligation to Pay for Personal Protective Equipment'' provides detailed guidance on this issue. It is available online on the Internet on OSHA's home page at http://www.OSHA.gov. The inclusion of this provision is consistent with recent OSHA standards, e.g., Cadmium, 29 CFR § 1910.1027; 1,3-Butadiene, 29 CFR 1910.1051; and Methylene Chloride, 29 CFR 1910.1052.

OSHA is aware that the Occupational Safety and Health Review Commission has not always agreed with the Agency that standards requiring an employer to ''provide'' safety or health equipment also require the employer to pay for that equipment. See, e.g., *Union Tank Car Co.*, OSHRC No. 96–0563 (October 16, 1997). OSHA believes the Commission is wrong about this issue. OSHA intends the language ''at no cost to the employee'' in paragraph (c)(4) to make the employer's obligation to pay for the respiratory protection required by this standard crystal clear.

The requirement that the employer bear the costs of employee training and medical evaluations has also been moved to paragraph (c)(4) of the final rule, in order to consolidate all similar provisions of the standard that clarify that, for these provisions, there is no cost to the employee. Section 6(b)(7) of the OSH Act requires that employers provide medical exams and evaluations at no cost to employees.

Paragraph (d)—Selection of Respirators

Overview

Paragraph (d) of the final rule contains respirator selection criteria and requirements. OSHA has included these provisions in the final rule because the record contains many examples of workers using respirators that are inappropriate for the type of respiratory hazards present (e.g., wearing paper dust masks where the exposure is to a gas or vapor contaminant (UAW, Ex. 54–387); using half facepiece respirators in acrylonitrile IDLH atmospheres of 20 ppm (International Chemical Workers Union (ICWU), Ex. 54–427)). In addition, OSHA's long enforcement experience has shown that employers often lack the information necessary to make informed choices about respirator selection. OSHA stated in the proposal (59 FR 58899) that a major deficiency of the previous standard is that it did not contain selection criteria; instead, it merely referred employers to the ANSI Z88.2–1969 standard.

No participant in this rulemaking disagreed with OSHA's decision that the final standard should include mandatory selection criteria. The record does show, however, that there are differences of opinion about how restrictive and comprehensive the required criteria should be, and how much flexibility should be left to employers in the selection process. For example, the Association of American Railroads (Ex. 54–286) stated that the details of respirator selection should be left to the regulated community and that OSHA should only specify the outcome desired, while the Service Employees International Union (SEIU) (Ex. 54–455) commented that OSHA should ''strengthen the wording to make it clear employers must obtain and account for all of the factors listed.'' OSHA believes that those employers who employ on-site occupational health professionals generally have the expertise to select respirators that are appropriate for their workers. The record contains a number of examples of well-thought-out selection programs (e.g., Exs. 142, 155, 163). These examples show that the current practice of many employers already conforms to the selection requirements of paragraph (d). For other employers, however, clearly stated

respirator selection rules and guidance are required.

OSHA notes that advice on the selection of respirators is available from many sources. NIOSH has developed a respirator decision logic, widely available and used since 1987, which provides a schematic selection guide covering all critical areas of respirator selection (Ex. 9). The selection guide for the ANSI Z88.2–1969 respirator standard was incorporated by reference into the previous OSHA standard, and the 1992 Z88.2 ANSI standard contains updated and comprehensive recommendations on respirator selection. OSHA believes that employers will find useful information in each of these guides on various technical problems that this standard may not cover explicitly. In addition, information is provided by respirator manufacturers who publish selection guides relating to their models (See, e.g., Mine Safety Appliances Company (MSA) Respirator Selection Guide, Ex. 150; and ISEA's Respirator Buyers Guide and Safety Video Resource List, referenced in Ex. 147). Manufacturers also provide selection advice through telephone help lines, sales staff, verbal communications or distribution of company product information, and on-site evaluations of product use (See, e.g., Tr. at 1438–1439). Chemical manufacturers also provide information about respirator selection to help the purchasers of their products (See CMA, Tr. 1726–7; Union Carbide Corporation, Ex. 54–255).

Because of the variety and detail of selection information available, OSHA believes it is necessary in the final rule to specify broad performance criteria, in addition to a few specific rules relating to highly hazardous operations (i.e., IDLH situations). The final rule sets forth general rules for selecting respirators for routine operations, prescribes specific kinds of respirators for identified highly hazardous atmospheres and emergency situations, and specifies when air-purifying respirators can reliably be used. OSHA chose not to specify in the regulatory text all the situations and respirator-related factors that an employer should consider but instead to state performance objectives. Only for workplace situations widely accepted as highly hazardous, such as those associated with IDLH atmospheres, does the standard require maximally protective respirators.

Because paragraph (d) does not address in detail all the relevant factors that may affect employers' selection of particular respirators, employers should rely on other information sources to ensure that the respirators they select are appropriate for conditions in their specific workplaces. Respirator manufacturers are the source of much useful information, and the record of this rulemaking indicates that much of this information is both helpful and reliable. Indeed, market mechanisms work to encourage the dissemination of accurate information. OSHA expects that smaller employers will thus generally be able to rely on the technical assistance provided by manufacturers on respirator selection and that doing so will mean that they will usually be in compliance with this standard. For these reasons, paragraph (d) concentrates on the minimum selection criteria that the record shows must be adhered to by all employers when selecting respirators for their employees' use.

In the following provision-by-provision summary and explanation, OSHA explains the changes reflected in the final rule, both from the provisions proposed and those in the Agency's previous respiratory protection standard (§ 1910.134).

Paragraph (d)(1)—General Requirements

Paragraph (d)(1) prescribes general rules that apply to the selection of all respirators. Paragraph (d)(1)(i) requires the employer to select and provide an appropriate respirator based on the respiratory hazard(s) to which the worker is or will be exposed and on the workplace and user factors that have the potential to affect respirator performance and reliability. This provision continues a requirement from the previous standard: (''respirators shall be selected on the basis of hazards to which the worker is exposed'' (§ 1910.134(b)(2)) and clarifies that the hazard must be viewed in the context of the workplace and worker conditions that may reduce or impair the effectiveness of a respirator otherwise appropriate for the hazard. There is general agreement that taking working conditions into account is crucial to proper respirator selection: a respirator that is protective under some conditions of wear will fail under others, while a respirator that is appropriate for a given hazard may not be workable in a particular workplace (e.g., an air supplied respirator in a tightly configured space). For example, a worker wearing SCBA who is required to perform extremely heavy work may deplete the air supply of the respirator well before its calculated service life is reached. This means that the employer must evaluate the employee's level of exertion in order to determine whether to choose a supplied-air respirator rather than a SCBA. The recent ANSI standard also states that the purpose of respirator selection is to determine which respirator type or class will offer ''adequate protection'' (ANSI Z88.2–1992).

Final paragraph (d)(1)(i) also requires employers to consider workplace and user factors that may affect the respirator's performance and reliability when making a respirator selection. Although other paragraphs of the standard address the major factors affecting respirator performance, i.e., fit, faceseal leakage, and maintenance and cleaning, factors specific to the job, user, or worksite often play an important role in respirator performance. OSHA noted in the proposal (59 FR 58900) that work activities and factors such as temperature and humidity ''also affect the stress level associated with wearing a respirator as well as the effectiveness of respirator filters and cartridges; employees using respirators for longer periods of time [under such stressful conditions] may need different types of respirators for more comfortable wear.''

Similarly, where the respirator-wearing employee must communicate with other workers, perhaps to warn them about the presence of workplace hazards, the respirator must allow the employee to perform this vital function. OSHA thus agrees with ANSI that ''it is important to ensure that respirator wearers can comfortably communicate when necessary, because a worker who is speaking very loudly or yelling may cause a facepiece seal leak, and the worker may be tempted to temporarily dislodge the device to communicate'' (ANSI Z88.2–1992, clause A.13). Therefore, for example, the employer must ensure that speaking will not interfere with the fit of the negative-pressure elastomeric respirator selected. If the employees are using PAPRs or SCBA, amplification devices, including speaking diaphragms and microphones, that can be worn with the respirators are available.

The proposal (59 FR 58900) noted another example in the proposal of worksite conditions that could affect respirator selection: ''* * * airline respirators should not be used by mobile employees around moving machinery unless entanglement of airlines in equipment is easily avoided.'' Employers have always been required by OSHA to consider such factors as these, because paragraph (a)(2) of the previous respirator standard required employers to select respirators that are ''applicable and suitable for the purpose intended.''

Paragraph (d)(1)(i) applies whenever employers provide respirators to their

employees and require their use, whether or not an OSHA standard mandates respirator use in the particular environment. The preamble discussion relating to paragraph (c)(1) discusses employer-required respirator use in more detail and explains OSHA's reasons for reaching this conclusion.

Paragraph (d)(1)(ii) requires the employer to select a NIOSH-certified respirator and to use the respirator only in ways that comply with the conditions of its certification. There was little controversy about this requirement, and there is no disagreement that respirators must be tested and found to be effective before they can be marketed. NIOSH has performed this function in the past and has begun to revise its certification requirements to ensure that its procedures continue to define the performance capabilities of acceptable respirator models, and to identify unacceptable models. The ISEA (Ex. 65–363), the trade association that represents most major respirator manufacturers, urged OSHA to require that only NIOSH-certified respirators be used to comply with this standard, and other commenters agreed (Exs. 54–187, 54–213, 54–387, 54–428).

The wording of this provision of the final rule differs slightly from that of the proposed provision. The proposal would have required that only NIOSH ''approved and certified'' respirators be selected. For clarity, the reference to NIOSH-approved respirators has been replaced in the final rule by a requirement that respirators be used only in accordance with the conditions of their certification. NIOSH approves respirators by certifying them; however, some certifications contain conditions limiting the situations in which the respirator may be used. This is sometimes described as NIOSH ''approval'' of the respirator for a particular use.

Increasingly, however, NIOSH does not certify respirators for specific uses. For example, NIOSH does not currently certify respirators for use against biological hazards. Where NIOSH has not specifically certified any respirator for use against the particular contaminant present in the workplace, the employer must select a NIOSH-certified respirator that has no limitation prohibiting its use against that contaminant. The respirator must be appropriate for the contaminant's physical form and chemical state and the conditions under which it will be used. All respirators must be chosen and used according to the limitations of the NIOSH certification, which appears on the NIOSH certification label.

The requirement for NIOSH certification is unconditional in the final standard, as it was in the proposal. However, because OSHA stated in the proposed preamble that this requirement would apply only when such respirators ''exist'' (59 FR 58901), some commenters urged OSHA to state in the regulatory text that the requirement for NIOSH certification applied only to existing certifications (See, e.g., Ex. 54–434). For example, the Department of the Army (Ex. 54–443) urged OSHA to permit the use of respirators not approved by NIOSH in situations where another authority has jurisdiction and the documentation to attest to the adequacy of the respirator's effectiveness against the contaminant of concern. The Army (Ex. 54–443D) stated that its employees and contractors may be exposed to certain ''military unique contaminants'' for which no NIOSH-approved respirator exists but for which military respirators, e.g., gas masks, have specifically been developed and tested and are being used by civilian and contractor personnel in operations subject to OSHA's jurisdiction. The Army urged OSHA to include in the standard ''approval authority of the Secretary of the Army for military respirators * * * for which no NIOSH approved respirator exists'' (Ex. 54–443D).

OSHA recognizes that there are unique contaminant situations, such as those involving chemical warfare agents, that involve primarily military exposure and that may require specialized respiratory protection equipment. NIOSH certification for respiratory protection specific to such hazards does not exist and is not likely to be forthcoming. OSHA also notes, however, that, although the Department of the Army argued strongly for OSHA recognition of Army authority to test and approve respirators, the Department of the Air Force commented that it uses only NIOSH-certified respirators, and requested no exception (Ex. 54–443A). OSHA will examine on a case-by-case basis those situations involving civilian contractors whose employees wear non-NIOSH tested respirators that they believe protect employees adequately and that have been tested and approved by other Federal agencies for use against unique contaminants.

A similar comment was raised by DOE regarding radioactive hazards (Ex. 54–215). DOE stated that, in the nuclear industry, no NIOSH-certified respirator exists for tritium applications and workers therefore must wear non-approved supplied-air suits; this equipment has been tested by Los Alamos National Laboratory, and the suits have been successfully used for many years. The DOE administers its own job-by-job approval system for these suits. OSHA's authority to enforce the Agency's safety and health standards at gaseous diffusion plants owned by DOE and leased to the United States Enrichment Corporation was established legislatively in 1992, and OSHA has recently completed a memorandum of understanding with DOE on this issue (60 FR 9949, Jan. 31, 1995). OSHA is currently evaluating an application from one of these facilities for a variance relating to these suits. The criteria set out in Section 6(d) of the OSH Act will govern this determination. OSHA is not determining the acceptability of supplied-air suits as part of this rulemaking proceeding, because the Agency believes the variance proceeding, which can focus closer attention on the strengths and limitations of these suits for the particular use situations, is the appropriate forum to decide this issue.

OSHA notes that NIOSH certification is a minimum qualification. The employer must still assess whether the respirator meets all other selection criteria in this standard before it can be chosen for a particular application. For example, as pointed out by an exchange with Richard Duffy of the International Association of Fire Fighters (IAFF), NIOSH representatives acknowledged that the employer must evaluate whether NIOSH-certified equipment will withstand the specific environmental conditions for firefighting because NIOSH flow rate requirements do not consider the stresses involved in firefighting, nor does NIOSH currently evaluate respirators for their ability to withstand those stresses (Tr. 364–365).

In his testimony at the OSHA hearings, Richard Duffy of the IAFF recommended that OSHA require that SCBAs used in firefighting meet the requirements of the National Fire Protection Association's NFPA–1981 Standard on Open Circuit Breathing Apparatus (Tr. 455). This NFPA standard establishes more stringent performance criteria for SCBAs used in firefighting than those currently used by NIOSH. NIOSH recognizes that its current 42 CFR 84 respirator certification standards may not be protective enough for respirators used in firefighting. In an October 7, 1997 letter to all manufacturers and interested parties, NIOSH announced its intent to develop new technical modules to update 42 CFR 84. One of the proposed technical modules to which NIOSH intends to give priority treatment will address SCBAs, including the

incorporation of NFPA performance requirements for SCBAs. NIOSH also intends to propose an Administrative/Quality Assurance module on the use of independent testing laboratories in the certification program, another issue raised by commenters in this proceeding. OSHA believes that NIOSH will resolve any deficiencies in its current respirator certification standards through these new 42 CFR 84 rulemaking modules. OSHA simply is not equipped to take on the respirator approval and certification process currently performed by NIOSH. Therefore, the final OSHA respirator standard continues to require the use of NIOSH-certified respirators and does not incorporate the NFPA performance requirements for SCBAs.

OSHA believes that carving out even limited exceptions to NIOSH control of respirator certification authority would confuse the regulated community and would not resolve the needs of the vast majority of respirator users. Comments by respirator users and worker representatives support OSHA's final decision (See, e.g., Exs. 54–265, 54–118, 54–213, 54–387, 54–455). The final rule, in paragraph (h), also requires that when respirator parts are replaced or changed, the replacement parts must be NIOSH certified.

In the proposal (59 FR 58901), OSHA stated that developing an OSHA respirator approval mechanism to fill in the gaps in NIOSH certification would not be an efficient use of government resources. Nonetheless, the Agency asked for comment on this issue. There was no consensus among the participants who commented on this point. Some commenters supported an OSHA role in approval on a temporary basis, while an employer waits for NIOSH approval, or an alternative governmental approval process (Exs. 54–213, 54–346, 54–443). Still others opposed OSHA's involvement in an approval process (Exs. 54–278, 54–265, 54–118, 54–213, 54–387, 54–455). The final rule is therefore similar to the proposal, which also discussed limited alternatives to NIOSH certification and concluded that ''it is inappropriate for OSHA to try to correct problems with present NIOSH/MSHA regulations in the revised respirator standard'' (59 FR 58891).

OSHA believes that NIOSH has focused on closing any gaps in its certification program. NIOSH's ability and experience in this area are unparalleled, and OSHA believes that NIOSH can best resolve any concerns through its own proceedings. Further, as stated in the proposal, OSHA lacks the resources to perform respirator testing. OSHA will, however, continue to evaluate, on a case-by-case basis, whether variance or compliance interpretations are appropriate in cases where employers claim that there are no NIOSH-certified respirators for use in a particular situation.

Paragraph (d)(1)(iii) of the final rule requires the employer to identify and evaluate the respiratory hazard(s) in the workplace. To perform this evaluation, the employer must make a ''reasonable estimate'' of the employee exposures anticipated to occur as a result of those hazards, including those likely to be encountered in reasonably foreseeable emergency situations, and must also identify the physical state and chemical form of such contaminant(s). Where conditions are such that the employer cannot carry out such an evaluation, e.g., where exposure monitoring or other means of estimation cannot be used, paragraph (d)(1)(iii) requires the employer to treat the atmosphere as IDLH. Many of the components of paragraph (d)(1)(iii) of the final standard have been required practice since 1971 because they were included in the selection provisions of the 1969 ANSI standard incorporated by reference into OSHA's previous respiratory protection standard. Paragraph (d)(1)(iii) of the new standard makes these provisions clearer by stating them explicitly in the regulatory text.

Identifying and evaluating the hazards a respirator is to provide protection against clearly play a pivotal role in respirator selection. For example, according to ANSI, ''Respirator selection involves reviewing each operation to * * * determine what hazards may be present (hazard determination)'' (ANSI Z88.2–1992, clause 7.2.2; See also AISI, Tr. 639). Many other commenters emphasized the important role of hazard identification in respirator selection (Exs. 54–168, 54–181, 54–186, 54–208, 54–234, 54–273, 54–307, 54–327, 54–346, 54–426, 54–428). Once an employer identifies the nature of the respiratory hazard or hazards present, the employer must evaluate the magnitude of the hazard to determine the potential exposure of each employee and the extent to which respirators of various types can reduce the harm caused by that exposure.

There was extensive comment on the selection process outlined in the proposed paragraph dealing with hazard evaluation (Exs. 54–154, 54–168, 54–181, 54–202, 54–219, 54–245, 54–278, 54–428). Commenters representing workers generally supported the detailed approach taken in the proposal toward hazard evaluation. For example, the Service Employees International Union ''support[ed] the detailed list of factors to be considered in respirator selection * * * [which] successfully incorporates the important framework from the NIOSH decision logic criteria in an easy-to-understand form'' (Ex. 54–428).

Some commenters, however (Exs. 54–154, 54–168, 54–181, 54–219, 54–245, 54–278), stated that the scope and depth of the hazard evaluation and the items to be covered should be left to the discretion of the employer. For example, the Eastman Chemical Company (Ex. 54–245) and the Dow Chemical Company (Ex. 54–278) requested that OSHA make the requirement ''performance oriented'' and ''flexible''; the Department of the Navy, Portsmouth Naval Shipyard (Ex. 54–154), noted that detailed analysis for each work situation is not necessary for shipbuilding, and that the timing and content of an appropriate evaluation vary.

In response to these comments, OSHA has revised paragraph (d)(1)(iii) to be more performance oriented; this provision of the final standard no longer specifies precisely how employers are to conduct the required evaluation. The proposal (at paragraph (d)(3)) would have required employers to ''obtain and evaluate'' information on eleven specific factors for each work situation. These proposed factors were the nature of the hazard; its physical and chemical properties; its adverse health effects; the occupational exposure level; the results of workplace sampling; the work operation; the time period of respirator wear; the work activities and stresses on the wearer; fit test results; warning properties; and the capabilities and limitations of respirator types. Although OSHA continues to believe that each of these factors is relevant to respirator selection under some circumstances, a review of the record has convinced OSHA that each factor is not crucial in every respirator selection process and that the proposed requirement would have led to needless duplication of effort and unnecessarily detailed evaluations.

The Oil, Chemical and Atomic Workers International Union (OCAW) (Ex. 54–202) urged OSHA to require a written hazard assessment each time that a respirator was selected. Paragraph (d)(1)(iii) of the final rule does not require a written assessment; this was not proposed, and OSHA believes that employers should be free to adopt the best approach for justifying their respirator selections, based on the hazard assessment. The final rule requires the employer to identify and evaluate the respiratory hazards present, determine their physical state and

chemical form (e.g., whether they are present in the form of a gas or vapor; what their valence state or condition is, where relevant), and assess the magnitude of the hazard they present to workers under normal conditions of use and in reasonably foreseeable emergency conditions.

OSHA finds that it is essential for employers to characterize the nature and magnitude of employee exposures to respiratory hazards before selecting respiratory protection equipment. The language contained in paragraph (d)(1)(iii) of the final rule does not specify how the employer is to make reasonable estimates of employee exposures for the purposes of selecting respirators, nor does the standard require the employer to measure worker exposures to airborne hazards. OSHA has always considered personal exposure monitoring the ''gold standard'' for determining employee exposures because this is the most reliable approach for assessing how much and what type of respiratory protection is required in a given circumstance. This general view is also shared by the industrial hygiene community. All of OSHA's comprehensive substance-specific health standards have required employee exposure monitoring to determine both the effectiveness of existing control measures and the type of respiratory protection needed.

OSHA continues to hold this view with regard to assessing employee exposure in connection with this respiratory protection standard. However, OSHA recognizes that there are many instances in which it may not be possible or necessary to take personal exposure measurements to determine whether respiratory protection is needed. Although sampling and analytical methods exist for the vast majority of substances for which OSHA has a PEL (29 CFR 1910.1000), there are numerous other substances for which there are no readily available methods for personal sampling. In other cases, the nature of the materials and products being used in the workplace, and the way in which they are used, make it highly unlikely that an employee working with them would be exposed in a manner that would make respiratory protection necessary. In these kinds of situations, the final rule permits employers to use other approaches for estimating worker exposures to respiratory hazards.

For example, employers may rely on information and data that indicate that use or handling of a product or material cannot, under worst-case conditions, release concentrations of a respiratory hazard above a level that would trigger the need for respirator use or require use of a more protective respirator. This approach is similar to that used in several OSHA substance-specific health standards, which permit employers to use objective data in lieu of exposure monitoring to demonstrate that their employees cannot be exposed above an action level (See, for example, 29 CFR 1910.1027, Cadmium; 1910.1048, Formaldehyde; 1910.1047, Ethylene Oxide; 1910.1028, Benzene). Objective data can be obtained from an industry study or from laboratory test results conducted by manufacturers of products or materials being used in the workplace. To generalize from data in an industry-wide survey to conditions in a specific workplace, the survey must have obtained data under conditions closely resembling the processes, types of materials, control methods, work practices, and environmental conditions in the workplace to which it will be generalized, i.e., the employer's operation.

Data from industry-wide surveys by trade associations for use by their members, as well as from stewardship programs operated by manufacturers for their customers, are often useful in assisting employers, particularly small-business owners, to obtain information on employee exposures in their workplaces. For example, representatives of the North American Insulation Manufacturer's Association (NAIMA) testified (Tr. 597) that * * * ''[w]e have conducted numerous surveys on end use customers, conducted research with Johns Hopkins University, for example to provide estimates of routine exposures and * * * those data, when collected appropriately and with organized labor and with other industry groups, * * * can assure that the right respirator is selected.'' NAIMA stated (Tr. 616, 618), ''it is ultimately the employer's responsibility'' to evaluate whether data provided by suppliers or others relate to their workplace conditions and operations. However, it is clear that such programs can often assist employers to estimate workplace exposures reliably enough to make correct respirator choices without the need for employee monitoring.

Another approach that can be used by employers to estimate employee exposures involves using mathematical approaches and obtainable information. Employers can use data on the physical and chemical properties of air contaminants, combined with information on room dimensions, air exchange rates, contaminant release rates, and other pertinent data, including exposure patterns and work practices, to estimate the maximum exposure that could be anticipated in the workplace. Methods that utilize this approach are readily available in several textbook sources; for example, the ACGIH Industrial Ventilation Manual contains calculations that can be applied to certain situations to estimate worker exposures. Relying on such an approach to estimate exposures requires the use of safety factors to account for uneven dispersion of the contaminant in the air and the proximity of the worker to the emission source. Usually, this approach works best in situations where employees use small amounts of a chemical product intermittently, or where contaminant releases are fairly constant and predictable. This approach must be used continuously, and the data obtained should therefore be interpreted conservatively (i.e., should err on the side of worker protection).

In workplaces involving many complex factors, the use of estimation techniques to characterize worker exposure is associated with a high degree of uncertainty. In these instances, OSHA recommends that employers conduct exposure monitoring instead of relying on estimation techniques because they will then be able to have confidence that the appropriate respiratory protection device has been selected and that they are in compliance with the standard. Furthermore, OSHA believes that in workplaces where many complex factors add uncertainty to exposure estimates obtained through modeling, employers will find it easier and less costly to conduct personal exposure monitoring to evaluate the need for respiratory protection.

Many commenters urged OSHA not to specifically require monitoring in the standard because other means of assessing potential exposures are available (Exs. 54–153, 54–208, 54–219, 54–237, 54–273, 54–307, 54–327, 54–443). These participants asked the Agency instead to adopt the approach taken in the ANSI standard Z88.2–1992, clause 7.2.2.1(e), which allows employers to estimate, as well as measure, exposures in the workplace. One commenter questioned the utility of exposure monitoring data for respirator selection because exposure sampling provides only a ''snapshot'' of hazards on any given day (Ex. 54–178). Other commenters disagreed, however. For example, Scott Schneider (Tr. 1520) of the AFL–CIO stated, ''In most workplaces that I've been in there really is very, very little exposure data to know how much a person is exposed to * * * exposures are quite variable from

day to day. And from worker to worker.'' (See comments to same effect by OCAW, Ex. 54–202.) Some participants specifically asked OSHA to make workplace sampling of airborne concentrations of contaminants explicit (Tr. 1009 and Ex. 54–428; Ex. 54–427).

That some exposure monitoring results may be inadequate begs the question of whether adequate monitoring should be conducted. OSHA's experience in enforcing permissible exposure limits in the Air Contaminant standard, 29 CFR 1910.1000, and for substance-specific standards, confirms that, unless operations are highly repetitive, conditions are constant, and estimates based on ''historical'' and ''objective data'' are made by experienced industrial hygiene professionals, most employers need exposure monitoring results to estimate employee exposure levels reliably. OSHA enforcement experience also demonstrates that, where exposures are highly variable, fragmentary monitoring results may mislead employees and employers, unless they are based on competent sampling strategies. The frequency and duration of monitoring, the representativeness of the employees and operations sampled, and the skill with which sampling and analysis are performed all influence the reliability of monitoring results. In making reasonable estimates of employee exposures to satisfy the requirements contained in paragraph (d)(1)(iii), OSHA expects employers to account for potential variation in exposure and to rely on data or information that reflect such variation. This is accomplished by using exposure data collected with a strategy that recognizes exposure variability, or by using worst-case assumptions and estimation techniques to evaluate the highest foreseeable levels to which employees may be exposed. The hazard assessment requirements in final paragraph (d)(1)(iii) carry over from the requirement of the previous standard, which incorporates by reference the ANSI Z88.2–1969 (clause 6.2) statement that ''[a]ny erring in the selection of respirators shall be on the safe side.''

Paragraph (d)(1)(iii) also requires an employer to consider the environment IDLH if employee exposures cannot be estimated reasonably. This provision is intended to address those limited situations where neither exposure monitoring, professional judgment, nor estimation techniques can be relied on to reliably select adequate respiratory protection equipment. This provision reflects a similar one in the 1992 ANSI standard, which requires atmospheres to be considered IDLH if it is not possible ''to determine what potentially hazardous contaminants may be present * * * or if no exposure limit or guideline is available, and estimates of toxicity cannot be made'' (ANSI Z88.2–1992, clause 7.2.2.2 (b)(c)).

Several commenters (Exs. 54–381, 54–352, 54–267) objected to OSHA's proposed requirement that atmospheres be considered IDLH ''where the concentration of the hazardous chemical is unknown'' (59 FR 58939), and stated that it would be neither practical nor necessary to wear positive pressure respirators in all such situations (Ex. 54–352). One commenter believed that requiring the most protective respirators for ''every unknown hazardous chemical atmosphere'' would result in 95 percent of the workforce being required to use them (Ex. 54–267). OSHA did not intend the absence of workplace-specific exposure measurements automatically to trigger selection of the most protective respirator; instead, the Agency intends employers to use such equipment when they do not have confidence that a less protective respirator is sufficient. An example of the kind of situation that should trigger the use of the most protective respirator was provided by a representative of CMA, who testified (Tr. at 1707) that, when a maintenance person opens a closed cycle manufacturing process to work on it for the first time, ''we don't know what the air concentration is so we put people in supplied-air respiratory protection under those circumstances.'' That is, the company in this case assumes that exposures will be extremely high and selects a respirator accordingly. OSHA believes that the language used in paragraph (d)(1)(iii) of the final rule makes OSHA's intent clear, i.e., that when reliable data or reasonable estimates of exposure are not available, the atmosphere must be considered IDLH.

Finally, a few participants suggested that exposure estimates should only be made by credentialed individuals (See, e.g., Ex. 54–327). OSHA agrees that persons trained and experienced in evaluating the respiratory hazards posed by workplace atmospheres are the most competent to evaluate exposure levels, especially in the absence of current exposure measurements. ANSI defines an ''occupational health professional'' as ''(a)n individual whom, by experience and education, is competent at recognizing, evaluating, and controlling health hazards in the workplace'' (ANSI Z88.2–1992, clause 3.39). This is the person who is responsible for performing expert evaluations under ANSI's recommended standard. OSHA believes that this definition has merit, and that employers whose workplaces have highly toxic respiratory hazards, or many different hazardous chemicals or mixtures, as well as other employers with the resources to do so, should utilize such professionals wherever possible. However, OSHA is not specifically including this requirement in the final rule because reasonable estimations can be conducted in many workplaces by persons with the qualifications required in the final rule for the respiratory protection program administrator.

Paragraph (d)(1)(iv) requires that the employer choose respirators from a sufficient number of respirator models and sizes so that the respirator is acceptable to and correctly fits the wearer. The 1992 ANSI standard includes a similar requirement aimed at achieving satisfactory fit and wearer acceptance (Z88.2–1992, clause 9.3.1. and 9.3.2.). This provision of the final standard revises the corresponding proposed provision, which would have required employers to provide for fit testing an array of three sizes and two brands of respirators with elastomeric facepieces. The dual intent of this provision was to assure that wearer acceptability plays a role in respirator selection, and that the respirators chosen maintain their fit over the period of use.

OSHA continues to believe that these goals for respirator selection are appropriate. However, OSHA was persuaded by this record that specifying the number of sizes, models and brands that an employer must provide is unnecessary. Therefore, the final provision deletes the specification language for the number of sizes, models and brands that must constitute the selection pool. Since this provision of the final standard applies to all respirators, the proposal's application only to ''elastomeric'' facepieces has been dropped.

Most participants (Exs. 54–1, 54–5, 54–75, 54–80, 54–91, 54–161, 54–208, 54–214, 54–237, 54–238, 54–246, 54–263, 54–273, 54–280, 54–291, 54–287, 54–350, 54–363, 54–389) endorsed the inclusion in the final rule of a performance-based provision addressing the selection of comfortably fitting respirators. Thus, most comment on this issue recognized that a sufficient assortment of respirators must be provided so that employees will obtain acceptable fits, but that more flexibility should be provided in the final rule. Commenters also stated that, in some cases, a single manufacturer has a variety of respirator models sufficient to

Final paragraph (h)(3)(i)(A) requires respirators for use in non-emergency situations to be inspected before each use and during cleaning. For respirators designated for use in an emergency situation, final paragraph (h)(3)(i)(B) requires that they be inspected at least monthly and in accordance with the manufacturer's instruction. In addition, emergency respirators must be examined to ensure that they are working properly before and after each use. Examining respirator performance before and after each use is not intended to be as extensive and thorough a process as respirator inspection. A basic examination conducted prior to each use will provide assurance to the wearer that the respirator which he/she is about to don in an emergency situation will work properly, e.g., that the cylinders on the SCBA are charged, that air is available and flowing. This examination can be done fairly quickly, and OSHA believes that this added measure of employee protection is both necessary and appropriate.

Respirators used for escape only are to be inspected prior to being carried into the workplace (paragraph (h)(3)(i)(C)). The Dow Chemical Company (Ex. 54–278) addressed the inspection of emergency escape respirators, stating, ''Emergency escape respirators such as mouthbit respirators, usually stored in the box or bag they come in, do not need to be inspected monthly.'' OSHA agrees with this statement. Mouthbit or other emergency escape respirators are carried by an individual worker into the workplace for personal use in an emergency, and must be inspected for proper condition prior to being carried into the workplace. Additional monthly inspections of emergency escape respirators that are stored for future use are unnecessary, since they will be inspected prior to being carried into the workplace. Final paragraph (h)(3)(i)(C) therefore specifies that ''escape-only'' respirators need only be inspected before being carried into the workplace.

Although no commenters were opposed to the inspection requirements, some participants raised the issues that are discussed below with respect to inspection frequency and procedures. When respirators are inspected, the final rule (paragraph (h)(3)(ii)(A)) requires that the inspection include an examination to ensure that respirators are working properly, including an examination of the tightness of connections and the condition of the various components. Two comments were made with respect to respirator inspection procedures. John Clarke of Electronic and Information Technologies (Ex. 54–162) stated that checking for proper function (examination to ensure that respirators work properly) presents a dilemma if use is to include sanitizing the facepiece. He pointed out that SCBAs reserved for use by multiple persons presents a special problem. Likewise, John O'Green of American Electric Power (Ex. 54–181) asked that ''functional check'' be better defined and clarified. He stated that requiring the actual activation of the respirator, including the flow of air to the facepiece, could be time consuming for all the emergency respirators in their facilities. OSHA does not intend that the respirator be physically placed on the employee to examine the respirator to ensure that it is working properly. Visual inspection can detect factors that would interfere with proper performance, e.g., distortion in shape (often the result of improper storage), missing or loose components, blockage, and improper connections. Alarms can also be examined without actually putting the respirator on the employee. In addition, examining elastomer parts for pliability and signs of deterioration, as required by final paragraph (h)(3)(ii)(B), can be performed without wearing the respirator.

Under paragraph (h)(3)(iii) of the final rule, SCBAs must be inspected monthly. The employer must ensure that the cylinders are fully charged. Recharging is required when the pressure falls below 90 percent of the manufacturer's recommended pressure level. The Westminster, Maryland Fire Department (Ex. 54–68) strongly recommended that the apparatus be inspected at the beginning of each shift or workday rather than monthly. OSHA notes that the final rule specifies only the minimum requirements for an effective respiratory protection program. Employers, however, are encouraged to exceed these minimum criteria if, by doing so, employee protection and operating efficiency are enhanced.

The final provision for recharging air and oxygen cylinders for SCBAs in paragraph (h)(3)(iii) is unchanged from proposed paragraph (h)(3)(i)(C). Although no commenters disagreed with this provision as proposed, a few commenters (Exs. 54–6, 54–220) asked OSHA to clarify the requirement that SCBA equipment be maintained in a fully charged state and recharged when the pressure falls to 90% or less of the manufacturer's recommended pressure level. By way of example, OSHA notes that if the manufacturer states that the cylinder is fully charged at 100 psi, the cylinder must be recharged when the pressure falls to 90 psi (i.e., 90% of the fully charged level). The 90 percent level was selected to ensure that sufficient air remains in the cylinder to allow emergency responders to perform their required duties in a contaminated or oxygen-deficient atmosphere and still have sufficient air available to escape from these conditions. The 90 percent level, and the requirement that cylinders be recharged once the pressure falls below 90 percent, was also recommended by the American Industrial Hygiene Association (Ex. 54–208).

In two separate submissions to the record (Exs. 54–121 and 54–135), Consolidated Engineering Services asked what type of training is required for employees who inspect respirators used for emergency response. OSHA notes that, under final paragraph (k), the specifics of an appropriate training program are left to the discretion of the employer. Regarding respirators for emergency use, final paragraph (k)(1)(iii) requires that employees be trained in how to use the respirator effectively in emergency situations, while final paragraph (k)(1)(iv) requires training on how to inspect the respirator. As these paragraphs make clear, OSHA requires the employer to develop appropriate training programs for employees who inspect emergency respirators.

As part of the inspection process for respirators that are maintained for use in emergencies, paragraph (h)(3)(iv) of the final standard requires certification of the inspection. Documentation of certification includes the date of inspection, the name or signature of the inspector, the findings of the inspection, any required remedial action, and a serial number or other means of identifying the inspected respirator. This information must be tagged to the respirator or its storage compartment, or otherwise stored in the form of inspection reports (i.e., paper or electronic), and be maintained until replaced following a subsequent certification.

This requirement was included in the proposal, and several comments addressed it. Dow Chemical (Ex. 54–278) stated that it supports the proposed requirement. The American Petroleum Institute (Ex. 54–330) recommended that OSHA require ''identification of the person that made the inspection'' in lieu of a signature. However, OSHA believes that the inspector's name or signature is a clear and precise identification, and therefore has retained this requirement in the final rule as proposed.

The final provision of paragraph (h) deals with respirator repairs and adjustments. Final paragraph (h)(4) provides that respirators that fail

inspections, or are otherwise defective, are to be removed from service and discarded, repaired, or adjusted according to the specified procedures. In addition, the employer shall ensure that repairs or adjustments to respirators are made only by persons appropriately trained to do so, and that they use only the respirator manufacturer's NIOSH-approved parts that are designed for the particular respirator. The repairs also must be made in accordance with the manufacturer's recommendations and specifications. Because components such as reducing and admission valves, regulators, and alarms are complex and essential to the safe functioning of the respirator, they are required to be adjusted and repaired only by the manufacturer or a technician trained by the manufacturer.

Several comments were submitted to the record regarding this particular provision. Consolidated Engineering Services (Exs. 54–121 and 54–135) and the Florida Department of Labor and Employment Security (Ex. 54–79) asked what type of training is required for employees who repair and adjust respirators. Motorola (Ex. 54–187) also addressed this point, but added that specialized training for most respirator repair work was not necessary, and that the training program required by the standard should provide employees with sufficient expertise to perform the necessary repair work, or at least to recognize when repair is beyond their ability. Another commenter (Ex. 54–293) asserted that, depending on the manufacturer's recommendation, a trained person may or may not be necessary to make repairs; for example, no training is required to replace a broken respirator strap.

In response to these concerns, OSHA does not believe that it is necessary or appropriate to specify in detail in the final rule the type of training that is required to qualify a person to repair and adjust respirators. However, because of the important health-related functions of respirators, the person making the repair needs to be properly trained. OSHA expects that such repair will often be performed by the manufacturer, particularly if special expertise is required. Where this is not the case, the employer must ensure that the employee or person repairing the respirator has the skills necessary to conduct the appropriate repair and adjustment functions. The use of the term ''appropriately trained'' refers to an individual who has received training from the respirator manufacturer or otherwise has demonstrated that he/she has the skills to return the respirator to its original state of effectiveness.

The AFL–CIO (Ex. 54–428) and Service Employees International Union (SEIU) (Ex. 54–455) recommended that OSHA require employers to tag as ''out of service'' those respirators that fail inspections. OSHA agrees that some means must be available for ensuring that only properly functioning respirators are introduced into the workplace. However, OSHA believes that the decision on how to handle respirators that fail inspection is most appropriately addressed in the employer's respirator protection program, as required under final paragraph (c). Specifically, final paragraph (c)(1)(v) would allow such procedures to be tailored to satisfy the needs of a particular workplace.

The SEIU (Ex. 54–455) recommended that OSHA require employers to keep an adequate supply of cartridges and other routine replacement parts in stock and readily accessible to employees so that they can replace needed parts. OSHA does not believe it is necessary to specify that employers must maintain an adequate number of spare parts. Final paragraph (h)(4) requires that defective respirators be removed from service unless they are repaired or adjusted, and an employer who does not keep on hand sufficient parts to allow respirators to be repaired will need to remove those respirators from service until suitable repairs can be made. Thus, an employer who does not maintain an adequate inventory of parts will either need to keep extra respirators on hand or cease operations that require respirator use until parts can be obtained or installed.

Paragraph (i)—Breathing Air Quality and Use

This paragraph of the respiratory protection standard requires that breathing air for atmosphere-supplying respirators be of high purity, meet quality levels for content, and not exceed certain contaminant levels and moisture requirements. The paragraph sets performance standards for the operation and maintenance of breathing air compressors and cylinders, establishes methods for ensuring breathing air quality, and sets requirements for the quality of purchased breathing air.

Paragraph (i)(1) of the final standard applies to atmosphere-supplying respirators that are being used to protect employees, and requires that breathing air supplied to these respirators be of high purity. This same requirement for breathing air quality was included in proposed paragraph (i)(1). Both the prior and final rules refer to a number of standard references that establish parameters for breathing air quality. For example, under (i)(1)(i), the final rule requires the employer to ensure that oxygen used for breathing purposes meets the requirements of the United States Pharmacopoeia (USP) for medical or breathing oxygen. This provision is the same as the requirement in OSHA's prior respiratory protection standard at paragraph (d)(1). The ANSI Z88.2–1992 respirator standard, in Clause 10.5.1, also requires that air be of high purity and that oxygen meet the USP requirements. Inclusion of this requirement in the final rule was strongly supported by the AFL-CIO (Ex. 54–428), which stated that the employer must ensure that ''compressed air, compressed oxygen, liquid air, and liquid oxygen used for respiration is of high purity and in accordance with the specifications listed in [proposed paragraph] (i)(1).''

Under paragraph (i)(1)(ii) of the final standard, breathing air must meet at least the requirements for Type I—Grade D breathing air, as described in the ANSI/CGA G–7.1–1989 standard, which is the latest revision of that reference standard and the one currently used by OSHA when determining breathing air quality. Final paragraph (i)(1)(ii) identifies the specifications for the contents of Grade D breathing air: oxygen content (volume/volume) of 19.5 to 23.5 percent; hydrocarbon (condensed) concentration of five milligrams or less per cubic meter of air; carbon monoxide level of 10 ppm or less; carbon dioxide level of 1,000 ppm or less; and a lack of noticeable odor.

The OSHA respiratory protection standard adopted in 1971 referenced the then-current CGA G–7.1–1966 breathing air quality standard. In 1973, and again in 1989, the CGA, in conjunction with ANSI, revised the G–7.1 standard. The Grade D specification was changed as part of the 1989 ANSI revision, at which time the carbon monoxide level was reduced from 20 ppm to 10 ppm. The OSHA Directorate of Compliance Programs subsequently issued letters of interpretation in 1991 and 1992 that required employers to use the updated Grade D specifications for breathing air quality.

The proposal requested comments on whether acceptable respirator breathing air quality should continue to meet the specifications for Grade D breathing air described in the ANSI/CGA G 7.1–1989 standard. Commenters supported inclusion of a requirement for use of the 1989 Grade D breathing air values in the final rule (Exs. 54–141, 54–189, 54–267, 54–286, 54–408, 54-443). For example, the Tennessee Valley Authority (Ex. 54–189) and Norfolk Southern (Ex. 54-267)

supported the Grade D breathing air requirement, stating that, in their experience, the Grade D air they have been using is fully adequate and safe, and that OSHA should not adopt more stringent requirements across the board.

Modern Safety Techniques, Inc. (Ex. 54–141) supported maintaining the Grade D breathing air quality requirement but recommended that the OSHA rule not specify the year of the ANSI/CGA standard, because, for example, employers were confused when the CGA revised the ANSI/CGA G–7.1 standard in 1989 and the OSHA standard referred to an earlier version of that standard. However, the regulations governing the incorporation of documents by reference (1 CFR 51) require that the revision date of incorporated references be specified when they are included in any new or revised standard. Where incorporated references are used in final paragraph (i), therefore, the latest revision dates for these references have been used.

The Los Alamos National Laboratory (LANL) (Ex. 36–52) recommended that Grade E air rather than Grade D air be used since most air that passes the Grade D requirements will also pass Grade E requirements. The Grade E specifications narrow the range of permitted oxygen content from 19.5–23.5 percent to 20 to 22 percent oxygen and lower the allowable carbon dioxide level from 1000 ppm to 500 ppm. LANL gave no specific safety or health reason for OSHA to adopt this more stringent recommendation. The Service Employees International Union (Ex. 54–455), however, points out that Grade E air of reliable quality may be difficult for employers to obtain. In addition, OSHA is not aware of any problems that have occurred as a result of breathing Grade D air, and believes that the Grade D specifications will fully protect employees who use atmosphere-supplying respirators. Therefore, OSHA is not convinced a higher grade of air is required, and the final rule specifies Grade D air.

OSHA has been informed that NIOSH has been working with the National Aeronautics and Space Administration (NASA) on a new ''liquid air SCBA'' that may be submitted for NIOSH certification in the future. In its revision of the 42 CFR 84 respirator certification standard, NIOSH incorporated the CGA Commodity Specification for Air in the CGA's G–7.1–1966 standard to maintain the quality verification category for Type II liquid compressed air, which had been removed from the updated ANSI/CGA G–7.1–1989 standard. NIOSH included this specification because a liquid compressed air quality category is needed for future evaluations of atmosphere-supplying respirators that use liquefied compressed air. NIOSH continues to recommend the use of the ANSI/CGA G–7.1–1989 standard for breathing air quality for currently issued respirator certifications.

Under paragraph (i)(2) of the final standard, employers are prohibited from using compressed oxygen in atmosphere-supplying respirators, including open-circuit SCBAs, that have previously used compressed air. This prohibition was proposed in the NPRM, and is intended to prevent the fires and explosions that could result if high pressure oxygen comes into contact with oil or grease that has been introduced to the respirator or the air lines during compressed air operations. Comments to the record (Exs. 10, 54–165, 54–208, 54–218) support this provision. Additionally, the prohibition is consistent with Clause 10.5.2 of the ANSI Z88.2–1992 standard.

Proposed paragraph (i)(3) would have prohibited the use of oxygen with supplied air respirators. This provision was intended to avoid the possibility of fires and explosions that can result when oxygen is used in high concentrations. However, some respiratory equipment is specifically designed to avoid fire and explosion hazards when used with oxygen in concentrations greater than 23.5%. Therefore, paragraph (i)(3) of the final standard specifies that oxygen in concentrations greater than 23.5% is to be used only with equipment designed specifically for oxygen service or distribution. Several commenters pointed out the need to specify a maximum oxygen concentration (Exs. 54–165, 54–208, 54–218, 54–219). Clause 10.5.2 of the ANSI Z88.2–1992 standard (Ex. 81) also states, ''Oxygen concentrations greater than 23.5% shall be used only in equipment designed for oxygen service or distribution.'' OSHA agrees with the recommendations made by the AIHA (Ex. 54–208), 3M (Ex. 54–218), and Monsanto (Ex. 54–219) that the final rule adopt the maximum oxygen concentration language from the ANSI standard, and the final rule reflects this recommendation.

Final paragraph (i)(4) requires that breathing air for respirators provided from cylinders or air compressors meet certain minimum standards. Under final paragraph (i)(4)(i), cylinders must be tested and maintained as prescribed in the Shipping Container Specification Regulations of the Department of Transportation (DOT) (49 CFR parts 173 and 178); these DOT regulations are also required for NIOSH respirator certification. The DOT regulations in parts 173 and 178 cover the construction, maintenance, and testing of these compressed air cylinders, and are necessary to prevent the explosions that can result if high pressure breathing air cylinders rupture. The proposal referenced only 49 CFR part 178, but the AIHA (Ex. 54–208) recommended that the DOT requirements found in 49 CFR part 173 also be specified in the final rule because they apply to breathing air cylinders. Final paragraph (i)(4)(i) therefore includes a reference to part 173 in addition to part 178.

Paragraph (i)(4)(ii) of the final standard includes a provision requiring employers to ensure that cylinders of purchased breathing air are accompanied by a certificate from the supplier stating that the air meets the requirements for Type 1-Grade D breathing air contained in paragraph (i)(1)(ii) of the final standard. Employers must obtain a certificate of analysis of purchased breathing air from the supplier to ensure that its content and quality meet the requirements for Grade D breathing air. This will allow the employer to have assurance that the purchased breathing air being used by employees is safe. The proposal did not include a requirement for the certification of the quality of purchased breathing air. There was, however, support in the record (Exs. 54–234, 54–266, 54–273, 54–330, 54–408) for adding this requirement. For example, the American Petroleum Institute (Ex. 54–330) and Duquesne Light Company (Ex. 54–408) recommended that additional guidance, similar to that in ANSI Z88.2–1992, be provided to ensure the quality of purchased breathing air. Exxon (Ex. 54–266) stated that OSHA should not allow the direct blending of compressed nitrogen and oxygen gases by the employer to produce Grade D air, citing the ''extreme consequences of having too little oxygen in a cylinder.'' Exxon further recommended that 100% of the cylinders be tested for oxygen content for all nitrogen/oxygen mixed cylinders (Ex. 54–266). The requirement that the employer obtain a certificate of analysis of purchased breathing air means that every cylinder will have been analyzed for oxygen content by the supplier and, therefore, the situation feared by Exxon will not arise.

Final paragraph (i)(4)(iii) requires that the moisture content of compressed air in air cylinders not exceed a dew point of $-50°$ F ($-45.6°$ C) at one atmosphere of pressure. This requirement will prevent respirator valves from freezing, which can occur when excess moisture accumulates on the valves. This provision has been revised from the proposed requirement to be consistent

with the latest versions of the standard references for moisture content of compressed breathing air, the ANSI Z88.2–1992 and ANSI/CGA G–7.1–1989 standards. Consistency between the required value and the standard references will avoid confusion in measuring moisture content and, consequently, will enhance employee protection. This dew point value, as the AIHA (Ex. 54–208) recommended, has been taken from the ANSI/CGA G–7.1–1989 specifications for Grade D air and replaces the 27 ml/m^3 value for moisture content specified in the proposal.

Final paragraph (i)(5)(i) requires that compressors that supply breathing air are to be constructed and situated so that contaminated air cannot enter the air supply system. This provision from the prior standard is retained and also reflects the intent of the proposed requirement. The purity of the air entering the compressor intake is a major factor in the purity of air delivered to the respirator user. The location of the intake is most important, and must be in an uncontaminated area where exhaust gases from nearby vehicles, the internal combustion motor that is powering the compressor itself (if applicable), or other exhaust gases being ventilated from the plant will not be picked up by the compressor air intake. Contaminated air or exhaust gases from internal combustion engines that are taken into the compressor are major hazards to the purity of breathing air from compressors, and these hazards occur with all compressors, not just oil-lubricated ones. Respirator users have died or been injured when the air intake was not properly located to avoid contaminants. Final paragraph (i)(5)(i), therefore, requires that air intakes for all compressors be located in a way that avoids entry of any contaminated air into the compressor.

Support for this requirement can be found in the Distler air compressor study (Ex. 32–1). This study recommended that engine exhaust gases should be piped upward or downwind from the compressor air intake, particularly where exhaust gases are not reliably dispersed, such as in partially enclosed spaces or in turbulent wind areas. The compressor exhaust piping used in the Distler study had to be repositioned several times to find a location where the exhaust gases would not be picked up by the compressor air intake. All of these findings reinforce the importance of locating the compressor's air intake in an area that ensures that only high-quality air can be taken in. No comments were received on the proposed requirement for the location of compressor air intakes.

Final paragraph (i)(5)(ii) has been slightly modified from proposed requirement (i)(4)(ii) to require that the moisture content of compressed air be minimized so that the dew point at one atmosphere of pressure is 10 degrees Fahrenheit (5.56 degrees Celsius) below the ambient temperature to prevent water freezing in valves and connections of the air supply system. Such freezing can block air lines, fittings, and pressure regulators. This final requirement is similar to the parallel provision of the previous standard, which required that breathing air meet the requirements of CGA G–7.1–1966. Two commenters (Exs. 54–208, 54–218) pointed out that the proposal specified a dew point of 10 degrees Celsius instead of the 10 degrees Fahrenheit specified in the ANSI/CGA G–7.1–1989 standard. The value in final paragraph (i)(5)(ii) has been revised to match the 10° F provision in the G–7.1–1989 standard for Grade D air, with an equivalent value of 5.56° C added to comply with a Federal government requirement (P.L. 100–418 and E.O. 12770) that scientific and technical measures are expressed as metric units.

Paragraph (d)(2)(ii) of the prior standard required air compressors to have a receiver of sufficient capacity to permit the respirator user to escape from a hazardous atmosphere in the event of compressor failure. However, under paragraph (d)(2) of the final standard, the only respirators that can now be used in IDLH atmospheres are either SCBAs or supplied-air respirators with an auxiliary self-contained air supply for escape. Consequently, a requirement for an air receiver to permit escape from IDLH atmospheres is no longer needed in the final rule. Also, the prior respiratory protection standard, in paragraph (d)(2)(ii), required compressors to have alarms to indicate compressor failure and overheating; this requirement was part of the same provision that specified that a receiver for escape from a contaminated atmosphere in the event of compressor failure be available. This alarm requirement was deleted from the proposal and is not part of the final standard. An alarm to indicate compressor failure or overheating is unnecessary in non-IDLH atmospheres since, as OSHA stated in the proposal, the respirator user can readily exit the hazardous area if the respirator fails.

The deletion from the final standard of the prior standard's requirement for compressors to be equipped with receivers if they were to be used in hazardous atmospheres will clarify an enforcement issue that has arisen in connection with ambient air movers. Ambient air movers have been developed to provide air to supplied-air respirators. These units are small electric compressors that are not oil-lubricated and have no air receiver. Such compressors are used in non-IDLH atmospheres. The use of ambient air movers has been allowed under an existing OSHA compliance directive even though such devices do not have the air receiver required for air compressors by the prior respiratory protection standard. However, the final standard removes the air receiver requirement for compressors, and ambient air movers will therefore be treated like any other air compressor used in non-IDLH atmospheres.

Under final paragraph (i)(5)(iii), compressors must be equipped with suitable in-line air-purifying sorbent beds and filters to further assure breathing air purity. The Associated Builders and Contractors, Inc. (Ex. 54–309) recommended that the corresponding provision in the proposal be revised to add the requirement that employers change air-purifying sorbent bed and filters in accordance with the manufacturer's instructions. Also, clause 10.5.4.2 of the ANSI Z88.2–1992 standard recommends that maintenance and replacement or refurbishment of the air-purifying and filter media be performed periodically by trained personnel and in accordance with the manufacturer's recommendations and instructions. OSHA agrees with the Associated Builders and Contractors that sorbent beds and filters must be maintained properly, and has added language to paragraph (i)(5)(iii) that is similar to that in ANSI Z88.2–1992, and requires sorbent beds and filters to be maintained and replaced or refurbished periodically in accordance with the manufacturer's recommendations. The Associated Builders and Contractors also recommended that sorbent bed and filter changes be documented, that such documentation be retained for one year, and that it be made available to OSHA on request. However, OSHA is not generally requiring that records of respirator maintenance performed under this standard be kept and does not believe such a requirement is necessary here. Instead, OSHA is requiring in paragraph (i)(5)(iv) that a tag containing the most recent date of sorbent bed replacement or refurbishing, along with the signature of the person performing the change, be kept at the compressor. This tagging requirement is also consistent with OSHA's efforts, as required by the Paperwork Reduction

Act of 1995, to reduce paperwork to the extent consistent with employee safety and health.

Paragraphs (I)(6) and (i)(7) address the control of carbon monoxide levels in breathing air. Paragraph (i)(6) requires that, for compressors that are not oil lubricated, the CO levels in the breathing air may not exceed 10ppm. Paragraph (i)(7) requires monitoring of CO levels for oil lubricated compressors. OSHA stated in the NPRM that one method to prevent contaminated air from reaching the breathing air supply was to require carbon monoxide filters with continuous alarms for all breathing air compressors. The agency requested comments on the use of carbon monoxide alarms, high-temperature alarms, and shutoff devices in the workplace (59 FR 58926). A number of comments were received that addressed the issue of carbon monoxide monitors and alarms.

Modern Safety Techniques, Inc. (MST) (Ex. 54–141) noted that in many workplaces it may be impossible or cost prohibitive to relocate the air intake to an area that would reduce the likelihood of carbon monoxide entering the system. In these cases, MST recommended continuous monitoring as the only method that would ensure breathing air quality. MST stated that the use of a carbon monoxide alarm or measuring device is necessary to tell whether carbon monoxide purifiers (e.g., Hopcalite filters) are functioning properly. MST stated, ''Unless continuous monitoring is being conducted on the breathing air supply, ''frequent'' monitoring, or proper placement of the breathing air supply, only assures that the requirements are met at *that* particular instance in time.'' [Emphasis in original.] Eugene Satrun, an industrial hygienist who runs a respirator program in Illinois (Ex. 54–261), supported the need for continuous carbon monoxide monitors, noting that automatic compressors can be operated with a vehicle running nearby and may consequently pull significant levels of carbon monoxide into the intake.

Several commenters were opposed to OSHA adopting a requirement for continuous carbon monoxide monitoring and alarms (Exs. 54–234, 54–250, 54–408). They stated that the requirements for sorbent bed filtration, proper air inlet location, and Grade D air quality, confirmed by periodic sampling, would be sufficient to control the carbon monoxide hazard. Kodak (Ex. 54–265) stated that it has assessed the purity of compressed air for breathing use over a period of 18 years at its plants, collecting and analyzing more than 1200 samples, and that no incidents of carbon monoxide production involving oil-lubricated compressors have been reported. Carbon monoxide production, Kodak stated, is best prevented by adequate procedures, awareness, and certification. Kodak did not provide specific procedures for determining air system compliance, nor further clarification of what is meant by awareness or certification. The Duquesne Light Company (Ex. 54–408) stated that continuous monitoring was unnecessary, and that requiring filtration or purification of the air supply, proper location of the air intake, and Grade D air purity should be sufficient to ensure a safe breathing air supply. Meridian Oil (Ex. 54–206) opposed continuous monitors because these devices can generate false alarms.

Other commenters proposed alternatives to continuous monitoring. Niagara Mohawk Power (Ex. 54–177), in comments opposing carbon monoxide alarms, stated that carbon monoxide filters with color-change indicators are an appropriate method to monitor carbon monoxide. Monsanto (Ex. 54–219) stated that OSHA should not require all compressors to have carbon monoxide filters and alarms. Monsanto stated that high-temperature alarms or automatic compressor shut downs would only be needed when there was a reasonable possibility of carbon monoxide production in the compressor due to equipment problems. TU Electric (Ex. 54–250) stated that carbon monoxide filters or continuous monitoring alarms should not be required for all breathing air compressors, but that regular testing of breathing air prior to use, and testing in specific locations on a regular basis during compressor use, should be required. This commenter also recommended against a requirement for carbon monoxide filters or monitors for oil-free compressors.

Other commenters (Exs. 54–206, 54–234, 54–250) supported testing ambient air near the intake on a regular basis, but did not recommend a testing frequency. General guidance for periodic sampling of air quality for compressors is specified in Clause 10.5.4.3 and Table 4 of the ANSI Z88.2–1992 standard. The ANSI procedure was recommended by several commenters (Exs. 54–234, 54–250, 54–263, 54–273, 54–363). ANSI Z88.2–1992 recommends acceptance testing prior to initial use and representative sampling at distribution supply points on a periodic basis to ensure ''a continued high-quality air supply.'' Norfolk Southern (Ex. 54–267) stated that OSHA should not require the use of carbon monoxide filters with compressor-supplied air, and that the employer should have the option of using a carbon monoxide detector. This commenter stated also that installing a carbon monoxide filter is not reasonable for those systems that already have a carbon monoxide detector and high-temperature alarm. St. Lawrence Gas (Ex. 54–402) commented that carbon monoxide alarms should not be required and noted that it has found the use of carbon monoxide-to-carbon dioxide converters (with color-change indicators) sufficient for detecting the presence of carbon monoxide. ORC (Ex. 54–424) stated that carbon monoxide alarms or high-temperature alarms are not needed for all compressors. ORC recommended that adequate procedures, awareness, and certification for installation are the best means to ensure that contaminated air does not enter the compressor. This language is similar to that used by Kodak (Ex. 54–265), and, like Kodak, ORC (Ex. 54–424) did not provide any elaboration of the phrase ''adequate procedures, awareness, and certification for installation.''

A carbon monoxide monitor with an alarm can be used to continuously measure the breathing air and warn respirator users when carbon monoxide levels exceed the 10 ppm limit set for Grade D breathing air. However, these alarms need to be properly maintained to function effectively. MST (Ex. 54–141) stated that the electrochemical type of sensors used today are specific for carbon monoxide, are relatively stable during temperature and humidity changes, and are accurate enough to meet the CGA G–7.1–1989 requirements. These sensors have replaced the older metal oxide sensors that had problems with false alarms. However, the electrochemical sensors must be calibrated periodically (usually on a monthly basis) to perform accurately. The Service Employees International Union (Ex. 54–455) also recommended that the final standard address regular replacement of alarm sensors and filter media.

Carbon monoxide filters with color-change indicators are used to convert carbon monoxide in breathing air to carbon dioxide, which is less likely to pose a hazard to the respirator user. The source of the carbon monoxide can be from contamination of the intake air or from carbon monoxide generated by the compressor. However, the color change in the indicator results from moisture in the breathing air that is trapped in the filter element. The color-change indicator, therefore, does not indicate the presence of carbon monoxide, but instead signals only the presence of moisture, which can render the sorbent filters ineffective. Consequently, the

color-change indicator cannot be used directly to detect carbon monoxide. In addition, these carbon monoxide filters, like carbon monoxide alarms, need periodic maintenance to ensure their continued effectiveness.

In summary, strong arguments favor a requirement for continuous carbon monoxide monitoring of compressor-generated breathing air. This is the case because preventing carbon monoxide contamination by locating the air intake for compressors in an area that is free of carbon monoxide contamination is difficult in many cases and impossible in others. Automatic compressors with poorly located air intakes may operate when a running vehicle is in the immediate area, thereby contaminating the air supply with carbon monoxide from the vehicle's exhaust. In addition, older compressors, which may still be operational after hundreds, if not thousands of operating hours, may allow increased oil blow-by due to piston ring and cylinder wear, which increases the possibility of carbon monoxide contamination.

The most convincing evidence against a requirement for continuous carbon monoxide monitoring comes from the 18-year collection of sampling results taken by Kodak (Ex. 54–265). OSHA notes, however, that Kodak's results are likely to be due to the company's careful observance of operating procedures, such as procedures ensuring the proper location of air intakes and regular and thorough maintenance and repair of all compressors. OSHA notes that Clause 10.5.4.3 of the ANSI Z88.2–1992 standard calls for periodic, rather than continuous, sampling of breathing air from the air supply.

The arguments for and against carbon monoxide alarms are less well defined than the case for carbon monoxide monitoring devices. Several commenters specifically recommended the use of carbon monoxide alarms whenever compressed air is being used as breathing air (Exs. 54–337, 54–428, 54–455). The AFL–CIO (Ex. 54–428) recommended the use of carbon monoxide alarms or monitors on all air supply systems that service respirators with Grade D breathing air. Both of these recommendations would assure an air supply uncontaminated by carbon monoxide. The proponents of carbon monoxide alarms (Exs. 54–141, 54–261, 54–337, 54–428, 54–455) state that they are needed to alert personnel that equipment is malfunctioning; the Exxon Company (Ex. 54–266) stated that gasoline- and diesel-powered compressors should be required to have carbon monoxide alarms to detect exhaust gases that enter the air supply, as well as compressor failure and high-temperature alarms; other commenters (Exs. 54–337, 54–428) would require the use of carbon monoxide alarms to prevent accidental carbon monoxide contamination whenever compressed air is being used as breathing air.

The opponents (Exs. 54–177, 54–206, 54–219, 54–234, 54–250, 54–265, 54–402) of carbon monoxide alarms cite the availability of alternate equipment and procedures that they claim are as effective as alarms in protecting the purity of breathing air. Examples of these alternatives are filters with color-change indicators, carbon monoxide-to-carbon dioxide converters, oil-free compressors, proper air intake placement, certification of air compressor systems, and periodic monitoring (Exs. 54–177, 54–206, 54–219, 54–250, 54–265, 54–330, 54–402, 54–408, 54–424).

OSHA believes that it is essential for the employer to ensure that excessive carbon monoxide is not in the compressed breathing air supplied to respirators. Final paragraphs (i)(6) and (i)(7), therefore, require that the employer prevent carbon monoxide levels in the breathing air from exceeding 10 ppm. For compressors that are not oil-lubricated, this requirement can be met by several different methods, including the use of continuous carbon monoxide alarms, carbon monoxide filters, proper air intake location in an area free of contaminants, frequent monitoring of air quality, or the use of high-temperature alarms and automatic shutoff devices, as appropriate. No single method will be appropriate in all situations, and several methods may need to be combined, *e.g.*, the use of carbon monoxide alarms with carbon monoxide filters where conditions are such that a reliable carbon monoxide-free area for compressor air intakes cannot be found. As the comments to the record show, there was no agreement on the most appropriate method for ensuring that carbon monoxide would not contaminate the breathing air coming from compressors. OSHA has decided that a performance-based requirement ensuring that carbon monoxide does not contaminate breathing air will give employers flexibility in selecting the method(s) most appropriate for conditions in their workplace.

Oil-lubricated compressors can produce carbon monoxide if the oil enters the combustion chamber and is ignited. This can be a particularly severe problem in older compressors whose piston rings and cylinders are worn. Final paragraph (i)(7) requires that such compressors have a high-temperature or carbon monoxide alarm, or both. If only a high-temperature alarm is used, the air from the oil-lubricated compressor must be monitored at intervals sufficient to prevent carbon monoxide in the breathing air from exceeding 10 ppm. The latter requirement ensures that carbon monoxide that enters a poorly located compressor air intake, as well as carbon monoxide generated by the compressor itself, is detected.

Final paragraph (i)(7) is similar to a provision in the previous standard. In the NPRM, OSHA proposed to delete the requirement from the previous respirator standard that oil-lubricated compressors be equipped with carbon monoxide alarms and high-temperature shutoff devices. However, a number of commenters (Exs. 54–144, 54–219, 54–266) stated that precautions against excessive carbon monoxide were needed when oil-lubricated compressors were used. Modern Safety Techniques (Ex. 54–144) stated that oil-lubricated compressors used by industry to supply breathing air often have hundreds of hours of use, allowing greater oil blow-by and therefore greater potential for carbon monoxide production, was reported in the Distler study. That study found that properly functioning air compressors are unlikely to reach temperatures at which carbon monoxide production occurs. Exxon (Ex. 54–266) encouraged OSHA to include a requirement for in-line carbon monoxide alarms for diesel- or gasoline-powered compressors, since its experience indicates that the use of these compressors increases the risk of carbon monoxide contamination from the compressor's exhaust. Monsanto (Ex. 54–219) stated that high-temperature alarms or automatic compressor shutoffs would be needed when there was a reasonable possibility of carbon monoxide production in the compressor due to equipment problems. The Service Employees International Union (Ex. 54–455) argued that the requirements specifying Grade D breathing air purity and location of the compressor air intake in an uncontaminated atmosphere were not sufficient to ensure that carbon monoxide is not entrained in the system.

An incident of carbon monoxide production by an oil-lubricated compressor was described in a MSHA Accident Investigation Report issued in January 1985 (Ex. 38–12). An oil-cooled, diesel-powered, two-stage, rotary air compressor overheated during a sandblasting operation at a limestone quarry. The air compressor thermo-bypass valve, which should have directed the oil through a cooling

radiator once the oil had reached a temperature of 185°F, failed, which allowed the temperature of the cooling oil to rise above its flashpoint of 420°F. The oil ignited, producing carbon monoxide. The compressor was equipped with a high-temperature shutoff switch set for 235°F, but it had been disconnected for at least 30 days prior to the incident. The compressor was not equipped with a carbon monoxide filter or alarm. The sandblaster collapsed from carbon monoxide poisoning. Monsanto (Ex. 54–219) stated that this incident resulted from a failure to follow the provision in the previous standard requiring that oil-lubricated compressors have a functional high-temperature or carbon monoxide alarm, or both. OSHA believes that this incident, as well as the comments described above, supports carrying the previous standard's requirement forward in the final rule.

Final paragraph (i)(8) requires that air line couplings be incompatible with outlets for non-respirable worksite air or other gas systems to prevent the inadvertent provision of nonrespirable gases to airline respirators. Breathing air couplings, therefore, are to be made incompatible with outlets from nonrespirable plant air and other gas systems. This requirement is similar to the provision in paragraph (d)(3) of the previous respiratory protection standard and proposed paragraph (i)(5) of the NPRM. Martin Marietta (Ex. 54–410) stated that there have been documented cases in which cross-connections have introduced hazardous contaminants into breathing air lines. To avoid this problem, Martin Marietta recommended that OSHA add a provision to the final standard that prohibits connecting breathing air lines to any nonrespirable gas source or process. Consistent with this recommendation, OSHA has added a sentence to paragraph (i)(8) requiring that no asphyxiating substance be introduced into breathing air lines. This requirement will cover not only the contamination of the breathing air system from cross-connections, but will also cover other potential contaminating conditions, *e.g.*, using nitrogen to blow out worksite air lines where the worksite air source is also used for breathing air.

The final standard also requires that the employer prevent utility oxygen, *i.e.*, oxygen supplied to meet other manufacturing needs, from entering the respirator air supply system. As discussed above, the standard permits oxygen to be used in respirators designed for oxygen service. The final standard prohibits the introduction of utility oxygen into breathing air systems that supply respirators that are not designed for oxygen service; this provision is needed to prevent the fires and explosions that could result if high-pressure oxygen comes into contact with oil or grease that has been introduced to the respirator or the air lines during compressed air operations.

Final rule paragraph (i)(9) requires employers to use breathing gas containers marked in accordance with the NIOSH respirator certification standard at 42 CFR part 84. This requirement differs from proposed paragraph (i)(6), which listed several additional standards for breathing gas containers. These additional standards have been incorporated into 42 CFR part 84, making reference to them in the final rule unnecessary.

Paragraph (j)—Identification of Filters, Cartridges, and Canisters

The final rule provides that the employer only use filter cartridges and canisters that are labeled and color coded with the NIOSH approval label and that the label not be removed or made illegible. This is similar to the parallel requirement in the proposal, which was supported by commenters (Exs. 54–361, 54–428, 54–455). OSHA has modified the proposed language in certain respects to add compliance flexibility while retaining the original objective, i.e., assurance that these elements meet NIOSH's stringent requirements. These comments and modifications are discussed below.

OSHA proposed to eliminate from the previous respiratory protection standard the language in paragraphs (g)(1) to (g)(6), which described labeling requirements, and Table I–1, which listed color codes assigned to canisters and cartridges. These requirements were adopted from the original national consensus standard (i.e., ANSI K13.1, ''Standard for Identification of Air-Purifying Respirator Canisters and Cartridges'') adopted by OSHA in 1971. In place of these requirements, proposed paragraph (j)(1) would have required employers to ensure that all filters, cartridges, and canisters bear a NIOSH approval label before being placed into service.

Proposed paragraph (j)(2) specified that the label not be removed, obscured, or defaced while the filter, cartridge, or canister was in service to ensure that the label provided information to the employee about the protection being afforded by the respirator. In the final standard, OSHA has combined proposed paragraphs (j)(1) and (j)(2) into a single paragraph (j). The changes from the previous standard recognize that employers who use respirators should be able to rely on labeling and color coding by respirator manufacturers for assurance that the respirators meet NIOSH requirements.

This position is consistent with that taken by many commenters, who noted that the labeling and color coding of filters are the responsibility of the respirator manufacturer (Exs. 54–208, 54–218, 54–219, 54–278, 54–289) and are required by NIOSH for certification. OSHA agrees that color coding and the attachment of NIOSH approval labels to respirators are the responsibility of the manufacturer. However, it is still the employer's responsibility to use only components bearing a NIOSH approval label, and to ensure that the NIOSH approval labels are not removed from the filters, cartridges, and canisters that are used in the workplace and remain legible.

The NIOSH label serves several purposes. It ensures selection of appropriate filters for the contaminants encountered in the workplace and permits the employee using the respirator to check and confirm that the respirator has the appropriate filters before the respirator is used. David Lee, a CIH, CSP, and respirator consultant (Ex. 54–304), commented that, once a filter selection is made and the respirator is donned, the label becomes meaningless. However, the employee is not the only one who uses the color coding and label. Color coding and labeling also allow fellow employees, supervisors, and the respirator program administrator to readily determine that the appropriate filters are being used by the employee. Cartridges that are appropriate for one operation may be inappropriate for another, and color coding and labeling allow respirator users with inappropriate filters to be identified in the workplace and potential respiratory hazards to be avoided.

Proposed paragraph (j)(2) required that the NIOSH approval label not be ''removed, obscured or defaced'' while respirators are being used. 3M (Ex. 54–218) and Monsanto (Ex. 54–219) urged OSHA to add the word ''intentionally'' before ''removed, obscured or defaced,'' since they believe that an employer would be in violation of this provision if, for example, a label is covered with paint overspray during use. Monsanto also stated that some OSHA substance-specific standards require that cartridges be dated by the employee to indicate when they were first put into service and that some employers could use this dating method to control cartridge use even when not required by OSHA. Accordingly, Monsanto urged OSHA to add the phrase ''except if it is to record

initial use information'' to paragraph (j)(2) to clarify that adding a date to the NIOSH label is allowed and will not be regarded as defacing the label. David Lee (Ex. 54–304) was concerned that dirt, dust, and debris can easily obscure the label once the respirator is in use and that employees would be required by the proposed provision to leave the area to clean the label to make it legible. Dow (Ex. 54–278) stated that, because of the small size of the label on some cartridges, the employer cannot date the cartridges without obscuring some of the information on the label. To resolve this problem, Dow suggested that the words ''pertinent information'' be added before ''obscured.''

OSHA has not added the term ''intentional'' to final paragraph (j) because it would be difficult, if not impossible, to determine if the removal or obscuring of a NIOSH label was accidental or intentional. Also, the final provision does not include an exemption for documenting the initial use date on cartridge and canister labels, since OSHA already permits this practice. OSHA's experience indicates that the initial use date can easily be added to a filter, cartridge, or canister without obscuring the label, and this procedure has not proven to be a problem in the substance-specific standards that require such dating. The term ''pertinent information'' has not been included in final paragraph (j) because OSHA believes that all of the information on the NIOSH approval label is pertinent. The degree of cleanliness required of the label while the respirator is in service should not be an issue because the label only needs to be legible and reasonably clean to provide the required information. Any dust, dirt, paint overspray, or other substance that completely obscures the label would also affect respirator cleanliness and the service life of the filter, resulting in replacement of the filter with new filters that have unobscured labels, as required by paragraph (g).

In summary, final paragraph (j) combines into a single provision the proposed requirements that employers ensure that the manufacturer's NIOSH approval label is on the cartridge, filter, or canister, and that employers maintain the labels in legible condition while the cartridge, filter, or canister is in service. As with the proposed paragraphs, this provision is a performance-based requirement that permits employers to adopt whatever procedures are appropriate to ensure that the label remains on the filter and is not removed, defaced, or obscured during respirator use.

Paragraph (k)—Training and Information

Paragraphs (k)(1)–(3) of the final standard require employers to provide effective training for employees required by the employer to wear respirators. Employees must be trained sufficiently to be able to demonstrate a knowledge of why the respirator is necessary; how improper fit, usage, or maintenance can compromise the protective effect of the respirator; the limitations and capabilities of the selected respirator; how to deal with emergency situations involving the use of respirators or with respirator malfunction; how to inspect, don and remove, and check the seal of the respirator; procedures for maintenance and storage of the respirator; the medical symptoms and signs that may limit or prevent the effective use of respirators; and the general requirements of this standard.

Paragraph (k)(4) allows for the ''portability'' of previous respirator training, and paragraph (k)(5) specifies the requirement for at least annual retraining. Also, as discussed earlier under the Summary and Explanation for paragraph (c), Respiratory Protection Program, final paragraph (k)(6) requires employers to provide the basic advisory information presented in Appendix D of this section to employees who voluntarily use respirators in their workplace.

The final standard requires that training be understandable and be given to the employee prior to using a respirator in the workplace, and annually thereafter. Additionally, if the employer has reason to believe that any employee who has already been trained does not have sufficient understanding and skill to use the respirator, the employer must retrain the employee in those areas in which his or her knowledge or skill is deficient. Retraining is also required when changes in the workplace or in the type of respirator used render previous training obsolete.

Section 1910.134(e)(5) of the previous standard required training in the selection, use, and maintenance of respirators and required respirator wearers to be provided an opportunity to handle the respirator, have it fitted properly, test its facepiece seal, and wear it in normal air for a familiarity period. The final training paragraph retains many of these provisions. However, the format of the final training provisions is different, and specific provisions for annual training and retraining are included in the final standard. Although the previous standard's requirement for a familiarity period has not specifically been retained, the final standard requires the respirator wearer to be trained sufficiently to demonstrate the ability to use the respirator properly, which may or may not necessitate wearing the respirator in normal air ''for a long familiarity period.''

The record shows widespread agreement that employee training is a critical part of a successful respiratory protection program and is essential for correct respirator use (Exs. 15–13, 15–18, 15–19, 15–22, 15–30, 15–33, 15–41, 15–45, 15–50, 15–53, 15–54, 15–67, 15–79, 54–5, 54–68, 54–91, 54–92, 54–165, 54–172, 54–208, 54–219, 54–278, 54–361, 54–387, 54–428, 54–455, Tr. 186, 387, 595, 1011, 1063, 1083, 1103, 1226).

For example, James Johnson of the Lawrence Livermore National Laboratory testified:

> The training element of the respiratory protection program is one of the most important elements to assure the respirator is properly used and is performing as intended * * *. This is the only time that the worker has a chance to interact with a trained professional who can properly instruct that person on the correct use of the respirator, the employee can see what is right, what doesn't work, and can understand this item that is given to him to wear throughout a year to help protect his health * * * (Tr. 186)

Dan Faulkner of the United Steelworkers of America concurred, commenting that:

> Training must be seen as a critical component of respiratory protection. This is an area that is grossly ignored under the current regulation * * *. The very first step in the education process must be to empower workers to identify the hazardous substances involved and at what levels they are exposed. In order for the workers to have confidence that his/her respirator is providing the necessary protection from the hostile work environment they must have a thorough knowledge of this entire process. Once this is understood, the worker can make an informed decision on what type of respirator to wear. (Tr. 1062)

ASARCO, Inc. (ASARCO) agrees about the importance of training and reports that its company Respiratory Protection Program Manual states: ''For the safe use of any respirator, it is essential that the user be properly instructed in the respirator's purpose, selection, fitting, use, and limitations' (Ex. 163).

OSHA agrees with the many commenters who urged OSHA to mandate a program that is performance oriented and can be presented informally (Exs. 15–13, 15–18, 15–22, 15–30, 15–41, 15–47, 15–62, 15–73, 15–75, 54–213, 54–265, 54–275, 54–455). The final standard does not specify how the training is to be performed nor the format to be used by the employer. As suggested by commenters (Ex. 15–53, Tr. 837, Tr. 1087), the employer can use

whatever training method is effective for the particular worksite, provided that the method addresses the required topics. Employers can use prepared materials such as audio-visual and slide presentations, formal classroom instruction, informal discussions during safety meetings, training programs developed or conducted by unions or outside sources such as respirator manufacturers, or a combination of these methods.

As in the proposal, several categories of training information must be addressed in the final rule. The final provisions have been simplified since the proposal, but the information to be covered is essentially the same as that proposed.

Paragraph (k)(1) requires the employer to ensure that before the employee uses the respirator in the workplace, the employee demonstrates that he/she has learned the information communicated under the training program. The employer can comply with this provision by reviewing with the employee, either in writing or orally, the informational part of the training program and by reviewing the employee's hands-on use of respirators.

OSHA's personal protective equipment standard (§ 1910.132(f)(2)) also requires that employees demonstrate effectiveness in using PPE before workplace use. When that standard was adopted in 1994, OSHA stated that ''in order for training to be successful, clear and measurable objectives must be set, and employees must demonstrate that the training objectives have been reached by showing that they understand the information provided and that they can use the PPE properly'' (59 FR 16339). This reasoning applies equally to respiratory protection. In the NPRM for the respiratory protection standard (proposed paragraph (k)(1)(iii)), OSHA proposed a similar requirement, which stated that the training itself was to include ''sufficient practice to enable the employee to become * * * effective in performing tasks [relating to inspection, donning and removal, checking the fit and seals, and in wearing the respirator.]''

The final standard's requirement that employees ''demonstrate'' competence in using respiratory equipment is supported by the recommendation of commenters that the PPE standard's similar requirement replace the less direct provision in the respiratory protection proposal (Exs. 54–213, 54–319). OSHA's enforcement of the PPE standard has reinforced the Agency's belief that training effectiveness must be evaluated by demonstrating how well employees use equipment on-the-job. OSHA believes that adopting a provision in the respirator standard that is worded similarly to the corresponding requirement in the PPE standard will promote compliance with both standards and uniformity of interpretations and enforcement actions. Moreover, measuring the adequacy of training by evaluating the employee's knowledge gained from the training is consistent with the performance orientation of the final standard and with the absence of specific hourly training requirements in the final standard.

The first category of information to be included in the training program, specified in final paragraph (k)(1)(i), is a discussion of why the use of the respirator is necessary. Proposed paragraph (k)(1)(i) specifically set forth that this discussion was to include information on the nature, extent, and effects of the respiratory hazards to which the employee may be exposed while using the respirator. The language of final paragraph (k)(1)(i) has been simplified; OSHA believes that training in why the respirator is necessary will include information on the nature, extent, and effects of the respiratory hazards. For example, such training would address the identification of the hazardous chemicals involved, the extent of employee exposures to those chemicals, and the potential health effects of such exposure. Much of this information will be available on the Material Safety Data Sheets that chemical manufacturers provide to employers under the Hazard Communication standard (29 CFR 1910.1200). Employee training on the health effects of hazardous chemicals is also required under the Hazard Communication standard, and the same training could help satisfy this respirator training requirement. Many commenters agreed that hazard information is an essential element of training (Exs. 15–10, 15–14, 15–18, 15–19, 15–27A, 15–41, 15–46, 15–53, 15–62, 15–73, 54–5, 54–68, 54–91, 54–165, 54–172, 54–208, 54–278, 54–361, 54–428, 54–455).

Information regarding the consequences of improper fit, usage or maintenance on respirator effectiveness must also be provided to employees under final paragraph (k)(1)(i). Improper attention to any of these program elements would obviously defeat the effectiveness of the respirator. Employees must understand that proper fit, usage and maintenance of respirators is critical to ensure that they can perform their protective function.

Under final paragraph (k)(1)(ii), employers are to explain the limitations and capabilities of the respirator selected for employee use. A discussion of the limitations and capabilities of the respirator must address how the respirator operates. This training would include, for example, an explanation of how the respirator provides protection by either filtering the air, absorbing the vapor or gas, or providing clean air from an uncontaminated source. Where appropriate, it also should include limitations on the use of the equipment, such as prohibitions against using an air-purifying respirator in IDLH atmospheres and an explanation of why such a respirator should not be used in such situations.

Paragraph (k)(1)(iii) requires that employees be provided with information on respirator use in emergency situations, including those in which the respirator malfunctions. This training requirement was included in proposed paragraph (k)(1)(v). Respirators malfunction on occasion, work routines change, and emergency situations occur that require a different respirator. The training program must discuss these possibilities and the procedures the employer has established to deal with them. Commenters concurred that comprehensive training is necessary where respirators are to be used in IDLH situations, including oxygen-deficient atmospheres, such as those that occur in firefighting, rescue operations and confined area entry (Exs. 15–18, 15–19, 15–26, 15–31, 15–33, 15–37, 15–41, 15–48, 15–50, 15–54, 15–55, 15–56, 15–59, 15–70).

The employee should be able to thoroughly understand the operation of the respirator as a result of this training and demonstrate the ability to properly use the respirator selected. Numerous commenters supported the elements in the training program provided for under final paragraphs (k)(1) (ii) and (iii) (Exs. 61–3, 15–14, 15–18, 15–27A, 15–41, 15–46, 15–53, 15–62, 15–73, 54–5, 54–68, 54–91, 54–172, 54–208, 54–361, 54–428, 54–455). For example, Michael P. Rehfeld, Safety Officer, Westminster Fire Department, stated that:

> In section (k) of the NPRM dealing with training, I strongly believe OSHA should put the strongest emphasis. It has been my experience that the stronger the employer training program the less likely that an employee would become injured or dies from a respiratory protection failure. OSHA has historically put a strong emphasis on training (1910.120, 1910.1200, 1910.138, 1910.146). The same emphasis should appear in this rule (Ex. 54–68).

Final paragraph (k)(1)(iv) requires the employer to provide specific instruction on how respirators are inspected, donned, removed, positive/negative pressure checked, and worn. Although the employer is required to ensure that respirator inspections are performed, employees using the equipment may frequently be responsible for inspecting the respirators assigned to them. In this case it is necessary that respirator users have this process explained and demonstrated to them so that they are capable of recognizing any problems that may diminish the protective capability of the respirator. The training must include the steps employees are to follow if they discover any problems during inspection, such as to whom problems should be reported and where replacement equipment can be obtained if needed. If, however, the employer routinely has extensive inspections done by separate personnel, individual respirator wearers are not required to be trained in how to perform full inspections. Training only in those parts of the inspection process that may be their responsibility would be sufficient.

The training under this paragraph must also include the procedures for donning and removing the respirator, checking the fit and seals, and using the respirator. Respirator fit in the workplace must be as close as possible to the fit obtained during fit testing; therefore, employees must know how to follow procedures that will improve fit in the workplace. The fit testing procedures can also help in training employees. For example, employers can use quantitative fit testing procedures to demonstrate to employees the dramatic improvement in measured fit when the respirator is adjusted properly (See the discussion above of paragraph (f) and Ex. 15–44, Tr. 1083).

Final paragraph (k)(1)(iv) requires training in how to check the respirator seal. Appendix B–1 describes methods for checking the seal of positive and negative pressure facepieces. Employees must be trained in the methods set forth in Appendix B–1 or in alternative methods that are equally effective. The training requirements set forth in paragraph (k)(1)(iv) were widely supported in the record (Exs. 15–10, 15–14, 15–22, 15–27A, 15–41, 15–46, 15–50, 15–62, 15–73, 54–5, 54–68, 54–91, 54–165, 54–172, 54–208, 54–219, 54–278, 54–361, 54–428, 54–455).

Final paragraph (k)(1)(v), like proposed paragraph (k)(1)(iv), requires the employer to explain the procedures for maintenance and storage of respirators. The extent of training required under this provision may vary according to workplace conditions. In some cases, where employees are responsible for performing some or all respirator maintenance and for storing respirators while not in use, detailed training in maintenance and storage procedures may be necessary. In other facilities where specific personnel or central repair facilities are assigned to perform these activities, employees may need only to be informed of the maintenance and storage procedures without having to learn significant technical maintenance information. The importance of providing some knowledge to all employees regarding maintenance and storage of respirators was recognized by a number of commenters. Those commenters stated that employees must be able to identify respirator deficiencies that can result from improper maintenance and storage of respirators so that they will not use improperly functioning respirators (Exs. 61–3, 61–8, 15–10, 15–14, 15–27A, 15–41, 15–46, 15–50, 15–62, Tr. 1063).

Final paragraph (k)(1)(vi) requires that employees be instructed in ways to recognize the medical signs and symptoms that may limit or prevent the effective use of respirators. This provision was not included in the proposed standard. However, the Agency agrees with the AFL–CIO (Ex. 54–428) that employee knowledge of this information is important to ensure implementation of a successful respirator program. An employee's knowledge of the medical problems that may preclude the employee from using some types of respirators or from wearing a respirator under certain workplace conditions helps assure that the employee receives the protection intended by the standard. Examples of medical conditions and signs and symptoms that may affect an employee's ability to use a respirator are provided in mandatory Appendix C of the final standard. Training in these signs and symptoms need not be medically sophisticated or burdensome. Employees must be provided only with medical information sufficient for them to recognize the signs or symptoms of medical conditions (e.g., shortness of breath, dizziness) that may affect their use of respirators. This information will also enable employees to understand the purpose of the medical assessment procedures required under paragraph (e) of the final standard, will improve the ability of employees to recognize and report medical signs and symptoms, and will give them the knowledge they need to initiate the follow-up medical evaluations required under paragraph (e) of this section, if necessary.

Final paragraph (k)(1)(vii) requires the employer to inform employees of the general requirements of this section. OSHA agrees with Organization Resources Counselors (Ex. 54–424) that ''general requirements'' better describes the substantive purpose of this provision than did the word ''contents,'' which was used in proposed paragraph (k)(1)(vi). OSHA believes it is necessary to ensure that employees know, in general, the employer's obligations under the standard with respect to employee protection. This discussion need not focus on the details of the standard's provisions but could, for example, simply inform employees that employers are obligated to develop a written program, properly select respirators, evaluate respirator use, correct deficiencies in respirator use, conduct medical evaluations, provide for the maintenance, storage, and cleaning of respirators, and retain and provide access to specific records.

Proposed paragraph (k)(1)(vi) would have required that employees be provided with information on the written respiratory protection program, as well as the location and availability of the written program and the standard. These elements are omitted from final paragraph (k)(1)(vii) because they are addressed in other provisions of the final standard. For example, employee access to the standard and written program is required under final paragraph (m)(4), and employee knowledge about the written respirator program will be imparted to employees under the training required by final paragraph (k)(1), which specifies the elements to be included in the written respirator program.

All of the training elements are important. They are presented in performance language to give the employer flexibility to adapt the training to specific workplace conditions and to the respirators used. Unless the training information is presented in a way that employees can understand, the training will not be effective. Therefore, final paragraph (k)(2) requires that training be conducted in a way that is understandable to employees. Employers should develop training programs based upon their employees' educational level and language background. This will ensure that all employees will receive training that will enable them to maximize the effectiveness of the respirators they use. Inclusion of a provision addressing training comprehension was supported in the record (Tr. 166) and is consistent with similar requirements in other recent OSHA rulemakings (Cadmium, 29 CFR 1910.1027; Bloodborne

pathogens, 29 CFR 1910.1030; Formaldehyde, 29 CFR 1910.1048).

Final paragraph (k)(3) requires the employer to provide training before the employee uses a respirator in the workplace. This provision was included under proposed paragraph (k)(2) and was widely supported by rulemaking participants (Tr. 1011, Tr. 1986; Exs. 54–91, 54–165, 54–196, 54–234, 54–267, 54–278, 54–298, 54–319, 54–334, 54–361, 54–387, 54–428, 54–455). No comments opposing this requirement were received.

Final paragraph (k)(4) provides that an employer who can demonstrate that a new employee has received training within the last 12 months that addressed the elements specified in paragraph (k)(1)(i) through (vii) is not required to repeat such training provided that, as required by paragraph (k)(1), the employee can demonstrate knowledge of the element(s). Employers availing themselves of this provision must, however, provide subsequent training no later than 12 months from the date of the previous training, as required by final paragraph (k)(4).

An employee who has been trained in the use of respirators who moves to another job that involves the use of respirators may not need to take all of the initial training prescribed in paragraph (k)(4). Prior training in the topics required by the standard may remain relevant in the new work setting. Thus, OSHA is permitting limited ''portability'' of training, as noted in the standard. Training in the elements listed in paragraph (k)(1) that has been provided in the past 12 months by a previous employer may be taken into account by the new employer when evaluating the training needs of that new employee.

The employer must demonstrate that the employee has received the prior training and retained the necessary knowledge before the prior training can be accepted as meeting the requirements of paragraph (k). Discussions with the employee and with the previous employer may be used to determine whether the previous training has been sufficient to enable the employee to wear, use, and care for the respirator successfully. If the employer cannot demonstrate that the new employee has been trained in the required elements of the program, and understands these elements, the new employer is obligated to train the employee. In cases where training in some elements is lacking or inadequate, the employer is required by paragraph (k)(4) to provide training in those elements.

Final paragraph (k)(5) requires retraining annually and when certain situations occur. The requirement for annual training was strongly supported by management, labor, and other rulemaking participants as being necessary to ensure the continuing effectiveness of the respirator program (Exs. 15–10, 15–18, 15–19, 15–20, 15–37, 15–44, 15–47, 15–48, 15–50, 15–54, 15–55, 15–71, 54–91, 54–157, 54–165, 54–173, 54–208, 54–222, 54–245, 54–265, 54–292, 54–319, 54–332, 54–361, 54–363, 54–387, 54–424, 54–427, 54–428, 54–442, 54–455, 122, 166; Tr. 187, 443, 547, 614, 1011, 1022, 1226, 1768). For example, the Railway Labor Executive Association testified:

> The training requirements as proposed should be mandated on an annual basis . . . Such a training schedule will assure continuous familiarization with the equipment and will serve to negate the inevitable effects of complacency on the part of both the employer and the employee. (Tr. 443)

Exxon stated that ''Annual training is good so the employee will feel comfortable with the respirator they will be using in the future'' (Tr. 547). James Johnson of Lawrence Livermore National Laboratory testified that annual training is ''. . . necessary to ensure a reasonable amount of recall and performance . . . '' (Tr. 187). Eastman Chemical Company (Ex. 54–245) commented that ''Eastman supports [the] annual training requirement . . . our Company believes this is necessary to adequately train employees.'' ASARCO and U.S. Steel require that their employees who wear respirators undergo annual training, and ASARCO states in its Respiratory Protection Manual that:

> All respirator wearing employees shall be given annual training on routine respirator use. . . . Applicable individuals will also be thoroughly instructed and trained annually in the use of respiratory protection and necessary procedures for non-routine or emergency situations. (Ex. 163)

The Respirator Protection Program training manual for U.S. Steel, submitted by AISI, requires that: ''Each respirator wearer should be retrained at least annually. Where necessary, more frequent training should be performed. The required use of respirators should be specified in routine training aids such as Safe Job Procedures.'' (Ex. 142)

A number of commenters recommended that training should be required less frequently than annually (Exs. 15–41, 54–316, 54–324) or should be required only in response to a change in the respirator program (Exs. 54–168, 54–172, 54–178, 54–187, 54–213, 54–234, 54–267, 54–273, 54–275, 54–278, 54–297, 54–307, 54–316, 54–324, 54–334, 54–352, 54–389, 54–408, 54–434). Other commenters recommended more frequent (than annual) training for employees required to use SCBAs, or for employees who may be required to use respirators in emergency situations (Exs. 54–210, 54–290, 54–363, 54–410, 54–424).

OSHA believes that annual training is necessary and appropriate to ensure that employees know about the respiratory protection program and that they cooperate and actively participate in the program. Further, as specifically noted by several witnesses at the hearing, annual training is necessary so that employees will be confident when using respirators (Tr. 547, Tr. 595). Annual training will also eliminate complacency on the part of both the employer and employees with respect to respirator use (Tr. 443), and annual training will ensure a reasonable amount of recall and performance on the part of the respirator user (Tr. 187). In addition, periodic training provides an opportunity for the employee to interact with trained professionals who can provide instruction and understanding in the correct use of the respirator (Tr. 186), which will serve to overcome employee resistance to proper respirator use (Tr. 1021). OSHA also believes that employee interaction with respirator instructors on at least an annual basis will reinforce employee knowledge about the correct use of respirators and other pertinent elements of the respiratory protection program.

Commenters requesting that training be required less frequently than annually provided no substantive data demonstrating that training every two years, for example, would be sufficient for respirator users to retain information critical to the successful use of respirators on a continuing basis (Exs. 54–316, 54–324). Less frequent periodic training would tend to diminish employee attention to proper respirator use and may result in a long period of poor respirator practice before problems are identified and corrected. OSHA notes that both the ANSI Z88.2–1980 and Z88.2–1992 respiratory protection standards provide for annual retraining. Further, annual periodic training of workers with respect to the use of respirators is required in other OSHA standards (i.e., 29 CFR 1910.1001, Asbestos; 29 CFR 1910.1017, Vinyl chloride; 29 CFR 1910.1018, Arsenic; 29 CFR 1910.1025, Lead; 29 CFR 1910.1029, Coke oven emissions; 29 CFR 1910.1043, Cotton dust; 29 CFR 1910.1044, Dibromochloropropane (DBCP); 29 CFR 1910.1045, Acrylonitrile; 29 CFR 1910.1047, Ethylene oxide; and 29 CFR 1910.1048, Formaldehyde). In addition, OSHA's

compliance experience has demonstrated that inadequate respirator training is a common problem (Ex. 33–5), and is often associated with respirator program deficiencies that could lead to employee exposures to workplace contaminants. Adherence to annual training will minimize respirator misuse. Thus, the Agency's experience under other rulemakings, as well as its compliance experience with the previous respiratory protection standard, serve, in part, as the basis for concluding that annual training for respirator users under this final standard is reasonable and appropriate.

As noted above, a number of commenters argued that training should be required only to inform employees about changes in the respirator program. This view suggests that regular, periodic training in the use of respirators is not necessary to ensure the success of a respirator program. However, as discussed above, evidence provided by management, labor, and other participants in this and other rulemaking records demonstrates the importance of reinforcing an employee's knowledge with respect to the use of respirators on a regular basis to ensure the successful use of respirators. Accordingly, the final standard in paragraph (k)(5) includes the requirement for annual training for respirator users. This provision ensures the successful implementation of the respiratory protection program by keeping employees thoroughly and accurately informed on a regular basis regarding the current status of the program.

Several commenters recommended that training be provided more frequently than annually to users of SCBAs and to employees who are required to use respirators during emergency situations (Exs. 54–210, 54–290, 54–363, 54–410, 54–424). OSHA agrees that retraining more frequently than annually may be appropriate for some users of SCBAs and emergency responders. This concern is addressed in final paragraph (k)(5), which contemplates such additional training in circumstances in which the employer has reason to believe that a previously trained employee does not have the understanding and skill required to use the respirator properly on a continuing basis. Although this provision is performance oriented, it requires that more frequent (than annual) periodic training be provided if necessary (e.g., because of the complexity of the respirator or exposure conditions). If respirator users must be trained more frequently than annually to retain the knowledge necessary to ensure proper use of the respirator, then the employer must provide the additional training.

Final paragraphs (k)(5)(i)–(iii) require additional training when changes in the workplace (process change, increase in exposure, new hazards) or in the type of respirator used by the employee render previous training obsolete, when the employee has not retained the requisite understanding or skill to use the respirator properly, or when any other situation arises in which retraining appears necessary. These provisions recognize circumstances that require supplemental training in addition to full annual training. For example, retraining with respect to the nature of the hazard may be necessary because of an increase in the workplace level of a hazardous substance. Retraining would also be required when an employee does not sufficiently understand any program element (Ex. 54–387). OSHA believes that the regulatory burden imposed on employers by final paragraph (k)(5) will be minimal because this paragraph only requires element-specific retraining on an as-needed basis to supplement annual training.

Final paragraph (k)(6) provides very basic protection for employees who use respirators voluntarily. As discussed, in connection with paragraph (c)(2), such employees are only covered by those provisions of this standard that are necessary to ensure that respirator use does not present a health hazard to these employees. Respirator use can create health and safety problems. For example, an employee who has chronic obstructive lung disease and who is given a negative pressure air-purifying respirator to wear may be at risk of hypertension, overexertion, and dizziness. Employees who voluntarily use some types of respirators (e.g., air-purifying respirators) are potentially exposed to the hazards associated with respirator use. Consequently, in paragraph (k)(6), OSHA requires employers to provide employees who voluntarily use some types of respirators (e.g., air purifying respirators) with the informational material in Appendix D so that the employee will be familiar with basic respirator use procedures.

Paragraph (l)—Program Evaluation

Paragraph (l) requires employers to perform evaluations to determine whether the respiratory protection program is functioning effectively. Problems with protection, irritation, breathing resistance, comfort, and other respirator-related factors occasionally arise in most respiratory protection programs. Although it is not possible to eliminate all problems associated with respirator use, the employer must eliminate as many problems as possible to improve respiratory protection and encourage employee acceptance and safe use of respirators. Eliminating problems is accomplished most effectively when the respiratory protection program is evaluated thoroughly and revised as necessary. Although the previous respiratory protection standard requires that the employer perform regular checks of the effectiveness of the respiratory protection program, it provided little guidance regarding how these evaluations are to be done. The final rule, like the proposal, describes the required program evaluation with greater specificity than OSHA's previous respiratory protection standard did.

Final paragraph (c) of the respirator standard requires the employer to establish a written respiratory protection program. The program must include procedures for evaluating the effectiveness of the respirator program and must designate a program administrator who is to monitor conditions in the workplace on a regular basis to ensure that the provisions of the written respiratory protection program are being properly implemented. Final paragraph (l) specifies certain steps the employer must take as part of his/her regular evaluation of the respiratory protection program.

Paragraph (l) requires the employer to consult employees who use respirators to ascertain whether they perceive any problems with the equipment and to obtain their views on program effectiveness. This assessment must evaluate such factors as difficulty breathing or fatigue during respirator use, whether the respirator interferes with hearing and vision, communication, or job performance or restricts movement, whether the respirator causes discomfort, and whether the employee has confidence in the respirator's effectiveness. The employer must correct any problems that are revealed by the evaluation.

The record supports the need to review and evaluate workplace respirator use to ensure the continuous effectiveness of the respirator program (Exs. 54–91, 54–153, 54–181, 54–213, 54–219, 54–234, 54–244, 54–252, 54–263, 54–265, 54–54–286, 54–297, 54–330, 54–352, 54–387, 54–424, 54–428, 54–455, Tr. 387, 1012, 1714, 1733, 1998). Based on the record, however, the final program evaluation provisions were modified, as discussed below, from those proposed.

Final paragraph (l)(1) requires the employer to conduct regular evaluations of the workplace to ensure that the

provisions of the written program are being properly implemented for all employees required to use respirators, and to ensure the continued effectiveness of the program. Proposed paragraph (l)(1) required the employer to review the written respiratory protection program at least annually and to conduct frequent random inspections of the workplace to ensure that the provisions of the program are being properly implemented for all employees. The review of the written program was to include an assessment of each written program element specified under proposed paragraph (c)(1) of the standard.

The final standard under paragraph (l) has deleted the proposed provisions for annual written program review of each element and ''frequent random'' workplace evaluations in favor of more performance-oriented requirements. Although a number of commenters supported annual written program review (Exs. 54–91, 54–153, 54–181, 54–213, 54–244, 54–265, 54–361, 54–387, 54–424, 54–428), others asserted that program review was necessary but should only be required on an as-needed, rather than annual, basis as necessitated by workplace or user conditions or characteristics (Exs. 54–177, 54–234, 54–263, 54–286, 54–297, 54–330, 54–352, 54–402, Tr. 1733). The Chemical Manufacturers Association (CMA) (Ex. 54–263), for example, stated:

> For simple programs such as a single air purifying respirator in use with a single contaminant, assessments might be necessary once every 3–5 years. For programs with numerous hazards that change repeatedly such as batch processes, reviews may be needed more frequently.

The CMA (Ex. 54–263) and Mobil Corporation (Ex. 54–234) support adoption of the ANSI Z88.2 (1992) recommendation that reads ''The program shall be periodically audited to ensure that it is implemented and reflects the written procedures.'' Consumer Power (Ex. 54–297) argued that program review and revision should be required ''as necessary to reflect changes in respirator used, training, fit test methods, and storage or maintenance of the respirator in use at the facility.''

OSHA agrees with commenters that a more performance-oriented approach with respect to written program review is appropriate in lieu of an annual requirement. The Agency believes that the final standard will ensure the maintenance of an up-to-date written respirator program without imposing an arbitrary review schedule. Final paragraph (c)(1) states, in part, that the program shall be updated as necessary to reflect changes in workplace conditions and respirator use. This provision requires employers to review the written program and to revise, as necessary, the written program elements specified in paragraph (c)(1) when workplace conditions affecting the use of respirators change.

Accordingly, the final standard does not contain the proposed requirement for an annual written program review but instead requires program review and revision as necessary based on workplace changes. Evaluation frequency to ensure the continued effectiveness of the program is to be based on program complexity and on factors such as the nature and extent of workplace hazards, types of respirators in use, variability of workplace processes and operations, number of respirator users, and worker experience in the use of respirators. In other words, the employer must audit respirator use in the workplace with sufficient frequency to ensure that continuous, successful implementation of all written respirator program elements prescribed under paragraph (c) is being achieved.

As noted previously, the proposed requirement for ''frequent random'' workplace evaluations has been deleted in favor of a requirement for evaluations conducted on an as-necessary basis. OSHA agrees with commenters' assertions that the meaning of the term ''frequent random'' was unclear (Exs. 54–181, 54–334), especially with respect to conditions of infrequent or brief respirator use (Exs. 54–166, 54–177). In such instances, the commenters indicated that evaluations would have to be scheduled based on when respirators are used. The Agency believes that the final standard's evaluation procedures incorporate a flexible and reasonable approach that will meet the needs of different workplaces while ensuring continued, effective implementation of the respirator program. OSHA emphasizes that the change in language in the final standard is not intended to deemphasize the importance of conducting evaluations.

Final paragraph (l)(2) requires the employer to consult regularly with employees who wear respirators to obtain their views on the effectiveness of the program and to correct any problems that are identified. This assessment must determine if the respirators are properly fitted. It must also evaluate whether employees are able to wear the respirators without interfering with effective workplace performance, whether respirators are correctly selected for the hazards encountered, whether respirators are being worn when necessary, and whether respirators are being maintained properly. Many commenters (Exs. 54–91, 54–153, 54–181, 54–213, 54–265, 54–361, 54–387, 54–424, 54–488) supported the proposed requirement for the employer periodically to consult with employees.

This requirement is essentially unchanged from the proposed provision. Some commenters (Exs. 54–187, 54–278) argued that the employer's obligations to consult with employees should be limited to those employees required by OSHA to wear respirators. However, as explained in detail in the Summary and Explanation for paragraphs (a) and (c), OSHA believes that all employees who are required to wear respirators should be covered by the program, regardless of whether their respirator use is required by OSHA or their employer.

Thus, final paragraph (l)(2) requires the employer to consult with employees who wear respirators when auditing the effectiveness of the respirator program. As discussed above in connection with paragraph (c), OSHA has consistently required employers who provide their employees with respirators to ensure that those respirators do not pose a health hazard (e.g., do not increase the work-of-breathing in a way that threatens health, do not impair vision or hearing). In general, assessments conducted to comply with paragraph (l) will involve a technical evaluation of whether respirators are being used properly. If respirators are not being used properly, the employer is required to correct any problems found during the assessment. The areas to be reevaluated include whether the respirator program is providing employees with properly fitting respirators and whether the appropriate respirators are being selected, used, and maintained properly.

Proposed paragraph (l)(2)(i), which would have required the employer to assess whether the program was ''preventing the occurrence of illness,'' has been deleted from the final rule. Commenters noted that the individual performing the program evaluation under this paragraph is not likely to be a health care professional with sufficient expertise to identify illnesses caused by improper respirator use, other than skin/eye irritation, which can readily be observed by the program administrator, supervisor, employer, or employee. Commenters argued that medical determinations and evaluations are part of the review of an employee's medical status required by paragraph (e) of this section (Exs. 54–187, 54–237). OSHA agrees and, accordingly, has

omitted this proposed requirement from final paragraph (l)(2). However, identification of respirator-related medical conditions, such as skin irritation, would properly be part of the program evaluation. Employees identified during the evaluation as having skin irritation can either be referred to the PLHCP or be advised by the program administrator about the need to leave the respirator use area as necessary to wash the face and facepiece, as permitted by paragraph (g). It should be noted that final paragraph (e)(7)(iii) requires medical evaluation if observations made during the program evaluation indicate that such evaluation is necessary.

Paragraph (m)—Recordkeeping

The final standard requires the employer to establish and retain written information regarding medical evaluations, fit testing, and the respirator program. The final provisions addressing these records differ in some respects from the proposed requirements. In the proposed rule, paragraph (c) contained recordkeeping provisions for the written respiratory program, paragraph (m) required retention of medical evaluation records, and fit testing records were required to be maintained under Appendix A. In the final rule, however, all recordkeeping requirements have been consolidated in paragraph (m), in response to those commenters who suggested that placing all recordkeeping provisions in one paragraph will improve understanding of the rule's recordkeeping obligations (Exs. 54–267, 54–286).

Paragraph (m)(1) of the final standard requires the employer to retain a medical evaluation record for each employee subject to medical evaluation under final paragraph (e). Such records are to be kept and made available as required by 29 CFR 1910.1020, OSHA's Access to Employee Exposure and Medical Records rule. The record is to include the result of the medical questionnaire and, if applicable, a copy of the PLHCP's written opinion and recommendations, including the results of relevant medical examinations and tests. It is standard medical practice to make and retain written records of medical examinations and evaluations. Retention of such records will enable PLHCPs in subsequent evaluations to determine whether the employee's health has deteriorated, and will enable employees to obtain copies for their personal physician or other licensed health care professional to review as necessary.

Although the format of final paragraph (m)(1) has been simplified from that of the proposed rule, the substance of the medical evaluation records to be retained is similar. Several proposed paragraphs referred specifically to provisions in 29 CFR 1910.1020 that address the maintenance, availability, and transfer of the medical evaluation records. As recommended by several commenters, however, only one reference to 29 CFR 1910.1020 is needed for this purpose, and the final respiratory protection rule has been revised accordingly (Exs. 54–220, 54-350, 54–362, 54–455, Tr. 1054).

Final paragraph (m)(2) addresses the retention of respirator fit-testing records. The provisions of this paragraph remain basically unchanged from the requirements of Appendix A, section II. 12 of the proposal. The records specified in final paragraphs (m)(2)(i)(A)—(E) consist of the name or identification of the person tested; the type of fit test performed (QLFT, QNFT—irritant smoke, saccharin, etc.); the make, model, and size of the respirator fitted; the date of the fit test; pass/fail results if a QLFT is used; or the fit factor and strip chart recording or other record of the test results if quantitative fit testing was performed.

Under final paragraph (m)(2)(ii), the fit test record must be maintained until the next fit test is administered. If the employee's use of a respirator is discontinued (e.g., because of a change of duties or successful implementation of engineering controls), fit test records need not be retained for the employee. Fit test records must be maintained to determine whether annual fit testing has been done, and whether the employee who was tested passed the QLFT or passed the QNFT with a fit factor that was appropriate for the type of respirator being used. OSHA agrees with commenters (Exs. 36–6, 36–17, 36–34, 36–46, 54–165, 54–210) who stated that fit testing records must be maintained to ensure that all respirator users have received a fit test, the respirator selected by fit testing is being used, and retesting is being performed annually.

Some commenters argued that the employer should only be required to certify that fit testing has been completed, and that retaining the other proposed information would provide little additional benefit (Exs. 54–222, 54–310). OSHA disagrees with this position. The Agency believes it is essential that fit test records identify the respirator and employee being fit tested. As noted in the preceding paragraph, other commenters stated that the information in this record would be the only means of determining whether the appropriate respirator was being used by the employee. OSHA believes that the effectiveness of the respiratory protection program will be substantially improved if these records are kept. Similar recordkeeping requirements are found in many OSHA standards: 29 CFR 1910.1027, Cadmium; 29 CFR 1910.1028, Benzene; 29 CFR 1910.1048, Formaldehyde; 29 CFR 1910.1050, Methylenedianiline.

Final paragraph (m)(3) specifically requires employers to maintain a written copy of the current respiratory protection program prescribed by final paragraph (c). As discussed under paragraph (c), a written program is necessary to assure the appropriate use of respirators and the on-going effectiveness of the program.

Final paragraph (m)(4) provides that written materials required to be maintained under final paragraph (m) must be made available, upon request, to employees and to the Assistant Secretary for examination and copying. This final paragraph replaces, but is consistent with, the record availability requirement of proposed paragraph (m)(2). Employee access to these records is necessary to ensure that employees can assess and verify information describing their exposure to respiratory hazards in the workplace and the effectiveness of the respirator program in protecting them from those hazards. Access to these records by the Assistant Secretary or his or her designees is necessary to allow OSHA to monitor compliance with the standard and its effectiveness.

The access provisions in final paragraph (m)(4) are consistent with provisions found in other OSHA standards: 29 CFR 1910.1001, Asbestos; 29 CFR 1910.1027, Cadmium; 29 CFR 1910.1028, Benzene; 29 CFR 1910.1047, Ethylene Oxide; 29 CFR 1910.1048, Formaldehyde; and 20 CFR 1910.1050, Methylenedianiline.

Paragraph (n)—Dates

The final Respiratory Protection standard will become effective on April 8, 1998. For most requirements of the standard, however, compliance need not be achieved until the start-up dates specified in paragraph (n) of the final rule. Unless a different start-up date is specified for a particular requirement, compliance must be achieved by the effective date.

The proposal would have required compliance with all provisions of the standard 90 days after publication of the final standard in the **Federal Register**. The Air Conditioning Contractors of America (Ex. 54–248) stated that a 90-day compliance period should be

sufficient if OSHA plans to disseminate information to employers in a ''user-friendly'' format, but that additional time would be required if industry organizations had to analyze and distribute information on the final standard by themselves. Several commenters recommended a 6–12 month effective date for implementing the final standard (Exs. 54–248, 54–271, 54–283, 54–293, 54–309). The U.S. Enrichment Corporation (Ex. 54–283) wanted the standard phased in over a 12-month period to allow additional time for the employer to obtain respiratory protection equipment from manufacturers and to perform fit testing. The American Subcontractors Association (Ex. 54–293) stated that small contractors rely on their organization and others for education and training regarding new standards, and that a 90-day period is too short a period for transition to a new program. They specifically mentioned training, updating written programs, changing written standard operating procedures (SOPs), and medical examinations as provisions in the standard that may be difficult to comply with in a short time period. The Associated Building Contractors (Ex. 54–309) also wanted the final standard to be phased in over 12 months to allow for revising written SOPs and programs, training, and medical evaluation of respirator users. Exxon (Ex. 54–266) and the American Petroleum Institute (Ex. 54–330) stated that employers could not fit test every employee within the specified 90-day effective date and recommended that employees be fit tested within one year of the effective date of the standard.

Based on many of these comments, OSHA concludes that additional time is required for employers to comply with certain provisions of the final standard. The Agency has therefore included extended start-up dates for some of the program elements. OSHA does intend, however, to disseminate information on this standard in a ''user friendly'' format.

Within 150 days of the effective date of the standard, employers must determine whether respirator use is required under paragraph (a). This period will afford employers sufficient time to become familiar with the final standard and to evaluate whether respirator use is required in their workplaces.

Employers must comply with all the remaining requirements of the respirator standard no later than 180 days after the effective date of the standard. OSHA concludes that with the start-up dates provided, all employers will have adequate time to comply. Paragraph (n)(3) states that if there is an administrative or judicial delay of the standard, the respiratory protection provisions of the previous standards (i.e., 29 CFR 1910.134 and 29 CFR 1926.103) will remain in effect and will be enforced until the issues have been resolved. Many employers already have an established respiratory protection program that includes specific program elements (e.g., fit testing, annual training, medical evaluations of respirator users, and program evaluation) that comply with the requirements of the Agency's prior respirator standards. Program elements that were implemented to meet the prior respirator standards' requirements may also meet the requirements of this final respiratory protection standard. Paragraph (n)(4) states that if, in the 12 month period preceding the effective date of the revised standard, the employer has conducted annual respirator training, fit testing, respirator program evaluation, or medical evaluations, the employer may use the results of these activities to comply with the corresponding provisions of this section, provided that these activities were conducted in a manner that meets the requirements of the revised standard. For example, if the employer has an existing fit testing program in place on the effective date of the final standard, the employer may continue that fit testing program if it meets the fit testing requirements of the final standard. In such cases, employees would be retested within one year of their last fit test date. Employers, therefore, can incorporate annual fit testing, training, and program evaluation into their existing respiratory protection programs if the appropriate program elements comply with the provisions of the final standard. This approach should help reduce the impact of the final rule on employers with effective existing respirator programs.

Paragraph (o)—Appendices

The final paragraph of the standard identifies four appendices that supplement the requirements specified in the regulatory text. Appendices A (Fit Testing Procedures), B–1 (User Seal Check Procedures), B–2 (Cleaning Procedures), and C (Medical Questionnaire) are mandatory, and contain requirements for performing fit testing, user seal checks, cleaning, and medical evaluations that supplement the regulatory requirements in paragraphs (e), (f), (g), and (h) of the final standard.

Appendix D (Information for Employees Using Respirators When Not Required Under The Standard) is nonmandatory.

The four appendices are discussed in detail under the Summary and Explanation sections of the corresponding paragraphs of the final standard: Appendix A in paragraph (f), ''Fit Testing''; Appendix B–1 in paragraph (g), ''Use of respirators''; Appendix B–2 in paragraph (h), ''Maintenance and care of respirators''; Appendix C in paragraph (e), ''Medical evaluation''; Appendix D in paragraph (c), ''Written program'' and paragraph (a), ''Permissible practice.''

Paragraph (p)—Revisions to Specific OSHA Standards

A number of OSHA standards regulating exposure to toxic substance and harmful physical agents incorporate certain provisions of 29 CFR 1910.134. OSHA proposed to revise these provisions to simplify compliance for employers by consolidating many of the Agency's respirator requirements, removing inconsistencies, and deleting duplicative requirements. The purpose of revising the respirator-related provisions of OSHA's existing standards was to conform these standards, to the extent possible, to each other and to revised 29 CFR 1910.134 in general. These standards will be improved by this process, because they will now refer to the revised respiratory protection standard, which is based on current respirator use and technology. For example, revising the respirator-approval references in these standards from MSHA/NIOSH, Bureau of Mines, and ANSI Z88.2–1969 to the recently published NIOSH regulation at 42 CFR Part 84 updates these respiratory protection provisions. The Agency concludes, therefore, that updating these standards is consistent with the proposed goal of bringing uniformity to OSHA's respiratory protection requirements. OSHA believes that regulatory consistency will improve compliance with the respiratory protection provisions, reduce the compliance burden on the regulated community, and, consequently, enhance the protection provided to employees who use respirators. OSHA's review of the rulemaking record shows that no commenters objected to updating the provisions of these standards to conform with the requirements of revised 29 CFR 1910.134.

The Agency also notes that revised 29 CFR 1910.134 is intended to serve as a ''building block'' standard with respect to future standards that may contain respiratory protection requirements. To the extent possible, therefore, future standards that regulate respirator use in

controlling employee exposure to toxic substances and harmful physical agents will refer to provisions of the final respiratory protection standard at 29 CFR 1910.134 instead of containing their own respirator requirements. (However, these standards will continue to have any respirator requirements, *e.g.*, canister/cartridge change schedules, that are specific to the substance or agent being regulated.)

In developing the final revision, OSHA also revised the wording and/or location of some paragraphs to improve the comprehensibility and uniformity of the requirements; however, the substantive requirements of the standards addressing respirators have not been revised. Additionally, the tables in the substance-specific standards specifying parameters for respirator selection have not been republished because these tables will remain unchanged and, thus, will continue to be part of the substance-specific standards until resolution of the reserved portions of this final standard.

OSHA found that the existing substance-specific standards were especially in need of revision. Except for a limited number of respirator provisions unique to each substance-specific standard, the remaining regulatory text on respirators now reads virtually the same for each of these standards. For example, all provisions addressing respirator use, selection, and fit testing were deleted from the substance-specific standards, making these standards consistent with the final respiratory protection standard with respect to these requirements. The Agency believes that revisions to 29 CFR 1910.134 are sufficiently comprehensive to allow deletion of those provisions in the substance-specific standards that duplicated provisions of revised 29 CFR 1910.134. A provision was retained only when it addressed conditions (for example, medical evaluation) that were unique and/or integral to the substance-specific standard. The Agency concludes, therefore, that deletion of duplicative provisions from the substance-specific standards will reduce confusion among members of the regulated community and decrease the burden of compliance. It will thereby enhance compliance with the respiratory protection requirements and, consequently, improve the protection afforded to employees who use respirators to control exposure to the toxic substances and harmful physical agents regulated by these standards. The proposed revisions to the substance-specific standards were widely supported by rulemaking participants (Exs. 54–187, 54–208, 54–219, 54–220, 54–233, 54–234, 54–261, 54–263, 54–266, 54–267, 54–273, 54–283, 54–289, 54–327, 54–333, 54–363, 54–424.)

In general, for the substance-specific standards, the incorporated provisions of revised 29 CFR 1910.134 cover the following requirements: definitions (paragraph (b)); respiratory protection program (paragraph (c)); selection of respirators (paragraph (d)); fit testing (paragraph (f)); use of respirators (paragraph (g)); maintenance and care of respirators (paragraph (h)); breathing air quality and use (paragraph (i)); identification of filters, cartridges, and canisters (paragraph (j)); training and information (paragraph (k)); program evaluation (paragraph (l)); and recordkeeping (paragraph (m)). Each of these requirements was addressed by paragraphs (b), (c), (d), (e), and (f) of the prior respiratory protection standard.

OSHA did not propose to conform the respirator provisions of its Cadmium, Benzene, Formaldehyde, 1,3-Butadiene, and Methylene chloride standards with the corresponding requirements of revised 29 CFR 1910.134. Rulemaking participants recommended that the respirator provisions of the existing Cadmium, Benzene, and Formaldehyde standards be revised to conform with those provisions of 29 CFR 1910.134 to improve regulatory consistency and uniformity (Exs. 54–194, 54–195, 54–208, 54–218, 54–275, 54–294, 54–337, 54–350, 54–387, 54–434). In view of these comments, the Agency assumes that a consensus exists among the regulated community to bring these standards (as well as the 1,3-Butadiene and Methylene chloride standards, which were issued after the close of the comment period for the respirator rulemaking) into conformity with the revised respiratory protection standard. Accordingly, these standards have been revised in the same manner as the other substance-specific standards for which OSHA proposed revisions.

In revising the fit-testing provisions (paragraph (f)) of the substance-specific standards, the frequency of respirator fit testing was revised from semiannually to annually for the Asbestos (29 CFR 1910.1001 and 1926.1101), Arsenic (29 CFR 1910.1018), Lead (29 CFR 1910.1025 and 1926.62) and Acrylonitrile (29 CFR 1910.1045) standards. The Agency believes that this revision will not diminish the effectiveness of respiratory protection provided by these standards. OSHA's experience in recent rulemakings (Cadmium, 1992; Methylenedianiline, 1992; Formaldehyde, 1992; Methylene chloride, 1997) has led the Agency to conclude that annual respirator fit testing, which is provided for in the recent standards, protects employees appropriately, and that semi-annual fit testing is not necessary for employee protection. The basis for adopting a semiannual fit-testing requirement is not discussed in the preambles to any of the standards that contain that requirement. For example, there is no discussion in the preambles of those standards that semiannual fit testing was adopted because of the toxic properties of the regulated substances or the particular characteristics of the respirators to be used.

Recent rulemakings, including proposed revisions to the respiratory protection standard, have provided the Agency with much more scientific and experiential information on fit testing than was available when the affected standards were adopted. A number of commenters in the current rulemaking asserted that provisions for semiannual fit testing in the existing Asbestos, Arsenic, Lead, and Acrylonitrile standards should be revised to conform to the annual fit testing requirements of the recently-adopted standards (Exs. 54–5, 54–179, 54–186, 54–208, 54–218, 54–219, 54–222, 54–242, 54–289, 54–326, 54–330, 54–348, 54–410, 54–424, 54–439, 54–443.) The Agency, therefore, concludes that it is reasonable and appropriate, for the purpose of regulatory consistency and uniformity, to require only annual respirator fit testing in its substance-specific standards.

While the proposal did not incorporate revised paragraph (m) (recordkeeping) into the existing substance-specific standards, OSHA incorporated this paragraph in the final rulemaking in the belief that such action: (1) Will make recordkeeping requirements consistent and uniform for employers who use respirators to control employee exposures to the airborne contaminants regulated by the substance-specific standards; (2) will reduce the regulatory burden on employers because they are currently required under 29 CFR 1910.1020 to maintain exposure and medical records; and, (3) it is a prevailing business and industrial-hygiene practice to retain fit-testing records to demonstrate that protection was provided to exposed employees.

For the 13 carcinogens addressed by existing 29 CFR 1910.1003 (the ''13 Carcinogens standard''), the provision requiring employers to ensure that employees use respirators ''in accordance with 29 CFR 1910.134'' was amended to require compliance with paragraphs (b), (c), (d) (except (d)(1)(iii), (iv), and (d)(3)), and (e)–(m) of the

final standard. While the proposal did not incorporate revised paragraph (e) (medical evaluation) into the 13 Carcinogens standard, OSHA did so in the final rulemaking because such incorporation is consistent with the requirements of existing 29 CFR 1910.134, conforms to accepted industry practice, and improves comprehension of, and compliance with, the respiratory protection requirements of the 13 Carcinogens standard.

Unlike 29 CFR 1910.1003, each of the existing substance-specific OSHA standards includes unique medical-evaluation requirements for employees who use respirators. OSHA believes that the medical-evaluation requirements for respirator use established under its existing substance-specific standards provide a high degree of medical protection to employees who are required to use respirators to control their exposures to the airborne substances regulated by the substance-specific standards. In addition, the medical-evaluation requirements for respirator use in the substance-specific standards are part of a comprehensive, integrated medical-surveillance program designed to evaluate employees for conditions and risks associated with exposure to the regulated substances; consequently, OSHA believes that any revision to the frequency or content of medical evaluations for respirator use would unnecessarily disrupt ongoing medical-surveillance programs and, therefore, jeopardize the health of employees who must use respirators to prevent exposure to hazardous workplace substances.

Paragraph (d)(1)(iii) of the revised respiratory protection standard, which requires employers to estimate exposure levels in selecting appropriate respirators, has not been incorporated into OSHA's substance-specific standards in the final rulemaking. The existing substance-specific standards, except the 13 Carcinogens standard, already include exposure assessment provisions that are more specific than the general exposure-assessment requirement in the final respiratory protection standard. With respect to the 13 Carcinogens standard, no PELs or other exposure criteria are specified in that standard that would be relevant to respirator selection. In the 13 Carcinogens standard, exposure estimates for the substances regulated by the standard are not necessary for respirator selection because appropriate respirators have been identified for specific work activities that occur during employee exposure to each of the 13 carcinogenic substances.

OSHA excepted substance-specific standards that already contain requirements for cartridge- and canister-change schedules (Vinyl chloride, Benzene, Acrylonitrile, Formaldehyde, and 1,3-Butadiene) from paragraphs (d)(3)(iii)(B) (*1*) and (*2*) of the revised respiratory protection standard, which also addresses change schedules, to preclude regulatory conflict. The Agency finds that information obtained during the rulemakings for these substance-specific standards resulted in the development of change schedules that were especially tailored to the chemistry of the specific substance, documented the exposure conditions requiring these schedules, and determined the types of respirators required for employee protection. Consequently, the Agency concludes that the change schedules adopted during these rulemakings must not be replaced by the generic change-schedule requirements of revised 29 CFR 1910.134.

As proposed, the Agency also removed a number of appendices from the substance-specific standards that addressed fit-testing requirements, replacing them with references to Appendix A of revised 29 CFR 1910.134. In this regard, the Agency proposed to update Section IV of Appendix B of 29 CFR 1910.1025 (the Lead standard) by citing Appendix A of 29 CFR 1910.134 as the reference for fit-testing procedures; the proposed revision has been made in the final rulemaking. While not proposed, the Agency revised the same information in Appendix B of 29 CFR 1926.62 (the Lead standard for Construction), removed the sixth paragraph from Section IV of Appendix B of 29 CFR 1910.1025 and 1926.62 as being outdated, and revised references for respirator approval in Section IV of Appendix B of 29 CFR 1910.1025, Section IV of Appendix A to 29 CFR 1910.1045 (the Acrylonitrile standard), Section IV of Appendix A to 29 CFR 1910.1047 (the Ethylene Oxide standard), Section III of Appendix A to 29 CFR 1910.1050 (the 4, 4'-Methylenedianiline standard), and Section IV of Appendix B to 29 CFR 1926.62, Lead in Construction. The Agency believes that these revisions will conform the affected standards with the provisions of the revised respiratory protection standard; the resulting consistency will, therefore, reduce confusion and ease compliance.

The following provisions, addressing fit-testing, respirator selection, and respirator use, have been deleted from OSHA's substance-specific standards because they duplicate requirements specified in revised 29 CFR 1910.134:

(1) *Fit Testing*

This requirement is specified in paragraph (f) of the revised respiratory protection standard, allowing for the removal of the following paragraphs:

(a) 29 CFR 1910.1001 Asbestos.
(g)(4) and Appendix C
(b) 29 CFR 1910.1018 Inorganic arsenic.
(h)(3) (i), (ii), and (iii)
(c) 29 CFR 1910.1025 Lead.
(f)(3) (i) and (ii), and Appendix D; Section IV of Appendix B revised in part
(d) 29 CFR 1910.1027 Cadmium.
(g)(4) and Appendix C
(e) 29 CFR 1910.1028 Benzene.
(g)(5) and Appendix E
(f) 29 CFR 1910.1045 Acrylonitrile.
(h)(3)(iii)
(g) 1910.1048 Formaldehyde.
(g)(3)(ii) and Appendix E
(h) 29 CFR 1910.1050 Methylenedianiline.
(h)(5) and Appendix E
(i) 29 CFR 1910.1051 1,3-Butadiene.
(h)(5) and Appendix E
(j) 29 CFR 1910.1052 Methylene chloride.
(g)(7)
(k) 29 CFR 1926.60 Methylenedianiline.
(i)(5) and Appendix E
(l) 29 CFR 1926.62 Lead.
(f)(3) (i) and (ii), and Appendix D; Section IV of Appendix B revised in part
(m) 29 CFR 1926.1101 Asbestos.
(h)(4) and Appendix C
(n) 29 CFR 1926.1127 Cadmium.
(g)(4) and Appendix C

(2) *Respirator-Approval Requirements that Reference MSHA or NIOSH 30 CFR Part 11*

The requirement to select respirators approved by NIOSH in 42 CFR part 84 is specified in paragraph (d)(1)(ii) of the revised respiratory protection standard. This requirement updates the existing respirator-approval requirement in the substance-specific standards to select respirators approved by MSHA or NIOSH under 30 CFR part 11, allowing for removal of the following paragraphs:

(a) 29 CFR 1910.1001 Asbestos.
(g)(2)(i) [part]
(b) 29 CFR 1910.1017 Vinyl chloride.
(g)(2)
(c) 29 CFR 1910.1018 Inorganic arsenic.
(h)(2)(iii)
(d) 29 CFR 1910.1025 Lead.
(f)(2)(iii); Section IV of Appendix B revised in part
(e) 29 CFR 1910.1027 Cadmium.
(g)(2)(i) [part]
(f) 29 CFR 1910.1028 Benzene

(g)(2)(ii)
(g) 29 CFR 1910.1029 Coke oven emissions.
(g)(2)(iii)
(h) 29 CFR 1910.1044 1,2-Dibromo-3-chloropropane.
(h)(2)(ii)
(i) 29 CFR 1910.1045 Acrylonitrile.
(h)(2)(ii); Section IV of Appendix A revised in part
(j) 29 CFR 1910.1047 Ethylene oxide.
(g)(2)(ii); Section IV of Appendix A revised in part
(k) 29 CFR 1910.1048 Formaldehyde.
(g)(2)(i) [part]
(l) 29 CFR 1910.1050 Methylenedianiline.
(h)(2)(ii); Section III of Appendix A revised in part
(m) 29 CFR 1910.1051 1,3-Butadiene.
(h)(2)(ii) [part]
(n) 29 CFR 1910.1052 Methylene chloride.
(g)(3) [part]
(o) 29 CFR 1926.60 Methylenedianiline.
(i)(2)(ii)
(p) 29 CFR 1926.62 Lead.
(f)(2)(iii); Section IV of Appendix B revised in part
(q) 29 CFR 1926.1101 Asbestos.
(h)(2)(ii)
(r) 29 CFR 1926.1127 Cadmium.
(g)(2)(i) [part]

(3) *Respirator Use*

Paragraph (g) of the revised respiratory protection standard addresses, in part, facepiece seal protection (paragraph (g)(1)), and employees leaving the work area to wash their faces and respirator facepieces (paragraph (g)(2)(ii)(A)) and to change filter elements (paragraph (g)(2)(ii) (B) and (C)), allowing removal of the following paragraphs:

(a) 29 CFR 1910.1001 Asbestos.
(g)(3) (ii) and (iii)
(b) 29 CFR 1910.1018 Inorganic arsenic.
(h)(4) (ii) and (iii)
(c) 29 CFR 1910.1025 Lead.
(f)(4) (ii) and (iii)
(d) 29 CFR 1910.1027 Cadmium.
(g)(3) (ii) and (iii)
(e) 29 CFR 1910.1028 Benzene.
(g)(4)(iii)
(f) 29 CFR 1910.1029 Coke oven emissions.
(g)(4)
(g) 29 CFR 1910.1043 Cotton dust.
(f)(4)
(h) 29 CFR 1910.1044 1,2-Dibromo-3-chloropropane.
(h)(3)(ii)
(i) 29 CFR 1910.1045 Acrylonitrile.
(h)(3)(iv)
(j) 29 CFR 1910.1048 Formaldehyde.
(g)(3)(v)
(k) 29 CFR 1910.1050 Methylenedianiline.
(h)(4)(ii)
(l) 29 CFR 1910.1051 1,3-Butadiene.
(h)(4)(v)
(m) 29 CFR 1910.1052 Methylene chloride.
(g)(5)
(n) 29 CFR 1926.60 Methylenedianiline. (i)(4)(ii)
(o) 29 CFR 1926.62 Lead.
(f)(4) (ii) and (iii)
(p) 1926.1101 Asbestos.
(h)(3) (ii) and (iii)
(q) 29 CFR 19126.1127 Cadmium.
(g)(3) (ii) and (iii)

The full text, after deletions and revisions, of the paragraphs dealing with respirators that remain in each of OSHA's existing substance specific standards has been published in Section XI of this preamble.

The provisions of the respiratory protection standard found in 29 CFR part 1926 (Construction), specifically 29 CFR 1926.103, are now identical to the new 29 CFR 1910.134. Following its policy of not repeating identical health provisions in order to reduce paperwork burden and to avoid regulatory confusion, OSHA is deleting the duplicate text in 29 CFR 1926.103 and cross-referencing the text in 29 CFR 1910.134. To implement this action, the title of this section remains, but a Note is added to read: ''Note: The requirements applicable to construction work under this section are identical to those set forth at 29 CFR 1910.134 of this chapter.'' For the convenience of the Construction industry, OSHA makes available an indexed manual that includes the full text of all regulations applicable to construction, including OSHA's respirator requirements.

OSHA is also revising or removing a number of provisions in addition to safety and health standards, other than the substance-specific standards, that duplicate provisions now found in the revised respiratory protection standard. These standards and their revisions include:

(1) 29 CFR 1910.94 Ventilation.

(a)(1)(i)—Removed the phrase ''continuous flow'' from the definition of abrasive-blasting respirator consistent with the proposed requirement to select respirators in accordance with 29 CFR 1910.134.

(a)(5)(i)—Revised the reference from ''30 CFR part 11'' to ''42 CFR Part 84.''

(a)(5)(iii)—Provided the reference ''42 CFR Part 84.''

(a)(5)(iv)—Revised the reference from ''§ 1910.134 (a) and (b)'' to ''§ 1910.134.''

(a)(6)—Revised the air-requirement reference for abrasive-blasting respirators from ''ANSI Z9.2–1960'' to ''29 CFR 1910.134(i).''

(c)(6)(iii)(a)—Revised the reference from ''MSHA/NIOSH/ANSI Z–88.2–1969'' to ''NIOSH under 42 CFR Part 84.''

(d)(9)(vi)—Revised the reference from ''MSHA/NIOSH'' to ''NIOSH under 42 CFR Part 84.''

(2) 29 CFR 1910.111 Storage and handling of anhydrous ammonia.

(a)(2)(x)—Revised the reference from ''MSHA'' to ''the National Institute for Occupational Safety and Health (NIOSH) under 42 CFR Part 84.''

(b)(10)(ii)—Revised the reference from ''Bureau of Mines'' to ''NIOSH under 42 CFR Part 84.''

(3) 29 CFR 1910.156 Fire brigades.

(f)(1)(i) and (v)—Revised the reference from ''MSHA/NIOSH'' to ''NIOSH under 42 CFR Part 84.''

(4) 29 CFR 1910.252 General requirements.

(c)(4)(ii) and (iii), (c)(7)(iii), (c)(9)(i), and (c)(10)—Revised the references from ''MSHA/NIOSH'' to ''National Institute for Occupational Safety and Health (NIOSH) under 42 CFR Part 84'' and ''NIOSH under 42 CFR Part 84.''

(5) 29 CFR 1910.261 Pulp, paper, and paperboard mills.

(b)(2) and (g)(10—Revised the reference from ''ANSI Z88.2–1969'' to ''29 CFR 1910.134.''

(h)(2)(iii) and (iv)—Revised the reference from ''ANSI Z–88.2–1969 and K–13.1–1967'' to ''29 CFR 1910.134.''

(6) 29 CFR 1926.57 Ventilation.

(f)(1)(ii)—Removed the phrase ''continuous flow'' from the definition of abrasive-blasting respirator consistent with the proposed requirement to select respirators in accordance with 29 CFR 1910.134.

(f)(5)(i)—Revised the reference from ''30 CFR Part 11'' to ''42 CFR Part 84.''

(f)(5)(iii)—Provided the reference ''42 CFR Part 84.''

(f)(6)—Revised the air-requirement reference for abrasive-blasting respirators from ''ANSI Z9.2–1960'' to ''29 CFR 1910.134(i).''

(h)(6)(iii)(A)—Revised the reference from ''MSHA/NIOSH/ANSI Z–88.2–1969'' to ''NIOSH under 42 CFR Part 84.''

(i)(9)(vi)—Revised the reference from ''MSHA/NIOSH'' to ''NIOSH under 42 CFR Part 84.''

(7) 29 CFR 1926.103 Respiratory protection.

Removed paragraphs (a) through (i) and replaced them with a note to read as follows:

Note: The requirements applicable to construction work under this section are identical to those set forth at § 1910.134 of this chapter.

(8) 29 CFR 1926.800 Underground construction.

(g)(2)—Revised the reference from ''MSHA/NIOSH'' to ''the National Institute for Occupational Safety and Health under 42 CFR Part 84,'' and from ''§ 1926.103 (b) and (c)'' to ''29 CFR 1926.103.''

Appendices

The four appendices are discussed in detail under the Summary and Explanation sections for the following paragraphs of the final standard: Appendix A in paragraph (f), ''Fit Testing''; Appendix B–1 in paragraph (g), ''Use of respirators''; Appendix B–2 in paragraph (h), ''Maintenance and care of respirators'; Appendix C in paragraph (e), ''Medical evaluation''; Appendix D in paragraphs (c), ''Written program'' and paragraph (a), ''Permissible practice.''

VIII. Authority and Signature

This document was prepared under the direction of Charles N. Jeffress, Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, 200 Constitution Avenue, NW., Washington, DC 20210.

Pursuant to sections 4, 6(b), 8(c), and 8(g) of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Sec. 107 of the Contract Work Hours and Safety Standards Act (the Construction Safety Act) (40 U.S.C. 333); Sec. 41, the Longshore and Harbor Worker's Compensation Act (33 U.S.C. 941); Secretary of Labor's Order Nos. 12–71 (36 FR 8754), 8–76 (41 FR 25059), 9–83 (48 FR 35736), 1–90 (55 FR 9033), or 6–96 (62 FR 111), as applicable; and 29 CFR part 1911; 29 CFR parts 1910 and 1926 are amended as set forth below.

List of Subjects in 29 CFR Parts 1910 and 1926

Health, Occupational safety and health, Reporting and recordkeeping requirements.

Signed at Washington, DC, this 15th day of December, 1997.

Charles N. Jeffress,

Assistant Secretary of Labor for Occupational Safety and Health.

IX. Amended Standards

Part 1910 of Title 29 of the Code of Federal Regulations is hearby amended as follows:

PART 1910—[AMENDED]

Subpart G—[Amended]

1. The authority citation for Subpart G of Part 1910 is revised to read as follows:

Authority: Secs. 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Orders 12–71 (36 FR 8754), 8–76 (41 FR 25059), 9-83 (48 FR 35736), 1–90 (55 FR 9033), or 6–96 (62 FR 111), as applicable; and 29 CFR part 1911.

2. Section 1910.94 is amended by revising paragraphs (a)(1)(ii), (a)(5)(i), (a)(5)(iii) introductory text, (a)(5)(iv), (a)(6), (c)(6)(iii)(*a*), and (d)(9)(vi) as follows:

§ 1910.94 Ventilation.

(a) * * *

(1) * * *

(ii) *Abrasive-blasting respirator.* A respirator constructed so that it covers the wearer's head, neck, and shoulders to protect the wearer from rebounding abrasive.

* * * * *

(5) *Personal protective equipment.* (i) Employers must use only respirators approved by the National Institute for Occupational Safety and Health (NIOSH) under 42 CFR part 84 to protect employees from dusts produced during abrasive-blasting operations.

* * * * *

(iii) Properly fitted particulate-filter respirators, commonly referred to as dust-filter respirators, may be used for short, intermittent, or occasional dust exposures such as cleanup, dumping of dust collectors, or unloading shipments of sand at a receiving point when it is not feasible to control the dust by enclosure, exhaust ventilation, or other means. The respirators used must be approved by NIOSH under 42 CFR part 84 for protection against the specific type of dust encountered.

* * * * *

(iv) For employees who use respirators required by this section, the employer must implement a respiratory protection program in accordance with 29 CFR 1910.134.

* * * * *

(6) *Air supply and air compressors.* Air for abrasive-blasting respirators must be free of harmful quantities of dusts, mists, or noxious gases, and must meet the requirements for supplied-air quality and use specified in 29 CFR 1910.134(i).

* * * * *

(c) * * *

(6) * * *

(iii) (*a*) When an operator is in a booth downstream from the object being sprayed, an air-supplied respirator or other type of respirator must be used by employees that has been approved by NIOSH under 42 CFR part 84 for the material being sprayed.

* * * * *

(d) * * *

(9) * * *

(vi) During the emergencies specified in paragraph (d)(11)(v) of this section, if employees must be in areas where the concentrations of air contaminants are greater than the limits set by paragraph (d)(2)(iii) of this section or the oxygen concentration is less than 19.5 percent, they must use respirators that reduce their exposure to a level below these limits or that provide adequate oxygen. Such respirators must also be provided in marked, quickly-accessible storage compartments built for this purpose when the possibility exists that hazardous concentrations of air contaminants could be released accidentally. The respirators must be approved by the NIOSH under 42 CFR part 84, selected by a competent industrial hygienist or other technically-qualified source, and used in accordance with 29 CFR 1910.134.

* * * * *

Subpart H—[Amended]

3. The authority citation for subpart H of part 1910 is revised to read as follows:

Authority: Secs. 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Orders 12–71 (36 FR 8754), 8–76 (41 FR 25059), 9-83 (48 FR 35736), 1–90 (55 FR 9033), or 6–96 (62 FR 111), as applicable; and 29 CFR part 1911.

4. Section 1910.111 is amended by revising paragraphs (a)(2)(x) and (b)(10)(ii) as follows:

§ 1910.111 Storage and handling of anhydrous ammonia.

(a) * * *

(2) * * *

(x) *Gas masks.* Gas masks must be approved by the National Institute for Occupational Safety and Health (NIOSH) under 42 CFR part 84 for use with anhydrous ammonia.

* * * * *

(b) * * *

(10) * * *

(ii) Stationary storage installations must have at least two suitable gas masks in readily-accessible locations. Full-face masks with ammonia canisters that have been approved by NIOSH under 42 CFR part 84 are suitable for emergency action involving most anhydrous ammonia leaks, particularly leaks that occur outdoors. For respiratory protection in concentrated ammonia atmospheres, a self-contained breathing apparatus is required.

* * * * *

Subpart I—[Amended]

5. The authority citation for Subpart I of Part 1910 is revised to read as follows:

Authority: Sections 4, 6, and 8, Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 12–71 (36 FR 8754), 8–76 (41 FR 25059), 9–83 (48 FR 35736), 1–90 (55 FR 9033), or 6–96 (62 FR 111), as applicable.

Sections 1910.132, 1910.134, and 1910.138 also issued under 29 CFR part 1911.

Sections 1910.133, 1910.135, and 1910.136 also issued under 29 CFR part 1911 and 5 U.S.C. 553.

6. Section 1910.134 is redesignated as § 1910.139 in subpart I and amended by revising its title and adding introductory text to read as follows:

§ 1910.139 Respiratory protection for M. tuberculosis.

This section applies only to respiratory protection against M. tuberculosis and applies in lieu of § 1910.134.

* * * * *

7. A new section 1910.134 is added to read as follows:

§ 1910.134 Respiratory protection.

This section applies to General Industry (part 1910), Shipyards (part 1915), Marine Terminals (part 1917), Longshoring (part 1918), and Construction (part 1926).

(a) *Permissible practice.* (1) In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, the primary objective shall be to prevent atmospheric contamination. This shall be accomplished as far as feasible by accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials). When effective engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used pursuant to this section.

(2) Respirators shall be provided by the employer when such equipment is necessary to protect the health of the employee. The employer shall provide the respirators which are applicable and suitable for the purpose intended. The employer shall be responsible for the establishment and maintenance of a respiratory protection program which shall include the requirements outlined in paragraph (c) of this section.

(b) *Definitions.* The following definitions are important terms used in the respiratory protection standard in this section.

Air-purifying respirator means a respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.

Assigned protection factor (APF) [Reserved]

Atmosphere-supplying respirator means a respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere, and includes supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.

Canister or cartridge means a container with a filter, sorbent, or catalyst, or combination of these items, which removes specific contaminants from the air passed through the container.

Demand respirator means an atmosphere-supplying respirator that admits breathing air to the facepiece only when a negative pressure is created inside the facepiece by inhalation.

Emergency situation means any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment that may or does result in an uncontrolled significant release of an airborne contaminant.

Employee exposure means exposure to a concentration of an airborne contaminant that would occur if the employee were not using respiratory protection.

End-of-service-life indicator (ESLI) means a system that warns the respirator user of the approach of the end of adequate respiratory protection, for example, that the sorbent is approaching saturation or is no longer effective.

Escape-only respirator means a respirator intended to be used only for emergency exit.

Filter or air purifying element means a component used in respirators to remove solid or liquid aerosols from the inspired air.

Filtering facepiece (dust mask) means a negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium.

Fit factor means a quantitative estimate of the fit of a particular respirator to a specific individual, and typically estimates the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn.

Fit test means the use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual. (See also Qualitative fit test QLFT and Quantitative fit test QNFT.)

Helmet means a rigid respiratory inlet covering that also provides head protection against impact and penetration.

High efficiency particulate air (HEPA) filter means a filter that is at least 99.97% efficient in removing monodisperse particles of 0.3 micrometers in diameter. The equivalent NIOSH 42 CFR 84 particulate filters are the N100, R100, and P100 filters.

Hood means a respiratory inlet covering that completely covers the head and neck and may also cover portions of the shoulders and torso.

Immediately dangerous to life or health (IDLH) means an atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere.

Interior structural firefighting means the physical activity of fire suppression, rescue or both, inside of buildings or enclosed structures which are involved in a fire situation beyond the incipient stage. (See 29 CFR 1910.155)

Loose-fitting facepiece means a respiratory inlet covering that is designed to form a partial seal with the face.

Maximum use concentration (MUC) [Reserved].

Negative pressure respirator (tight fitting) means a respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator.

Oxygen deficient atmosphere means an atmosphere with an oxygen content below 19.5% by volume.

Physician or other licensed health care professional (PLHCP) means an individual whose legally permitted scope of practice (*i.e.*, license, registration, or certification) allows him or her to independently provide, or be delegated the responsibility to provide, some or all of the health care services required by paragraph (e) of this section.

Positive pressure respirator means a respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

Powered air-purifying respirator (PAPR) means an air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

Pressure demand respirator means a positive pressure atmosphere-supplying respirator that admits breathing air to the facepiece when the positive pressure

is reduced inside the facepiece by inhalation.

Qualitative fit test (QLFT) means a pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.

Quantitative fit test (QNFT) means an assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

Respiratory inlet covering means that portion of a respirator that forms the protective barrier between the user's respiratory tract and an air-purifying device or breathing air source, or both. It may be a facepiece, helmet, hood, suit, or a mouthpiece respirator with nose clamp.

Self-contained breathing apparatus (SCBA) means an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

Service life means the period of time that a respirator, filter or sorbent, or other respiratory equipment provides adequate protection to the wearer.

Supplied-air respirator (SAR) or airline respirator means an atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.

This section means this respiratory protection standard.

Tight-fitting facepiece means a respiratory inlet covering that forms a complete seal with the face.

User seal check means an action conducted by the respirator user to determine if the respirator is properly seated to the face.

(c) *Respiratory protection program*. This paragraph requires the employer to develop and implement a written respiratory protection program with required worksite-specific procedures and elements for required respirator use. The program must be administered by a suitably trained program administrator. In addition, certain program elements may be required for voluntary use to prevent potential hazards associated with the use of the respirator. The Small Entity Compliance Guide contains criteria for the selection of a program administrator and a sample program that meets the requirements of this paragraph. Copies of the Small Entity Compliance Guide will be available on or about April 8, 1998 from the Occupational Safety and Health Administration's Office of Publications, Room N 3101, 200 Constitution Avenue, NW, Washington, DC, 20210 (202–219–4667).

(1) In any workplace where respirators are necessary to protect the health of the employee or whenever respirators are required by the employer, the employer shall establish and implement a written respiratory protection program with worksite-specific procedures. The program shall be updated as necessary to reflect those changes in workplace conditions that affect respirator use. The employer shall include in the program the following provisions of this section, as applicable:

(i) Procedures for selecting respirators for use in the workplace;

(ii) Medical evaluations of employees required to use respirators;

(iii) Fit testing procedures for tight-fitting respirators;

(iv) Procedures for proper use of respirators in routine and reasonably foreseeable emergency situations;

(v) Procedures and schedules for cleaning, disinfecting, storing, inspecting, repairing, discarding, and otherwise maintaining respirators;

(vi) Procedures to ensure adequate air quality, quantity, and flow of breathing air for atmosphere-supplying respirators;

(vii) Training of employees in the respiratory hazards to which they are potentially exposed during routine and emergency situations;

(viii) Training of employees in the proper use of respirators, including putting on and removing them, any limitations on their use, and their maintenance; and

(ix) Procedures for regularly evaluating the effectiveness of the program.

(2) Where respirator use is not required:

(i) An employer may provide respirators at the request of employees or permit employees to use their own respirators, if the employer determines that such respirator use will not in itself create a hazard. If the employer determines that any voluntary respirator use is permissible, the employer shall provide the respirator users with the information contained in Appendix D to this section (''Information for Employees Using Respirators When Not Required Under the Standard''); and

(ii) In addition, the employer must establish and implement those elements of a written respiratory protection program necessary to ensure that any employee using a respirator voluntarily is medically able to use that respirator, and that the respirator is cleaned, stored, and maintained so that its use does not present a health hazard to the user. Exception: Employers are not required to include in a written respiratory protection program those employees whose only use of respirators involves the voluntary use of filtering facepieces (dust masks).

(3) The employer shall designate a program administrator who is qualified by appropriate training or experience that is commensurate with the complexity of the program to administer or oversee the respiratory protection program and conduct the required evaluations of program effectiveness.

(4) The employer shall provide respirators, training, and medical evaluations at no cost to the employee.

(d) *Selection of respirators.* This paragraph requires the employer to evaluate respiratory hazard(s) in the workplace, identify relevant workplace and user factors, and base respirator selection on these factors. The paragraph also specifies appropriately protective respirators for use in IDLH atmospheres, and limits the selection and use of air-purifying respirators.

(1) *General requirements.* (i) The employer shall select and provide an appropriate respirator based on the respiratory hazard(s) to which the worker is exposed and workplace and user factors that affect respirator performance and reliability.

(ii) The employer shall select a NIOSH-certified respirator. The respirator shall be used in compliance with the conditions of its certification.

(iii) The employer shall identify and evaluate the respiratory hazard(s) in the workplace; this evaluation shall include a reasonable estimate of employee exposures to respiratory hazard(s) and an identification of the contaminant's chemical state and physical form. Where the employer cannot identify or reasonably estimate the employee exposure, the employer shall consider the atmosphere to be IDLH.

(iv) The employer shall select respirators from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.

(2) *Respirators for IDLH atmospheres.* (i) The employer shall provide the following respirators for employee use in IDLH atmospheres:

(A) A full facepiece pressure demand SCBA certified by NIOSH for a minimum service life of thirty minutes, or

(B) A combination full facepiece pressure demand supplied-air respirator (SAR) with auxiliary self-contained air supply.

(ii) Respirators provided only for escape from IDLH atmospheres shall be NIOSH-certified for escape from the atmosphere in which they will be used.

(iii) All oxygen-deficient atmospheres shall be considered IDLH. Exception: If the employer demonstrates that, under all foreseeable conditions, the oxygen concentration can be maintained within

the ranges specified in Table II of this section (i.e., for the altitudes set out in the table), then any atmosphere-supplying respirator may be used.

(3) *Respirators for atmospheres that are not IDLH.* (i) The employer shall provide a respirator that is adequate to protect the health of the employee and ensure compliance with all other OSHA statutory and regulatory requirements, under routine and reasonably foreseeable emergency situations.

(A) *Assigned Protection Factors (APFs)* [Reserved]

(B) *Maximum Use Concentration (MUC)* [Reserved]

(ii) The respirator selected shall be appropriate for the chemical state and physical form of the contaminant.

(iii) For protection against gases and vapors, the employer shall provide:

(A) An atmosphere-supplying respirator, or

(B) An air-purifying respirator, provided that:

(*1*) The respirator is equipped with an end-of-service-life indicator (ESLI) certified by NIOSH for the contaminant; or

(*2*) If there is no ESLI appropriate for conditions in the employer's workplace, the employer implements a change schedule for canisters and cartridges that is based on objective information or data that will ensure that canisters and cartridges are changed before the end of their service life. The employer shall describe in the respirator program the information and data relied upon and the basis for the canister and cartridge change schedule and the basis for reliance on the data.

(iv) For protection against particulates, the employer shall provide:

(A) An atmosphere-supplying respirator; or

(B) An air-purifying respirator equipped with a filter certified by NIOSH under 30 CFR part 11 as a high efficiency particulate air (HEPA) filter, or an air-purifying respirator equipped with a filter certified for particulates by NIOSH under 42 CFR part 84; or

(C) For contaminants consisting primarily of particles with mass median aerodynamic diameters (MMAD) of at least 2 micrometers, an air-purifying respirator equipped with any filter certified for particulates by NIOSH.

TABLE I.—Assigned Protection Factors [Reserved]

TABLE II

Altitude (ft.)	Oxygen deficient Atmospheres (% 0_2) for which the employer may rely on atmosphere-supplying respirators
Less than 3,001	16.0–19.5
3,001–4,000	16.4–19.5
4,001–5,000	17.1–19.5
5,001–6,000	17.8–19.5
6,001–7,000	18.5–19.5
7,001–8,000[1]	19.3–19.5.

[1] Above 8,000 feet the exception does not apply. Oxygen-enriched breathing air must be supplied above 14,000 feet.

(e) *Medical evaluation.* Using a respirator may place a physiological burden on employees that varies with the type of respirator worn, the job and workplace conditions in which the respirator is used, and the medical status of the employee. Accordingly, this paragraph specifies the minimum requirements for medical evaluation that employers must implement to determine the employee's ability to use a respirator.

(1) *General.* The employer shall provide a medical evaluation to determine the employee's ability to use a respirator, before the employee is fit tested or required to use the respirator in the workplace. The employer may discontinue an employee's medical evaluations when the employee is no longer required to use a respirator.

(2) *Medical evaluation procedures.* (i) The employer shall identify a physician or other licensed health care professional (PLHCP) to perform medical evaluations using a medical questionnaire or an initial medical examination that obtains the same information as the medical questionnaire.

(ii) The medical evaluation shall obtain the information requested by the questionnaire in Sections 1 and 2, Part A of Appendix C of this section.

(3) *Follow-up medical examination.* (i) The employer shall ensure that a follow-up medical examination is provided for an employee who gives a positive response to any question among questions 1 through 8 in Section 2, Part A of Appendix C or whose initial medical examination demonstrates the need for a follow-up medical examination.

(ii) The follow-up medical examination shall include any medical tests, consultations, or diagnostic procedures that the PLHCP deems necessary to make a final determination.

(4) *Administration of the medical questionnaire and examinations.* (i) The medical questionnaire and examinations shall be administered confidentially during the employee's normal working hours or at a time and place convenient to the employee. The medical questionnaire shall be administered in a manner that ensures that the employee understands its content.

(ii) The employer shall provide the employee with an opportunity to discuss the questionnaire and examination results with the PLHCP.

(5) *Supplemental information for the PLHCP.* (i) The following information must be provided to the PLHCP before the PLHCP makes a recommendation concerning an employee's ability to use a respirator:

(A) The type and weight of the respirator to be used by the employee;

(B) The duration and frequency of respirator use (including use for rescue and escape);

(C) The expected physical work effort;

(D) Additional protective clothing and equipment to be worn; and

(E) Temperature and humidity extremes that may be encountered.

(ii) Any supplemental information provided previously to the PLHCP regarding an employee need not be provided for a subsequent medical evaluation if the information and the PLHCP remain the same.

(iii) The employer shall provide the PLHCP with a copy of the written respiratory protection program and a copy of this section.

Note to Paragraph (e)(5)(iii): When the employer replaces a PLHCP, the employer must ensure that the new PLHCP obtains this information, either by providing the documents directly to the PLHCP or having the documents transferred from the former PLHCP to the new PLHCP. However, OSHA does not expect employers to have employees medically reevaluated solely because a new PLHCP has been selected.

(6) *Medical determination.* In determining the employee's ability to use a respirator, the employer shall:

(i) Obtain a written recommendation regarding the employee's ability to use the respirator from the PLHCP. The recommendation shall provide only the following information:

(A) Any limitations on respirator use related to the medical condition of the employee, or relating to the workplace conditions in which the respirator will be used, including whether or not the employee is medically able to use the respirator;

(B) The need, if any, for follow-up medical evaluations; and

(C) A statement that the PLHCP has provided the employee with a copy of the PLHCP's written recommendation.

(ii) If the respirator is a negative pressure respirator and the PLHCP finds a medical condition that may place the employee's health at increased risk if the respirator is used, the employer shall provide a PAPR if the PLHCP's medical evaluation finds that the employee can use such a respirator; if a subsequent medical evaluation finds that the employee is medically able to use a negative pressure respirator, then the employer is no longer required to provide a PAPR.

(7) *Additional medical evaluations.* At a minimum, the employer shall provide additional medical evaluations that comply with the requirements of this section if:

(i) An employee reports medical signs or symptoms that are related to ability to use a respirator;

(ii) A PLHCP, supervisor, or the respirator program administrator informs the employer that an employee needs to be reevaluated;

(iii) Information from the respiratory protection program, including observations made during fit testing and program evaluation, indicates a need for employee reevaluation; or

(iv) A change occurs in workplace conditions (e.g., physical work effort, protective clothing, temperature) that may result in a substantial increase in the physiological burden placed on an employee.

(f) *Fit testing.* This paragraph requires that, before an employee may be required to use any respirator with a negative or positive pressure tight-fitting facepiece, the employee must be fit tested with the same make, model, style, and size of respirator that will be used. This paragraph specifies the kinds of fit tests allowed, the procedures for conducting them, and how the results of the fit tests must be used.

(1) The employer shall ensure that employees using a tight-fitting facepiece respirator pass an appropriate qualitative fit test (QLFT) or quantitative fit test (QNFT) as stated in this paragraph.

(2) The employer shall ensure that an employee using a tight-fitting facepiece respirator is fit tested prior to initial use of the respirator, whenever a different respirator facepiece (size, style, model or make) is used, and at least annually thereafter.

(3) The employer shall conduct an additional fit test whenever the employee reports, or the employer, PLHCP, supervisor, or program administrator makes visual observations of, changes in the employee's physical condition that could affect respirator fit. Such conditions include, but are not limited to, facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight.

(4) If after passing a QLFT or QNFT, the employee subsequently notifies the employer, program administrator, supervisor, or PLHCP that the fit of the respirator is unacceptable, the employee shall be given a reasonable opportunity to select a different respirator facepiece and to be retested.

(5) The fit test shall be administered using an OSHA-accepted QLFT or QNFT protocol. The OSHA-accepted QLFT and QNFT protocols and procedures are contained in Appendix A of this section.

(6) QLFT may only be used to fit test negative pressure air-purifying respirators that must achieve a fit factor of 100 or less.

(7) If the fit factor, as determined through an OSHA-accepted QNFT protocol, is equal to or greater than 100 for tight-fitting half facepieces, or equal to or greater than 500 for tight-fitting full facepieces, the QNFT has been passed with that respirator.

(8) Fit testing of tight-fitting atmosphere-supplying respirators and tight-fitting powered air-purifying respirators shall be accomplished by performing quantitative or qualitative fit testing in the negative pressure mode, regardless of the mode of operation (negative or positive pressure) that is used for respiratory protection.

(i) Qualitative fit testing of these respirators shall be accomplished by temporarily converting the respirator user's actual facepiece into a negative pressure respirator with appropriate filters, or by using an identical negative pressure air-purifying respirator facepiece with the same sealing surfaces as a surrogate for the atmosphere-supplying or powered air-purifying respirator facepiece.

(ii) Quantitative fit testing of these respirators shall be accomplished by modifying the facepiece to allow sampling inside the facepiece in the breathing zone of the user, midway between the nose and mouth. This requirement shall be accomplished by installing a permanent sampling probe onto a surrogate facepiece, or by using a sampling adapter designed to temporarily provide a means of sampling air from inside the facepiece.

(iii) Any modifications to the respirator facepiece for fit testing shall be completely removed, and the facepiece restored to NIOSH-approved configuration, before that facepiece can be used in the workplace.

(g) *Use of respirators.* This paragraph requires employers to establish and implement procedures for the proper use of respirators. These requirements include prohibiting conditions that may result in facepiece seal leakage, preventing employees from removing respirators in hazardous environments, taking actions to ensure continued effective respirator operation throughout the work shift, and establishing procedures for the use of respirators in IDLH atmospheres or in interior structural firefighting situations.

(1) *Facepiece seal protection.* (i) The employer shall not permit respirators with tight-fitting facepieces to be worn by employees who have:

(A) Facial hair that comes between the sealing surface of the facepiece and the face or that interferes with valve function; or

(B) Any condition that interferes with the face-to-facepiece seal or valve function.

(ii) If an employee wears corrective glasses or goggles or other personal protective equipment, the employer shall ensure that such equipment is worn in a manner that does not interfere with the seal of the facepiece to the face of the user.

(iii) For all tight-fitting respirators, the employer shall ensure that employees perform a user seal check each time they put on the respirator using the procedures in Appendix B–1 or procedures recommended by the respirator manufacturer that the employer demonstrates are as effective as those in Appendix B–1 of this section.

(2) *Continuing respirator effectiveness.* (i) Appropriate surveillance shall be maintained of work area conditions and degree of employee exposure or stress. When there is a change in work area conditions or degree of employee exposure or stress that may affect respirator effectiveness, the employer shall reevaluate the continued effectiveness of the respirator.

(ii) The employer shall ensure that employees leave the respirator use area:

(A) To wash their faces and respirator facepieces as necessary to prevent eye or skin irritation associated with respirator use; or

(B) If they detect vapor or gas breakthrough, changes in breathing resistance, or leakage of the facepiece; or

(C) To replace the respirator or the filter, cartridge, or canister elements.

(iii) If the employee detects vapor or gas breakthrough, changes in breathing resistance, or leakage of the facepiece, the employer must replace or repair the respirator before allowing the employee to return to the work area.

(3) *Procedures for IDLH atmospheres.* For all IDLH atmospheres, the employer shall ensure that:

(i) One employee or, when needed, more than one employee is located outside the IDLH atmosphere;

(ii) Visual, voice, or signal line communication is maintained between the employee(s) in the IDLH atmosphere and the employee(s) located outside the IDLH atmosphere;

(iii) The employee(s) located outside the IDLH atmosphere are trained and equipped to provide effective emergency rescue;

(iv) The employer or designee is notified before the employee(s) located outside the IDLH atmosphere enter the IDLH atmosphere to provide emergency rescue;

(v) The employer or designee authorized to do so by the employer, once notified, provides necessary assistance appropriate to the situation;

(vi) Employee(s) located outside the IDLH atmospheres are equipped with:

(A) Pressure demand or other positive pressure SCBAs, or a pressure demand or other positive pressure supplied-air respirator with auxiliary SCBA; and either

(B) Appropriate retrieval equipment for removing the employee(s) who enter(s) these hazardous atmospheres where retrieval equipment would contribute to the rescue of the employee(s) and would not increase the overall risk resulting from entry; or

(C) Equivalent means for rescue where retrieval equipment is not required under paragraph (g)(3)(vi)(B).

(4) *Procedures for interior structural firefighting.* In addition to the requirements set forth under paragraph (g)(3), in interior structural fires, the employer shall ensure that:

(i) At least two employees enter the IDLH atmosphere and remain in visual or voice contact with one another at all times;

(ii) At least two employees are located outside the IDLH atmosphere; and

(iii) All employees engaged in interior structural firefighting use SCBAs.

Note 1 to paragraph (g): One of the two individuals located outside the IDLH atmosphere may be assigned to an additional role, such as incident commander in charge of the emergency or safety officer, so long as this individual is able to perform assistance or rescue activities without jeopardizing the safety or health of any firefighter working at the incident.

Note 2 to paragraph (g): Nothing in this section is meant to preclude firefighters from performing emergency rescue activities before an entire team has assembled.

(h) *Maintenance and care of respirators.* This paragraph requires the employer to provide for the cleaning and disinfecting, storage, inspection, and repair of respirators used by employees.

(1) *Cleaning and disinfecting.* The employer shall provide each respirator user with a respirator that is clean, sanitary, and in good working order. The employer shall ensure that respirators are cleaned and disinfected using the procedures in Appendix B–2 of this section, or procedures recommended by the respirator manufacturer, provided that such procedures are of equivalent effectiveness. The respirators shall be cleaned and disinfected at the following intervals:

(i) Respirators issued for the exclusive use of an employee shall be cleaned and disinfected as often as necessary to be maintained in a sanitary condition;

(ii) Respirators issued to more than one employee shall be cleaned and disinfected before being worn by different individuals;

(iii) Respirators maintained for emergency use shall be cleaned and disinfected after each use; and

(iv) Respirators used in fit testing and training shall be cleaned and disinfected after each use.

(2) *Storage.* The employer shall ensure that respirators are stored as follows:

(i) All respirators shall be stored to protect them from damage, contamination, dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals, and they shall be packed or stored to prevent deformation of the facepiece and exhalation valve.

(ii) In addition to the requirements of paragraph (h)(2)(i) of this section, emergency respirators shall be:

(A) Kept accessible to the work area;

(B) Stored in compartments or in covers that are clearly marked as containing emergency respirators; and

(C) Stored in accordance with any applicable manufacturer instructions.

(3) *Inspection.* (i) The employer shall ensure that respirators are inspected as follows:

(A) All respirators used in routine situations shall be inspected before each use and during cleaning;

(B) All respirators maintained for use in emergency situations shall be inspected at least monthly and in accordance with the manufacturer's recommendations, and shall be checked for proper function before and after each use; and

(C) Emergency escape-only respirators shall be inspected before being carried into the workplace for use.

(ii) The employer shall ensure that respirator inspections include the following:

(A) A check of respirator function, tightness of connections, and the condition of the various parts including, but not limited to, the facepiece, head straps, valves, connecting tube, and cartridges, canisters or filters; and

(B) A check of elastomeric parts for pliability and signs of deterioration.

(iii) In addition to the requirements of paragraphs (h)(3)(i) and (ii) of this section, self-contained breathing apparatus shall be inspected monthly. Air and oxygen cylinders shall be maintained in a fully charged state and shall be recharged when the pressure falls to 90% of the manufacturer's recommended pressure level. The employer shall determine that the regulator and warning devices function properly.

(iv) For respirators maintained for emergency use, the employer shall:

(A) Certify the respirator by documenting the date the inspection was performed, the name (or signature) of the person who made the inspection, the findings, required remedial action, and a serial number or other means of identifying the inspected respirator; and

(B) Provide this information on a tag or label that is attached to the storage compartment for the respirator, is kept with the respirator, or is included in inspection reports stored as paper or electronic files. This information shall be maintained until replaced following a subsequent certification.

(4) *Repairs.* The employer shall ensure that respirators that fail an inspection or are otherwise found to be defective are removed from service, and are discarded or repaired or adjusted in accordance with the following procedures:

(i) Repairs or adjustments to respirators are to be made only by persons appropriately trained to perform such operations and shall use only the respirator manufacturer's NIOSH-approved parts designed for the respirator;

(ii) Repairs shall be made according to the manufacturer's recommendations and specifications for the type and extent of repairs to be performed; and

(iii) Reducing and admission valves, regulators, and alarms shall be adjusted or repaired only by the manufacturer or a technician trained by the manufacturer.

(i) *Breathing air quality and use.* This paragraph requires the employer to provide employees using atmosphere-supplying respirators (supplied-air and SCBA) with breathing gases of high purity.

(1) The employer shall ensure that compressed air, compressed oxygen, liquid air, and liquid oxygen used for respiration accords with the following specifications:

(i) Compressed and liquid oxygen shall meet the United States Pharmacopoeia requirements for medical or breathing oxygen; and

(ii) Compressed breathing air shall meet at least the requirements for Type 1-Grade D breathing air described in ANSI/Compressed Gas Association Commodity Specification for Air, G–7.1–1989, to include:

(A) Oxygen content (v/v) of 19.5–23.5%;

(B) Hydrocarbon (condensed) content of 5 milligrams per cubic meter of air or less;

(C) Carbon monoxide (CO) content of 10 ppm or less;

(D) Carbon dioxide content of 1,000 ppm or less; and

(E) Lack of noticeable odor.

(2) The employer shall ensure that compressed oxygen is not used in atmosphere-supplying respirators that have previously used compressed air.

(3) The employer shall ensure that oxygen concentrations greater than 23.5% are used only in equipment designed for oxygen service or distribution.

(4) The employer shall ensure that cylinders used to supply breathing air to respirators meet the following requirements:

(i) Cylinders are tested and maintained as prescribed in the Shipping Container Specification Regulations of the Department of Transportation (49 CFR part 173 and part 178);

(ii) Cylinders of purchased breathing air have a certificate of analysis from the supplier that the breathing air meets the requirements for Type 1—Grade D breathing air; and

(iii) The moisture content in the cylinder does not exceed a dew point of −50 °F (−45.6 °C) at 1 atmosphere pressure.

(5) The employer shall ensure that compressors used to supply breathing air to respirators are constructed and situated so as to:

(i) Prevent entry of contaminated air into the air-supply system;

(ii) Minimize moisture content so that the dew point at 1 atmosphere pressure is 10 degrees F (5.56 °C) below the ambient temperature;

(iii) Have suitable in-line air-purifying sorbent beds and filters to further ensure breathing air quality. Sorbent beds and filters shall be maintained and replaced or refurbished periodically following the manufacturer's instructions.

(iv) Have a tag containing the most recent change date and the signature of the person authorized by the employer to perform the change. The tag shall be maintained at the compressor.

(6) For compressors that are not oil-lubricated, the employer shall ensure that carbon monoxide levels in the breathing air do not exceed 10 ppm.

(7) For oil-lubricated compressors, the employer shall use a high-temperature or carbon monoxide alarm, or both, to monitor carbon monoxide levels. If only high-temperature alarms are used, the air supply shall be monitored at intervals sufficient to prevent carbon monoxide in the breathing air from exceeding 10 ppm.

(8) The employer shall ensure that breathing air couplings are incompatible with outlets for nonrespirable worksite air or other gas systems. No asphyxiating substance shall be introduced into breathing air lines.

(9) The employer shall use breathing gas containers marked in accordance with the NIOSH respirator certification standard, 42 CFR part 84.

(j) *Identification of filters, cartridges, and canisters.* The employer shall ensure that all filters, cartridges and canisters used in the workplace are labeled and color coded with the NIOSH approval label and that the label is not removed and remains legible.

(k) *Training and information.* This paragraph requires the employer to provide effective training to employees who are required to use respirators. The training must be comprehensive, understandable, and recur annually, and more often if necessary. This paragraph also requires the employer to provide the basic information on respirators in Appendix D of this section to employees who wear respirators when not required by this section or by the employer to do so.

(1) The employer shall ensure that each employee can demonstrate knowledge of at least the following:

(i) Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator;

(ii) What the limitations and capabilities of the respirator are;

(iii) How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions;

(iv) How to inspect, put on and remove, use, and check the seals of the respirator;

(v) What the procedures are for maintenance and storage of the respirator;

(vi) How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators; and

(vii) The general requirements of this section.

(2) The training shall be conducted in a manner that is understandable to the employee.

(3) The employer shall provide the training prior to requiring the employee to use a respirator in the workplace.

(4) An employer who is able to demonstrate that a new employee has received training within the last 12 months that addresses the elements specified in paragraph (k)(1)(i) through (vii) is not required to repeat such training provided that, as required by paragraph (k)(1), the employee can demonstrate knowledge of those element(s). Previous training not repeated initially by the employer must be provided no later than 12 months from the date of the previous training.

(5) Retraining shall be administered annually, and when the following situations occur:

(i) Changes in the workplace or the type of respirator render previous training obsolete;

(ii) Inadequacies in the employee's knowledge or use of the respirator indicate that the employee has not retained the requisite understanding or skill; or

(iii) Any other situation arises in which retraining appears necessary to ensure safe respirator use.

(6) The basic advisory information on respirators, as presented in Appendix D of this section, shall be provided by the employer in any written or oral format, to employees who wear respirators when such use is not required by this section or by the employer.

(l) *Program evaluation.* This section requires the employer to conduct evaluations of the workplace to ensure that the written respiratory protection program is being properly implemented, and to consult employees to ensure that they are using the respirators properly.

(1) The employer shall conduct evaluations of the workplace as necessary to ensure that the provisions of the current written program are being effectively implemented and that it continues to be effective.

(2) The employer shall regularly consult employees required to use respirators to assess the employees' views on program effectiveness and to identify any problems. Any problems that are identified during this assessment shall be corrected. Factors to be assessed include, but are not limited to:

(i) Respirator fit (including the ability to use the respirator without interfering with effective workplace performance);

(ii) Appropriate respirator selection for the hazards to which the employee is exposed;

(iii) Proper respirator use under the workplace conditions the employee encounters; and

(iv) Proper respirator maintenance.

(m) *Recordkeeping.* This section requires the employer to establish and retain written information regarding medical evaluations, fit testing, and the respirator program. This information will facilitate employee involvement in the respirator program, assist the employer in auditing the adequacy of the program, and provide a record for compliance determinations by OSHA.

(1) *Medical evaluation.* Records of medical evaluations required by this section must be retained and made available in accordance with 29 CFR 1910.1020.

(2) *Fit testing.* (i) The employer shall establish a record of the qualitative and quantitative fit tests administered to an employee including:

(A) The name or identification of the employee tested;

(B) Type of fit test performed;

(C) Specific make, model, style, and size of respirator tested;

(D) Date of test; and

(E) The pass/fail results for QLFTs or the fit factor and strip chart recording or other recording of the test results for QNFTs.

(ii) Fit test records shall be retained for respirator users until the next fit test is administered.

(3) A written copy of the current respirator program shall be retained by the employer.

(4) Written materials required to be retained under this paragraph shall be made available upon request to affected employees and to the Assistant Secretary or designee for examination and copying.

(n) *Dates.* (1) *Effective date.* This section is effective April 8, 1998. The obligations imposed by this section commence on the effective date unless otherwise noted in this paragraph. Compliance with obligations that do not commence on the effective date shall occur no later than the applicable start-up date.

(2) *Compliance dates.* All obligations of this section commence on the effective date except as follows:

(i) The determination that respirator use is required (paragraph (a)) shall be completed no later than September 8, 1998.

(ii) Compliance with provisions of this section for all other provisions shall be completed no later than October 5, 1998.

(3) The provisions of 29 CFR 1910.134 and 29 CFR 1926.103, contained in the 29 CFR parts 1900 to 1910.99 and the 29 CFR part 1926 editions, revised as of July 1, 1997, are in effect and enforceable until April 8, 1998, or during any administrative or judicial stay of the provisions of this section.

(4) *Existing Respiratory Protection Programs.* If, in the 12 month period preceding April 8, 1998, the employer has conducted annual respirator training, fit testing, respirator program evaluation, or medical evaluations, the employer may use the results of those activities to comply with the corresponding provisions of this section, providing that these activities were conducted in a manner that meets the requirements of this section.

(o) *Appendices.* (1) Compliance with Appendix A, Appendix B–1, Appendix B–2, and Appendix C of this section is mandatory.

(2) Appendix D of this section is non-mandatory and is not intended to create any additional obligations not otherwise imposed or to detract from any existing obligations.

Appendix A to § 1910.134: Fit Testing Procedures (Mandatory)

Part I. OSHA-Accepted Fit Test Protocols

A. Fit Testing Procedures—General Requirements

The employer shall conduct fit testing using the following procedures. The requirements in this appendix apply to all OSHA-accepted fit test methods, both QLFT and QNFT.

1. The test subject shall be allowed to pick the most acceptable respirator from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.

2. Prior to the selection process, the test subject shall be shown how to put on a respirator, how it should be positioned on the face, how to set strap tension and how to determine an acceptable fit. A mirror shall be available to assist the subject in evaluating the fit and positioning of the respirator. This instruction may not constitute the subject's formal training on respirator use, because it is only a review.

3. The test subject shall be informed that he/she is being asked to select the respirator that provides the most acceptable fit. Each respirator represents a different size and shape, and if fitted and used properly, will provide adequate protection.

4. The test subject shall be instructed to hold each chosen facepiece up to the face and eliminate those that obviously do not give an acceptable fit.

5. The more acceptable facepieces are noted in case the one selected proves unacceptable; the most comfortable mask is donned and worn at least five minutes to assess comfort. Assistance in assessing comfort can be given by discussing the points in the following item A.6. If the test subject is not familiar with using a particular respirator, the test subject shall be directed to don the mask several times and to adjust the straps each time to become adept at setting proper tension on the straps.

6. Assessment of comfort shall include a review of the following points with the test subject and allowing the test subject adequate time to determine the comfort of the respirator:

(a) Position of the mask on the nose

(b) Room for eye protection

(c) Room to talk

(d) Position of mask on face and cheeks

7. The following criteria shall be used to help determine the adequacy of the respirator fit:

(a) Chin properly placed;

(b) Adequate strap tension, not overly tightened;

(c) Fit across nose bridge;

(d) Respirator of proper size to span distance from nose to chin;

(e) Tendency of respirator to slip;

(f) Self-observation in mirror to evaluate fit and respirator position.

8. The test subject shall conduct a user seal check, either the negative and positive pressure seal checks described in Appendix B–1 of this section or those recommended by the respirator manufacturer which provide equivalent protection to the procedures in Appendix B–1. Before conducting the negative and positive pressure checks, the subject shall be told to seat the mask on the face by moving the head from side-to-side and up and down slowly while taking in a few slow deep breaths. Another facepiece shall be selected and retested if the test subject fails the user seal check tests.

9. The test shall not be conducted if there is any hair growth between the skin and the facepiece sealing surface, such as stubble beard growth, beard, mustache or sideburns which cross the respirator sealing surface. Any type of apparel which interferes with a satisfactory fit shall be altered or removed.

10. If a test subject exhibits difficulty in breathing during the tests, she or he shall be referred to a physician or other licensed health care professional, as appropriate, to determine whether the test subject can wear a respirator while performing her or his duties.

11. If the employee finds the fit of the respirator unacceptable, the test subject shall be given the opportunity to select a different respirator and to be retested.

12. Exercise regimen. Prior to the commencement of the fit test, the test subject shall be given a description of the fit test and the test subject's responsibilities during the test procedure. The description of the process shall include a description of the test exercises that the subject will be performing. The respirator to be tested shall be worn for at least 5 minutes before the start of the fit test.

13. The fit test shall be performed while the test subject is wearing any applicable safety equipment that may be worn during actual respirator use which could interfere with respirator fit.

14. Test Exercises. (a) The following test exercises are to be performed for all fit testing methods prescribed in this appendix, except for the CNP method. A separate fit testing exercise regimen is contained in the CNP protocol. The test subject shall perform exercises, in the test environment, in the following manner:

(1) Normal breathing. In a normal standing position, without talking, the subject shall breathe normally.

(2) Deep breathing. In a normal standing position, the subject shall breathe slowly and deeply, taking caution so as not to hyperventilate.

(3) Turning head side to side. Standing in place, the subject shall slowly turn his/her head from side to side between the extreme positions on each side. The head shall be held at each extreme momentarily so the subject can inhale at each side.

(4) Moving head up and down. Standing in place, the subject shall slowly move his/her head up and down. The subject shall be instructed to inhale in the up position (i.e., when looking toward the ceiling).

(5) Talking. The subject shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The subject can read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song.

Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.

(6) Grimace. The test subject shall grimace by smiling or frowning. (This applies only to QNFT testing; it is not performed for QLFT)

(7) Bending over. The test subject shall bend at the waist as if he/she were to touch his/her toes. Jogging in place shall be substituted for this exercise in those test environments such as shroud type QNFT or QLFT units that do not permit bending over at the waist.

(8) Normal breathing. Same as exercise (1).

(b) Each test exercise shall be performed for one minute except for the grimace exercise which shall be performed for 15 seconds. The test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of respirator shall be tried. The respirator shall not be adjusted once the fit test exercises begin. Any adjustment voids the test, and the fit test must be repeated.

B. Qualitative Fit Test (QLFT) Protocols

1. General

(a) The employer shall ensure that persons administering QLFT are able to prepare test solutions, calibrate equipment and perform tests properly, recognize invalid tests, and ensure that test equipment is in proper working order.

(b) The employer shall ensure that QLFT equipment is kept clean and well maintained so as to operate within the parameters for which it was designed.

2. Isoamyl Acetate Protocol

Note: This protocol is not appropriate to use for the fit testing of particulate respirators. If used to fit test particulate respirators, the respirator must be equipped with an organic vapor filter.

(a) Odor Threshold Screening

Odor threshold screening, performed without wearing a respirator, is intended to determine if the individual tested can detect the odor of isoamyl acetate at low levels.

(1) Three 1 liter glass jars with metal lids are required.

(2) Odor-free water (e.g., distilled or spring water) at approximately 25° C (77° F) shall be used for the solutions.

(3) The isoamyl acetate (IAA) (also known at isopentyl acetate) stock solution is prepared by adding 1 ml of pure IAA to 800 ml of odor-free water in a 1 liter jar, closing the lid and shaking for 30 seconds. A new solution shall be prepared at least weekly.

(4) The screening test shall be conducted in a room separate from the room used for actual fit testing. The two rooms shall be well-ventilated to prevent the odor of IAA from becoming evident in the general room air where testing takes place.

(5) The odor test solution is prepared in a second jar by placing 0.4 ml of the stock solution into 500 ml of odor-free water using a clean dropper or pipette. The solution shall be shaken for 30 seconds and allowed to stand for two to three minutes so that the IAA concentration above the liquid may reach equilibrium. This solution shall be used for only one day.

(6) A test blank shall be prepared in a third jar by adding 500 cc of odor-free water.

(7) The odor test and test blank jar lids shall be labeled (e.g., 1 and 2) for jar identification. Labels shall be placed on the lids so that they can be peeled off periodically and switched to maintain the integrity of the test.

(8) The following instruction shall be typed on a card and placed on the table in front of the two test jars (i.e., 1 and 2): ''The purpose of this test is to determine if you can smell banana oil at a low concentration. The two bottles in front of you contain water. One of these bottles also contains a small amount of banana oil. Be sure the covers are on tight, then shake each bottle for two seconds. Unscrew the lid of each bottle, one at a time, and sniff at the mouth of the bottle. Indicate to the test conductor which bottle contains banana oil.''

(9) The mixtures used in the IAA odor detection test shall be prepared in an area separate from where the test is performed, in order to prevent olfactory fatigue in the subject.

(10) If the test subject is unable to correctly identify the jar containing the odor test solution, the IAA qualitative fit test shall not be performed.

(11) If the test subject correctly identifies the jar containing the odor test solution, the test subject may proceed to respirator selection and fit testing.

(b) Isoamyl Acetate Fit Test

(1) The fit test chamber shall be a clear 55-gallon drum liner suspended inverted over a 2-foot diameter frame so that the top of the chamber is about 6 inches above the test subject's head. If no drum liner is available, a similar chamber shall be constructed using plastic sheeting. The inside top center of the chamber shall have a small hook attached.

(2) Each respirator used for the fitting and fit testing shall be equipped with organic vapor cartridges or offer protection against organic vapors.

(3) After selecting, donning, and properly adjusting a respirator, the test subject shall wear it to the fit testing room. This room shall be separate from the room used for odor threshold screening and respirator selection, and shall be well-ventilated, as by an exhaust fan or lab hood, to prevent general room contamination.

(4) A copy of the test exercises and any prepared text from which the subject is to read shall be taped to the inside of the test chamber.

(5) Upon entering the test chamber, the test subject shall be given a 6-inch by 5-inch piece of paper towel, or other porous, absorbent, single-ply material, folded in half and wetted with 0.75 ml of pure IAA. The test subject shall hang the wet towel on the hook at the top of the chamber. An IAA test swab or ampule may be substituted for the IAA wetted paper towel provided it has been demonstrated that the alternative IAA source will generate an IAA test atmosphere with a concentration equivalent to that generated by the paper towel method.

(6) Allow two minutes for the IAA test concentration to stabilize before starting the fit test exercises. This would be an appropriate time to talk with the test subject; to explain the fit test, the importance of his/her cooperation, and the purpose for the test exercises; or to demonstrate some of the exercises.

(7) If at any time during the test, the subject detects the banana-like odor of IAA, the test is failed. The subject shall quickly exit from the test chamber and leave the test area to avoid olfactory fatigue.

(8) If the test is failed, the subject shall return to the selection room and remove the respirator. The test subject shall repeat the odor sensitivity test, select and put on another respirator, return to the test area and again begin the fit test procedure described in (b) (1) through (7) above. The process continues until a respirator that fits well has been found. Should the odor sensitivity test be failed, the subject shall wait at least 5 minutes before retesting. Odor sensitivity will usually have returned by this time.

(9) If the subject passes the test, the efficiency of the test procedure shall be demonstrated by having the subject break the respirator face seal and take a breath before exiting the chamber.

(10) When the test subject leaves the chamber, the subject shall remove the saturated towel and return it to the person conducting the test, so that there is no significant IAA concentration buildup in the chamber during subsequent tests. The used towels shall be kept in a self-sealing plastic bag to keep the test area from being contaminated.

3. Saccharin Solution Aerosol Protocol

The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

(a) Taste threshold screening. The saccharin taste threshold screening,

performed without wearing a respirator, is intended to determine whether the individual being tested can detect the taste of saccharin.

(1) During threshold screening as well as during fit testing, subjects shall wear an enclosure about the head and shoulders that is approximately 12 inches in diameter by 14 inches tall with at least the front portion clear and that allows free movements of the head when a respirator is worn. An enclosure substantially similar to the 3M hood assembly, parts # FT 14 and # FT 15 combined, is adequate.

(2) The test enclosure shall have a ¾-inch (1.9 cm) hole in front of the test subject's nose and mouth area to accommodate the nebulizer nozzle.

(3) The test subject shall don the test enclosure. Throughout the threshold screening test, the test subject shall breathe through his/her slightly open mouth with tongue extended. The subject is instructed to report when he/she detects a sweet taste.

(4) Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, the test conductor shall spray the threshold check solution into the enclosure. The nozzle is directed away from the nose and mouth of the person. This nebulizer shall be clearly marked to distinguish it from the fit test solution nebulizer.

(5) The threshold check solution is prepared by dissolving 0.83 gram of sodium saccharin USP in 100 ml of warm water. It can be prepared by putting 1 ml of the fit test solution (see (b)(5) below) in 100 ml of distilled water.

(6) To produce the aerosol, the nebulizer bulb is firmly squeezed so that it collapses completely, then released and allowed to fully expand.

(7) Ten squeezes are repeated rapidly and then the test subject is asked whether the saccharin can be tasted. If the test subject reports tasting the sweet taste during the ten squeezes, the screening test is completed. The taste threshold is noted as ten regardless of the number of squeezes actually completed.

(8) If the first response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin is tasted. If the test subject reports tasting the sweet taste during the second ten squeezes, the screening test is completed. The taste threshold is noted as twenty regardless of the number of squeezes actually completed.

(9) If the second response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin is tasted. If the test subject reports tasting the sweet taste during the third set of ten squeezes, the screening test is completed. The taste threshold is noted as thirty regardless of the number of squeezes actually completed.

(10) The test conductor will take note of the number of squeezes required to solicit a taste response.

(11) If the saccharin is not tasted after 30 squeezes (step 10), the test subject is unable to taste saccharin and may not perform the saccharin fit test.

Note to paragraph 3. (a): If the test subject eats or drinks something sweet before the screening test, he/she may be unable to taste the weak saccharin solution.

(12) If a taste response is elicited, the test subject shall be asked to take note of the taste for reference in the fit test.

(13) Correct use of the nebulizer means that approximately 1 ml of liquid is used at a time in the nebulizer body.

(14) The nebulizer shall be thoroughly rinsed in water, shaken dry, and refilled at least each morning and afternoon or at least every four hours.

(b) Saccharin solution aerosol fit test procedure.

(1) The test subject may not eat, drink (except plain water), smoke, or chew gum for 15 minutes before the test.

(2) The fit test uses the same enclosure described in 3. (a) above.

(3) The test subject shall don the enclosure while wearing the respirator selected in section I. A. of this appendix. The respirator shall be properly adjusted and equipped with a particulate filter(s).

(4) A second DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent is used to spray the fit test solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the screening test solution nebulizer.

(5) The fit test solution is prepared by adding 83 grams of sodium saccharin to 100 ml of warm water.

(6) As before, the test subject shall breathe through the slightly open mouth with tongue extended, and report if he/she tastes the sweet taste of saccharin.

(7) The nebulizer is inserted into the hole in the front of the enclosure and an initial concentration of saccharin fit test solution is sprayed into the enclosure using the same number of squeezes (either 10, 20 or 30 squeezes) based on the number of squeezes required to elicit a taste response as noted during the screening test. A minimum of 10 squeezes is required.

(8) After generating the aerosol, the test subject shall be instructed to perform the exercises in section I. A. 14. of this appendix.

(9) Every 30 seconds the aerosol concentration shall be replenished using one half the original number of squeezes used initially (e.g., 5, 10 or 15).

(10) The test subject shall indicate to the test conductor if at any time during the fit test the taste of saccharin is detected. If the test subject does not report tasting the saccharin, the test is passed.

(11) If the taste of saccharin is detected, the fit is deemed unsatisfactory and the test is failed. A different respirator shall be tried and the entire test procedure is repeated (taste threshold screening and fit testing).

(12) Since the nebulizer has a tendency to clog during use, the test operator must make periodic checks of the nebulizer to ensure that it is not clogged. If clogging is found at the end of the test session, the test is invalid.

4. Bitrex™ (Denatonium Benzoate) Solution Aerosol Qualitative Fit Test Protocol

The Bitrex™ (Denatonium benzoate) solution aerosol QLFT protocol uses the published saccharin test protocol because that protocol is widely accepted. Bitrex is routinely used as a taste aversion agent in household liquids which children should not be drinking and is endorsed by the American Medical Association, the National Safety Council, and the American Association of Poison Control Centers. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

(a) Taste Threshold Screening.

The Bitrex taste threshold screening, performed without wearing a respirator, is intended to determine whether the individual being tested can detect the taste of Bitrex.

(1) During threshold screening as well as during fit testing, subjects shall wear an enclosure about the head and shoulders that is approximately 12 inches (30.5 cm) in diameter by 14 inches (35.6 cm) tall. The front portion of the enclosure shall be clear from the respirator and allow free movement of the head when a respirator is worn. An enclosure substantially similar to the 3M hood assembly, parts #14 and #15 combined, is adequate.

(2) The test enclosure shall have a ¾ inch (1.9 cm) hole in front of the test subject's nose and mouth area to accommodate the nebulizer nozzle.

(3) The test subject shall don the test enclosure. Throughout the threshold screening test, the test subject shall breathe through his or her slightly open mouth with tongue extended. The subject is instructed to report when he/she detects a bitter taste.

(4) Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, the test conductor shall spray the Threshold Check Solution into the enclosure. This Nebulizer shall be clearly marked to distinguish it from the fit test solution nebulizer.

(5) The Threshold Check Solution is prepared by adding 13.5 milligrams of Bitrex to 100 ml of 5% salt (NaCl) solution in distilled water.

(6) To produce the aerosol, the nebulizer bulb is firmly squeezed so that the bulb collapses completely, and is then released and allowed to fully expand.

(7) An initial ten squeezes are repeated rapidly and then the test subject is asked whether the Bitrex can be tasted. If the test subject reports tasting the bitter taste during the ten squeezes, the screening test is completed. The taste threshold is noted as ten regardless of the number of squeezes actually completed.

(8) If the first response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the Bitrex is tasted. If the test subject reports tasting the bitter taste during the second ten squeezes, the screening test is completed. The taste threshold is noted as twenty regardless of the number of squeezes actually completed.

(9) If the second response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the Bitrex is tasted. If the test subject reports tasting the bitter taste during the third set of ten squeezes, the screening test is completed. The taste threshold is noted as thirty regardless of the number of squeezes actually completed.

(10) The test conductor will take note of the number of squeezes required to solicit a taste response.

(11) If the Bitrex is not tasted after 30 squeezes (step 10), the test subject is unable to taste Bitrex and may not perform the Bitrex fit test.

(12) If a taste response is elicited, the test subject shall be asked to take note of the taste for reference in the fit test.

(13) Correct use of the nebulizer means that approximately 1 ml of liquid is used at a time in the nebulizer body.

(14) The nebulizer shall be thoroughly rinsed in water, shaken to dry, and refilled at least each morning and afternoon or at least every four hours.

(b) Bitrex Solution Aerosol Fit Test Procedure.

(1) The test subject may not eat, drink (except plain water), smoke, or chew gum for 15 minutes before the test.

(2) The fit test uses the same enclosure as that described in 4. (a) above.

(3) The test subject shall don the enclosure while wearing the respirator selected according to section I. A. of this appendix. The respirator shall be properly adjusted and equipped with any type particulate filter(s).

(4) A second DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent is used to spray the fit test solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the screening test solution nebulizer.

(5) The fit test solution is prepared by adding 337.5 mg of Bitrex to 200 ml of a 5% salt (NaCl) solution in warm water.

(6) As before, the test subject shall breathe through his or her slightly open mouth with tongue extended, and be instructed to report if he/she tastes the bitter taste of Bitrex..

(7) The nebulizer is inserted into the hole in the front of the enclosure and an initial concentration of the fit test solution is sprayed into the enclosure using the same number of squeezes (either 10, 20 or 30 squeezes) based on the number of squeezes required to elicit a taste response as noted during the screening test.

(8) After generating the aerosol, the test subject shall be instructed to perform the exercises in section I. A. 14. of this appendix.

(9) Every 30 seconds the aerosol concentration shall be replenished using one half the number of squeezes used initially (e.g., 5, 10 or 15).

(10) The test subject shall indicate to the test conductor if at any time during the fit test the taste of Bitrex is detected. If the test subject does not report tasting the Bitrex, the test is passed.

(11) If the taste of Bitrex is detected, the fit is deemed unsatisfactory and the test is failed. A different respirator shall be tried and the entire test procedure is repeated (taste threshold screening and fit testing).

5. Irritant Smoke (Stannic Chloride) Protocol

This qualitative fit test uses a person's response to the irritating chemicals released in the ''smoke'' produced by a stannic chloride ventilation smoke tube to detect leakage into the respirator.

(a) General Requirements and Precautions

(1) The respirator to be tested shall be equipped with high efficiency particulate air (HEPA) or P100 series filter(s).

(2) Only stannic chloride smoke tubes shall be used for this protocol.

(3) No form of test enclosure or hood for the test subject shall be used.

(4) The smoke can be irritating to the eyes, lungs, and nasal passages. The test conductor shall take precautions to minimize the test subject's exposure to irritant smoke. Sensitivity varies, and certain individuals may respond to a greater degree to irritant smoke. Care shall be taken when performing the sensitivity screening checks that determine whether the test subject can detect irritant smoke to use only the minimum amount of smoke necessary to elicit a response from the test subject.

(5) The fit test shall be performed in an area with adequate ventilation to prevent exposure of the person conducting the fit test or the build-up of irritant smoke in the general atmosphere.

(b) Sensitivity Screening Check

The person to be tested must demonstrate his or her ability to detect a weak concentration of the irritant smoke.

(1) The test operator shall break both ends of a ventilation smoke tube containing stannic chloride, and attach one end of the smoke tube to a low flow air pump set to deliver 200 milliliters per minute, or an aspirator squeeze bulb. The test operator shall cover the other end of the smoke tube with a short piece of tubing to prevent potential injury from the jagged end of the smoke tube.

(2) The test operator shall advise the test subject that the smoke can be irritating to the eyes, lungs, and nasal passages and instruct the subject to keep his/her eyes closed while the test is performed.

(3) The test subject shall be allowed to smell a weak concentration of the irritant smoke before the respirator is donned to become familiar with its irritating properties and to determine if he/she can detect the irritating properties of the smoke. The test operator shall carefully direct a small amount of the irritant smoke in the test subject's direction to determine that he/she can detect it.

(c) Irritant Smoke Fit Test Procedure

(1) The person being fit tested shall don the respirator without assistance, and perform the required user seal check(s).

(2) The test subject shall be instructed to keep his/her eyes closed.

(3) The test operator shall direct the stream of irritant smoke from the smoke tube toward the faceseal area of the test subject, using the low flow pump or the squeeze bulb. The test operator shall begin at least 12 inches from the facepiece and move the smoke stream around the whole perimeter of the mask. The operator shall gradually make two more passes around the perimeter of the mask, moving to within six inches of the respirator.

(4) If the person being tested has not had an involuntary response and/or detected the irritant smoke, proceed with the test exercises.

(5) The exercises identified in section I.A. 14. of this appendix shall be performed by the test subject while the respirator seal is being continually challenged by the smoke, directed around the perimeter of the respirator at a distance of six inches.

(6) If the person being fit tested reports detecting the irritant smoke at any time, the test is failed. The person being retested must repeat the entire sensitivity check and fit test procedure.

(7) Each test subject passing the irritant smoke test without evidence of a response (involuntary cough, irritation) shall be given a second sensitivity screening check, with the smoke from the same smoke tube used during the fit test, once the respirator has been removed, to determine whether he/she still reacts to the smoke. Failure to evoke a response shall void the fit test.

(8) If a response is produced during this second sensitivity check, then the fit test is passed.

C. Quantitative Fit Test (QNFT) Protocols

The following quantitative fit testing procedures have been demonstrated to be acceptable: Quantitative fit testing using a non-hazardous test aerosol (such as corn oil, polyethylene glycol 400 [PEG 400], di-2-ethyl hexyl sebacate [DEHS], or sodium chloride) generated in a test chamber, and employing instrumentation to quantify the fit of the respirator; Quantitative fit testing using ambient aerosol as the test agent and appropriate instrumentation (condensation nuclei counter) to quantify the respirator fit; Quantitative fit testing using controlled negative pressure and appropriate instrumentation to measure the volumetric leak rate of a facepiece to quantify the respirator fit.

1. General

(a) The employer shall ensure that persons administering QNFT are able to calibrate equipment and perform tests properly, recognize invalid tests, calculate fit factors properly and ensure that test equipment is in proper working order.

(b) The employer shall ensure that QNFT equipment is kept clean, and is maintained and calibrated according to the manufacturer's instructions so as to operate at the parameters for which it was designed.

2. Generated Aerosol Quantitative Fit Testing Protocol

(a) Apparatus.

(1) Instrumentation. Aerosol generation, dilution, and measurement systems using particulates (corn oil, polyethylene glycol 400 [PEG 400], di-2-ethyl hexyl sebacate [DEHS] or sodium chloride) as test aerosols shall be used for quantitative fit testing.

(2) Test chamber. The test chamber shall be large enough to permit all test subjects to perform freely all required exercises without disturbing the test agent concentration or the measurement apparatus. The test chamber shall be equipped and constructed so that the test agent is effectively isolated from the ambient air, yet uniform in concentration throughout the chamber.

(3) When testing air-purifying respirators, the normal filter or cartridge element shall be replaced with a high efficiency particulate air (HEPA) or P100 series filter supplied by the same manufacturer.

(4) The sampling instrument shall be selected so that a computer record or strip chart record may be made of the test showing the rise and fall of the test agent concentration with each inspiration and expiration at fit factors of at least 2,000.

Integrators or computers that integrate the amount of test agent penetration leakage into the respirator for each exercise may be used provided a record of the readings is made.

(5) The combination of substitute air-purifying elements, test agent and test agent concentration shall be such that the test subject is not exposed in excess of an established exposure limit for the test agent at any time during the testing process, based upon the length of the exposure and the exposure limit duration.

(6) The sampling port on the test specimen respirator shall be placed and constructed so that no leakage occurs around the port (e.g., where the respirator is probed), a free air flow is allowed into the sampling line at all times, and there is no interference with the fit or performance of the respirator. The in-mask sampling device (probe) shall be designed and used so that the air sample is drawn from the breathing zone of the test subject, midway between the nose and mouth and with the probe extending into the facepiece cavity at least 1/4 inch.

(7) The test setup shall permit the person administering the test to observe the test subject inside the chamber during the test.

(8) The equipment generating the test atmosphere shall maintain the concentration of test agent constant to within a 10 percent variation for the duration of the test.

(9) The time lag (interval between an event and the recording of the event on the strip chart or computer or integrator) shall be kept to a minimum. There shall be a clear association between the occurrence of an event and its being recorded.

(10) The sampling line tubing for the test chamber atmosphere and for the respirator sampling port shall be of equal diameter and of the same material. The length of the two lines shall be equal.

(11) The exhaust flow from the test chamber shall pass through an appropriate filter (i.e., high efficiency particulate or P100 series filter) before release.

(12) When sodium chloride aerosol is used, the relative humidity inside the test chamber shall not exceed 50 percent.

(13) The limitations of instrument detection shall be taken into account when determining the fit factor.

(14) Test respirators shall be maintained in proper working order and be inspected regularly for deficiencies such as cracks or missing valves and gaskets.

(b) Procedural Requirements.

(1) When performing the initial user seal check using a positive or negative pressure check, the sampling line shall be crimped closed in order to avoid air pressure leakage during either of these pressure checks.

(2) The use of an abbreviated screening QLFT test is optional. Such a test may be utilized in order to quickly identify poor fitting respirators that passed the positive and/or negative pressure test and reduce the amount of QNFT time. The use of the CNC QNFT instrument in the count mode is another optional method to obtain a quick estimate of fit and eliminate poor fitting respirators before going on to perform a full QNFT.

(3) A reasonably stable test agent concentration shall be measured in the test chamber prior to testing. For canopy or shower curtain types of test units, the determination of the test agent's stability may be established after the test subject has entered the test environment.

(4) Immediately after the subject enters the test chamber, the test agent concentration inside the respirator shall be measured to ensure that the peak penetration does not exceed 5 percent for a half mask or 1 percent for a full facepiece respirator.

(5) A stable test agent concentration shall be obtained prior to the actual start of testing.

(6) Respirator restraining straps shall not be over-tightened for testing. The straps shall be adjusted by the wearer without assistance from other persons to give a reasonably comfortable fit typical of normal use. The respirator shall not be adjusted once the fit test exercises begin.

(7) The test shall be terminated whenever any single peak penetration exceeds 5 percent for half masks and 1 percent for full facepiece respirators. The test subject shall be refitted and retested.

(8) Calculation of fit factors.

(i) The fit factor shall be determined for the quantitative fit test by taking the ratio of the average chamber concentration to the concentration measured inside the respirator for each test exercise except the grimace exercise.

(ii) The average test chamber concentration shall be calculated as the arithmetic average of the concentration measured before and after each test (i.e., 7 exercises) or the arithmetic average of the concentration measured before and after each exercise or the true average measured continuously during the respirator sample.

(iii) The concentration of the challenge agent inside the respirator shall be determined by one of the following methods:

(*A*) Average peak penetration method means the method of determining test agent penetration into the respirator utilizing a strip chart recorder, integrator, or computer. The agent penetration is determined by an average of the peak heights on the graph or by computer integration, for each exercise except the grimace exercise. Integrators or computers that calculate the actual test agent penetration into the respirator for each exercise will also be considered to meet the requirements of the average peak penetration method.

(*B*) Maximum peak penetration method means the method of determining test agent penetration in the respirator as determined by strip chart recordings of the test. The highest peak penetration for a given exercise is taken to be representative of average penetration into the respirator for that exercise.

(*C*) Integration by calculation of the area under the individual peak for each exercise except the grimace exercise. This includes computerized integration.

(*D*) The calculation of the overall fit factor using individual exercise fit factors involves first converting the exercise fit factors to penetration values, determining the average, and then converting that result back to a fit factor. This procedure is described in the following equation:

$$\text{Overall Fit Factor} = \frac{\text{Number of exercises}}{1/ff_1 + 1/ff_2 + 1/ff_3 + 1/ff_4 + 1/ff_5 + 1/ff_7 + 1/ff_8}$$

Where ff_1, ff_2, ff_3, etc. are the fit factors for exercises 1, 2, 3, etc.

(9) The test subject shall not be permitted to wear a half mask or quarter facepiece respirator unless a minimum fit factor of 100 is obtained, or a full facepiece respirator unless a minimum fit factor of 500 is obtained.

(10) Filters used for quantitative fit testing shall be replaced whenever increased breathing resistance is encountered, or when the test agent has altered the integrity of the filter media.

3. Ambient aerosol condensation nuclei counter (CNC) quantitative fit testing protocol.

The ambient aerosol condensation nuclei counter (CNC) quantitative fit testing (Portacount™) protocol quantitatively fit tests respirators with the use of a probe. The probed respirator is only used for quantitative fit tests. A probed respirator has a special sampling device, installed on the respirator, that allows the probe to sample the air from inside the mask. A probed respirator is required for each make, style, model, and size that the employer uses and can be obtained from the respirator manufacturer or distributor. The CNC instrument manufacturer, TSI Inc., also provides probe attachments (TSI sampling adapters) that permit fit testing in an employee's own respirator. A minimum fit factor pass level of at least 100 is necessary for a half-mask respirator and a minimum fit factor pass level of at least 500 is required for a full facepiece negative pressure respirator. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

(a) Portacount Fit Test Requirements.

(1) Check the respirator to make sure the respirator is fitted with a high-efficiency filter and that the sampling probe and line are properly attached to the facepiece.

(2) Instruct the person to be tested to don the respirator for five minutes before the fit test starts. This purges the ambient particles trapped inside the respirator and permits the wearer to make certain the respirator is comfortable. This individual shall already have been trained on how to wear the respirator properly.

(3) Check the following conditions for the adequacy of the respirator fit: Chin properly placed; Adequate strap tension, not overly tightened; Fit across nose bridge; Respirator of proper size to span distance from nose to chin; Tendency of the respirator to slip; Self-observation in a mirror to evaluate fit and respirator position.

(4) Have the person wearing the respirator do a user seal check. If leakage is detected, determine the cause. If leakage is from a poorly fitting facepiece, try another size of the same model respirator, or another model of respirator.

(5) Follow the manufacturer's instructions for operating the Portacount and proceed with the test.

(6) The test subject shall be instructed to perform the exercises in section I. A. 14. of this appendix.

(7) After the test exercises, the test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of respirator shall be tried.

(b) Portacount Test Instrument.

(1) The Portacount will automatically stop and calculate the overall fit factor for the entire set of exercises. The overall fit factor is what counts. The Pass or Fail message will indicate whether or not the test was successful. If the test was a Pass, the fit test is over.

(2) Since the pass or fail criterion of the Portacount is user programmable, the test operator shall ensure that the pass or fail criterion meet the requirements for minimum respirator performance in this Appendix.

(3) A record of the test needs to be kept on file, assuming the fit test was successful. The record must contain the test subject's name; overall fit factor; make, model, style, and size of respirator used; and date tested.

4. Controlled negative pressure (CNP) quantitative fit testing protocol.

The CNP protocol provides an alternative to aerosol fit test methods. The CNP fit test method technology is based on exhausting air from a temporarily sealed respirator facepiece to generate and then maintain a constant negative pressure inside the facepiece. The rate of air exhaust is controlled so that a constant negative pressure is maintained in the respirator during the fit test. The level of pressure is selected to replicate the mean inspiratory pressure that causes leakage into the respirator under normal use conditions. With pressure held constant, air flow out of the respirator is equal to air flow into the respirator. Therefore, measurement of the exhaust stream that is required to hold the pressure in the temporarily sealed respirator constant yields a direct measure of leakage air flow into the respirator. The CNP fit test method measures leak rates through the facepiece as a method for determining the facepiece fit for negative pressure respirators. The CNP instrument manufacturer Dynatech Nevada also provides attachments (sampling manifolds) that replace the filter cartridges to permit fit testing in an employee's own respirator. To perform the test, the test subject closes his or her mouth and holds his/her breath, after which an air pump removes air from the respirator facepiece at a pre-selected constant pressure. The facepiece fit is expressed as the leak rate through the facepiece, expressed as milliliters per minute. The quality and validity of the CNP fit tests are determined by the degree to which the in-mask pressure tracks the test pressure during the system measurement time of approximately five seconds. Instantaneous feedback in the form of a real-time pressure trace of the in-mask pressure is provided and used to determine test validity and quality. A minimum fit factor pass level of 100 is necessary for a half-mask respirator and a minimum fit factor of at least 500 is required for a full facepiece respirator. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

(a) CNP Fit Test Requirements.

(1) The instrument shall have a non-adjustable test pressure of 15.0 mm water pressure.

(2) The CNP system defaults selected for test pressure shall be set at—1.5 mm of water (-0.58 inches of water) and the modeled inspiratory flow rate shall be 53.8 liters per minute for performing fit tests.

(**Note:** CNP systems have built-in capability to conduct fit testing that is specific to unique work rate, mask, and gender situations that might apply in a specific workplace. Use of system default values, which were selected to represent respirator wear with medium cartridge resistance at a low-moderate work rate, will allow inter-test comparison of the respirator fit.)

(3) The individual who conducts the CNP fit testing shall be thoroughly trained to perform the test.

(4) The respirator filter or cartridge needs to be replaced with the CNP test manifold. The inhalation valve downstream from the manifold either needs to be temporarily removed or propped open.

(5) The test subject shall be trained to hold his or her breath for at least 20 seconds.

(6) The test subject shall don the test respirator without any assistance from the individual who conducts the CNP fit test.

(7) The QNFT protocol shall be followed according to section I. C. 1. of this appendix with an exception for the CNP test exercises.

(b) CNP Test Exercises.

(1) Normal breathing. In a normal standing position, without talking, the subject shall breathe normally for 1 minute. After the normal breathing exercise, the subject needs to hold head straight ahead and hold his or her breath for 10 seconds during the test measurement.

(2) Deep breathing. In a normal standing position, the subject shall breathe slowly and deeply for 1 minute, being careful not to hyperventilate. After the deep breathing exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during test measurement.

(3) Turning head side to side. Standing in place, the subject shall slowly turn his or her head from side to side between the extreme positions on each side for 1 minute. The head shall be held at each extreme momentarily so the subject can inhale at each side. After the turning head side to side exercise, the subject needs to hold head full left and hold his or her breath for 10 seconds during test measurement. Next, the subject needs to hold head full right and hold his or her breath for 10 seconds during test measurement.

(4) Moving head up and down. Standing in place, the subject shall slowly move his or her head up and down for 1 minute. The subject shall be instructed to inhale in the up position (i.e., when looking toward the ceiling). After the moving head up and down exercise, the subject shall hold his or her head full up and hold his or her breath for 10 seconds during test measurement. Next, the subject shall hold his or her head full down and hold his or her breath for 10 seconds during test measurement.

(5) Talking. The subject shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The subject can read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song for 1 minute. After the talking exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement.

(6) Grimace. The test subject shall grimace by smiling or frowning for 15 seconds.

(7) Bending Over. The test subject shall bend at the waist as if he or she were to touch his or her toes for 1 minute. Jogging in place shall be substituted for this exercise in those test environments such as shroud-type QNFT units that prohibit bending at the waist. After the bending over exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement.

(8) Normal Breathing. The test subject shall remove and re-don the respirator within a one-minute period. Then, in a normal standing position, without talking, the subject shall breathe normally for 1 minute. After the normal breathing exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement. After the test exercises, the test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of a respirator shall be tried.

(c) CNP Test Instrument.

(1) The test instrument shall have an effective audio warning device when the test subject fails to hold his or her breath during the test. The test shall be terminated whenever the test subject failed to hold his or her breath. The test subject may be refitted and retested.

(2) A record of the test shall be kept on file, assuming the fit test was successful. The record must contain the test subject's name; overall fit factor; make, model, style and size of respirator used; and date tested.

Part II. New Fit Test Protocols

A. Any person may submit to OSHA an application for approval of a new fit test protocol. If the application meets the following criteria, OSHA will initiate a rulemaking proceeding under section 6(b)(7) of the OSH Act to determine whether to list

the new protocol as an approved protocol in this Appendix A.

B. The application must include a detailed description of the proposed new fit test protocol. This application must be supported by either:

1. A test report prepared by an independent government research laboratory (e.g., Lawrence Livermore National Laboratory, Los Alamos National Laboratory, the National Institute for Standards and Technology) stating that the laboratory has tested the protocol and had found it to be accurate and reliable; or

2. An article that has been published in a peer-reviewed industrial hygiene journal describing the protocol and explaining how test data support the protocol's accuracy and reliability.

C. If OSHA determines that additional information is required before the Agency commences a rulemaking proceeding under this section, OSHA will so notify the applicant and afford the applicant the opportunity to submit the supplemental information. Initiation of a rulemaking proceeding will be deferred until OSHA has received and evaluated the supplemental information.

Appendix B–1 to § 1910.134: User Seal Check Procedures (Mandatory)

The individual who uses a tight-fitting respirator is to perform a user seal check to ensure that an adequate seal is achieved each time the respirator is put on. Either the positive and negative pressure checks listed in this appendix, or the respirator manufacturer's recommended user seal check method shall be used. User seal checks are not substitutes for qualitative or quantitative fit tests.

I. Facepiece Positive and/or Negative Pressure Checks

A. *Positive pressure check.* Close off the exhalation valve and exhale gently into the facepiece. The face fit is considered satisfactory if a slight positive pressure can be built up inside the facepiece without any evidence of outward leakage of air at the seal. For most respirators this method of leak testing requires the wearer to first remove the exhalation valve cover before closing off the exhalation valve and then carefully replacing it after the test.

B. *Negative pressure check.* Close off the inlet opening of the canister or cartridge(s) by covering with the palm of the hand(s) or by replacing the filter seal(s), inhale gently so that the facepiece collapses slightly, and hold the breath for ten seconds. The design of the inlet opening of some cartridges cannot be effectively covered with the palm of the hand. The test can be performed by covering the inlet opening of the cartridge with a thin latex or nitrile glove. If the facepiece remains in its slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is considered satisfactory.

II. Manufacturer's Recommended User Seal Check Procedures

The respirator manufacturer's recommended procedures for performing a user seal check may be used instead of the positive and/or negative pressure check procedures provided that the employer demonstrates that the manufacturer's procedures are equally effective.

Appendix B–2 to § 1910.134: Respirator Cleaning Procedures (Mandatory)

These procedures are provided for employer use when cleaning respirators. They are general in nature, and the employer as an alternative may use the cleaning recommendations provided by the manufacturer of the respirators used by their employees, provided such procedures are as effective as those listed here in Appendix B–2. Equivalent effectiveness simply means that the procedures used must accomplish the objectives set forth in Appendix B–2, i.e., must ensure that the respirator is properly cleaned and disinfected in a manner that prevents damage to the respirator and does not cause harm to the user.

I. Procedures for Cleaning Respirators

A. Remove filters, cartridges, or canisters. Disassemble facepieces by removing speaking diaphragms, demand and pressure-demand valve assemblies, hoses, or any components recommended by the manufacturer. Discard or repair any defective parts.

B. Wash components in warm (43° C [110° F] maximum) water with a mild detergent or with a cleaner recommended by the manufacturer. A stiff bristle (not wire) brush may be used to facilitate the removal of dirt.

C. Rinse components thoroughly in clean, warm (43° C [110° F] maximum), preferably running water. Drain.

D. When the cleaner used does not contain a disinfecting agent, respirator components should be immersed for two minutes in one of the following:

1. Hypochlorite solution (50 ppm of chlorine) made by adding approximately one milliliter of laundry bleach to one liter of water at 43° C (110° F); or,

2. Aqueous solution of iodine (50 ppm iodine) made by adding approximately 0.8 milliliters of tincture of iodine (6–8 grams ammonium and/or potassium iodide/100 cc of 45% alcohol) to one liter of water at 43° C (110° F); or,

3. Other commercially available cleansers of equivalent disinfectant quality when used as directed, if their use is recommended or approved by the respirator manufacturer.

E. Rinse components thoroughly in clean, warm (43° C [110° F] maximum), preferably running water. Drain. The importance of thorough rinsing cannot be overemphasized. Detergents or disinfectants that dry on facepieces may result in dermatitis. In addition, some disinfectants may cause deterioration of rubber or corrosion of metal parts if not completely removed.

F. Components should be hand-dried with a clean lint-free cloth or air-dried.

G. Reassemble facepiece, replacing filters, cartridges, and canisters where necessary.

H. Test the respirator to ensure that all components work properly.

Appendix C to § 1910.134: OSHA Respirator Medical Evaluation Questionnaire (Mandatory)

To the employer: Answers to questions in Section 1, and to question 9 in Section 2 of Part A, do not require a medical examination.

To the employee:

Can you read (circle one): Yes/No

Your employer must allow you to answer this questionnaire during normal working hours, or at a time and place that is convenient to you. To maintain your confidentiality, your employer or supervisor must not look at or review your answers, and your employer must tell you how to deliver or send this questionnaire to the health care professional who will review it.

Part A. Section 1. (Mandatory) The following information must be provided by every employee who has been selected to use any type of respirator (please print).

1. Today's date: _____
2. Your name: _____
3. Your age (to nearest year): _____
4. Sex (circle one): Male/Female
5. Your height: _____ ft. _____ in.
6. Your weight: _____ lbs.
7. Your job title: _____
8. A phone number where you can be reached by the health care professional who reviews this questionnaire (include the Area Code): _____
9. The best time to phone you at this number: _____
10. Has your employer told you how to contact the health care professional who will review this questionnaire (circle one): Yes/No
11. Check the type of respirator you will use (you can check more than one category):
    a. _____ N, R, or P disposable respirator (filter-mask, non-cartridge type only).
    b. _____ Other type (for example, half- or full-facepiece type, powered-air purifying, supplied-air, self-contained breathing apparatus).
12. Have you worn a respirator (circle one): Yes/No

    If ''yes,'' what type(s): _____

Part A. Section 2. (Mandatory) Questions 1 through 9 below must be answered by every employee who has been selected to use any type of respirator (please circle ''yes'' or ''no'').

1. Do you *currently* smoke tobacco, or have you smoked tobacco in the last month: Yes/No
2. Have you *ever had* any of the following conditions?
    a. Seizures (fits): Yes/No
    b. Diabetes (sugar disease): Yes/No
    c. Allergic reactions that interfere with your breathing: Yes/No
    d. Claustrophobia (fear of closed-in places): Yes/No
    e. Trouble smelling odors: Yes/No
3. Have you *ever had* any of the following pulmonary or lung problems?
    a. Asbestosis: Yes/No
    b. Asthma: Yes/No

c. Chronic bronchitis: Yes/No
d. Emphysema: Yes/No
e. Pneumonia: Yes/No
f. Tuberculosis: Yes/No
g. Silicosis: Yes/No
h. Pneumothorax (collapsed lung): Yes/No
i. Lung cancer: Yes/No
j. Broken ribs: Yes/No
k. Any chest injuries or surgeries: Yes/No
l. Any other lung problem that you've been told about: Yes/No

4. Do you *currently* have any of the following symptoms of pulmonary or lung illness?
a. Shortness of breath: Yes/No
b. Shortness of breath when walking fast on level ground or walking up a slight hill or incline: Yes/No
c. Shortness of breath when walking with other people at an ordinary pace on level ground: Yes/No
d. Have to stop for breath when walking at your own pace on level ground: Yes/No
e. Shortness of breath when washing or dressing yourself: Yes/No
f. Shortness of breath that interferes with your job: Yes/No
g. Coughing that produces phlegm (thick sputum): Yes/No
h. Coughing that wakes you early in the morning: Yes/No
i. Coughing that occurs mostly when you are lying down: Yes/No
j. Coughing up blood in the last month: Yes/No
k. Wheezing: Yes/No
l. Wheezing that interferes with your job: Yes/No
m. Chest pain when you breathe deeply: Yes/No
n. Any other symptoms that you think may be related to lung problems: Yes/No

5. Have you *ever had* any of the following cardiovascular or heart problems?
a. Heart attack: Yes/No
b. Stroke: Yes/No
c. Angina: Yes/No
d. Heart failure: Yes/No
e. Swelling in your legs or feet (not caused by walking): Yes/No
f. Heart arrhythmia (heart beating irregularly): Yes/No
g. High blood pressure: Yes/No
h. Any other heart problem that you've been told about: Yes/No

6. Have you *ever had* any of the following cardiovascular or heart symptoms?
a. Frequent pain or tightness in your chest: Yes/No
b. Pain or tightness in your chest during physical activity: Yes/No
c. Pain or tightness in your chest that interferes with your job: Yes/No
d. In the past two years, have you noticed your heart skipping or missing a beat: Yes/No
e. Heartburn or indigestion that is not related to eating: Yes/No
f. Any other symptoms that you think may be related to heart or circulation problems: Yes/No

7. Do you *currently* take medication for any of the following problems?
a. Breathing or lung problems: Yes/No
b. Heart trouble: Yes/No
c. Blood pressure: Yes/No
d. Seizures (fits): Yes/No

8. If you've used a respirator, have you *ever had* any of the following problems? (If you've never used a respirator, check the following space and go to question 9:)
a. Eye irritation: Yes/No
b. Skin allergies or rashes: Yes/No
c. Anxiety: Yes/No
d. General weakness or fatigue: Yes/No
e. Any other problem that interferes with your use of a respirator: Yes/No

9. Would you like to talk to the health care professional who will review this questionnaire about your answers to this questionnaire: Yes/No

Questions 10 to 15 below must be answered by every employee who has been selected to use either a full-facepiece respirator or a self-contained breathing apparatus (SCBA). For employees who have been selected to use other types of respirators, answering these questions is voluntary.

10. Have you *ever lost* vision in either eye (temporarily or permanently): Yes/No

11. Do you *currently* have any of the following vision problems?
a. Wear contact lenses: Yes/No
b. Wear glasses: Yes/No
c. Color blind: Yes/No
e. Any other eye or vision problem: Yes/No

12. Have you *ever had* an injury to your ears, including a broken ear drum: Yes/No

13. Do you *currently* have any of the following hearing problems?
a. Difficulty hearing: Yes/No
b. Wear a hearing aid: Yes/No
c. Any other hearing or ear problem: Yes/No

14. Have you *ever had* a back injury: Yes/No

15. Do you *currently* have any of the following musculoskeletal problems?
a. Weakness in any of your arms, hands, legs, or feet: Yes/No
b. Back pain: Yes/No
c. Difficulty fully moving your arms and legs: Yes/No
d. Pain or stiffness when you lean forward or backward at the waist: Yes/No
e. Difficulty fully moving your head up or down: Yes/No
f. Difficulty fully moving your head side to side: Yes/No
g. Difficulty bending at your knees: Yes/No
h. Difficulty squatting to the ground: Yes/No
i. Climbing a flight of stairs or a ladder carrying more than 25 lbs: Yes/No
j. Any other muscle or skeletal problem that interferes with using a respirator: Yes/No

Part B Any of the following questions, and other questions not listed, may be added to the questionnaire at the discretion of the health care professional who will review the questionnaire.

1. In your present job, are you working at high altitudes (over 5,000 feet) or in a place that has lower than normal amounts of oxygen: Yes/No
If ''yes,'' do you have feelings of dizziness, shortness of breath, pounding in your chest, or other symptoms when you're working under these conditions: Yes/No

2. At work or at home, have you ever been exposed to hazardous solvents, hazardous airborne chemicals (*e.g.*, gases, fumes, or dust), or have you come into skin contact with hazardous chemicals: Yes/No

If ''yes,'' name the chemicals if you know them: _____

_____

_____

3. Have you ever worked with any of the materials, or under any of the conditions, listed below:
a. Asbestos: Yes/No
b. Silica (*e.g.*, in sandblasting): Yes/No
c. Tungsten/cobalt (*e.g.*, grinding or welding this material): Yes/No
d. Beryllium: Yes/No
e. Aluminum: Yes/No
f. Coal (for example, mining): Yes/No
g. Iron: Yes/No
h. Tin: Yes/No
i. Dusty environments: Yes/No
j. Any other hazardous exposures: Yes/No
If ''yes,'' describe these exposures: _____

_____

_____

4. List any second jobs or side businesses you have: _____

_____

5. List your previous occupations: _____

_____

6. List your current and previous hobbies: __

_____

7. Have you been in the military services? Yes/No
If ''yes,'' were you exposed to biological or chemical agents (either in training or combat): Yes/No

8. Have you ever worked on a HAZMAT team? Yes/No

9. Other than medications for breathing and lung problems, heart trouble, blood pressure, and seizures mentioned earlier in this questionnaire, are you taking any other medications for any reason (including over-the-counter medications): Yes/No

If ''yes,'' name the medications if you know them: _____

10. Will you be using any of the following items with your respirator(s)?
a. HEPA Filters: Yes/No
b. Canisters (for example, gas masks): Yes/No
c. Cartridges: Yes/No

11. How often are you expected to use the respirator(s) (circle ''yes'' or ''no'' for all answers that apply to you)?:
a. Escape only (no rescue): Yes/No
b. Emergency rescue only: Yes/No
c. Less than 5 hours *per week:* Yes/No
d. Less than 2 hours *per day:* Yes/No
e. 2 to 4 hours *per day:* Yes/No

f. Over 4 hours *per day:* Yes/No

12. During the period you are using the respirator(s), is your work effort:

a. *Light* (less than 200 kcal per hour): Yes/No

If ''yes,'' how long does this period last during the average shift:_____hrs._____mins.

Examples of a light work effort are *sitting* while writing, typing, drafting, or performing light assembly work; or *standing* while operating a drill press (1–3 lbs.) or controlling machines.

b. *Moderate* (200 to 350 kcal per hour): Yes/No

If ''yes,'' how long does this period last during the average shift:_____hrs._____mins.

Examples of moderate work effort are *sitting* while nailing or filing; *driving* a truck or bus in urban traffic; *standing* while drilling, nailing, performing assembly work, or transferring a moderate load (about 35 lbs.) at trunk level; *walking* on a level surface about 2 mph or down a 5-degree grade about 3 mph; or *pushing* a wheelbarrow with a heavy load (about 100 lbs.) on a level surface.

c. *Heavy* (above 350 kcal per hour): Yes/No

If ''yes,'' how long does this period last during the average shift:_____hrs._____mins.

Examples of heavy work are *lifting* a heavy load (about 50 lbs.) from the floor to your waist or shoulder; *working* on a loading dock; *shoveling; standing* while bricklaying or chipping castings; *walking* up an 8-degree grade about 2 mph; *climbing* stairs with a heavy load (about 50 lbs.).

13. Will you be wearing protective clothing and/or equipment (other than the respirator) when you're using your respirator: Yes/No

If ''yes,'' describe this protective clothing and/or equipment: _____

_____

14. Will you be working under hot conditions (temperature exceeding 77° F): Yes/No

15. Will you be working under humid conditions: Yes/No

16. Describe the work you'll be doing while you're using your respirator(s):

_____

_____

17. Describe any special or hazardous conditions you might encounter when you're using your respirator(s) (for example, confined spaces, life-threatening gases):

_____

_____

18. Provide the following information, if you know it, for each toxic substance that you'll be exposed to when you're using your respirator(s):

Name of the first toxic substance: _____

Estimated maximum exposure level per shift: _____

Duration of exposure per shift _____

Name of the second toxic substance: _____

Estimated maximum exposure level per shift: _____

Duration of exposure per shift: _____

Name of the third toxic substance: _____

Estimated maximum exposure level per shift: _____

Duration of exposure per shift: _____

The name of any other toxic substances that you'll be exposed to while using your respirator:

_____

_____

_____

19. Describe any special responsibilities you'll have while using your respirator(s) that may affect the safety and well-being of others (for example, rescue, security):

_____

Appendix D to § 1910.134 (Non-Mandatory) Information for Employees Using Respirators When Not Required Under the Standard

Respirators are an effective method of protection against designated hazards when properly selected and worn. Respirator use is encouraged, even when exposures are below the exposure limit, to provide an additional level of comfort and protection for workers. However, if a respirator is used improperly or not kept clean, the respirator itself can become a hazard to the worker. Sometimes, workers may wear respirators to avoid exposures to hazards, even if the amount of hazardous substance does not exceed the limits set by OSHA standards. If your employer provides respirators for your voluntary use, of if you provide your own respirator, you need to take certain precautions to be sure that the respirator itself does not present a hazard.

You should do the following:

1. Read and heed all instructions provided by the manufacturer on use, maintenance, cleaning and care, and warnings regarding the respirators limitations.

2. Choose respirators certified for use to protect against the contaminant of concern. NIOSH, the National Institute for Occupational Safety and Health of the U.S. Department of Health and Human Services, certifies respirators. A label or statement of certification should appear on the respirator or respirator packaging. It will tell you what the respirator is designed for and how much it will protect you.

3. Do not wear your respirator into atmospheres containing contaminants for which your respirator is not designed to protect against. For example, a respirator designed to filter dust particles will not protect you against gases, vapors, or very small solid particles of fumes or smoke.

4. Keep track of your respirator so that you do not mistakenly use someone else's respirator.

Subpart L—[Amended]

8. The authority citation for Subpart L of Part 1910 is revised to read as follows:

Authority: Secs. 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Orders 12–71 (36 FR 8754), 8–76 (41 FR 25059), 9–83 (48 FR 35736), 1–90 (55 FR 9033), or 6–96 (62 FR 111), as applicable.

9. Section 1910.156 is amended by revising paragraphs (f)(1)(i) and (f)(1)(v) as follows:

§ 1910.156 Fire brigades.

* * * * *

(f) *Respiratory protection.* (1) *General.* (i) The employer must ensure that respirators are provided to, and used by, fire brigade members, and that the respirators meet the requirements of 29 CFR 1910.134 and this paragraph.

* * * * *

(v) Self-contained breathing apparatuses must have a minimum service-life rating of 30 minutes in accordance with the methods and requirements specified by NIOSH under 42 CFR part 84, except for escape self-contained breathing apparatus (ESCBAs) used only for emergency escape purposes.

* * * * *

Subpart Q—[Amended]

10. The authority citation for Subpart Q of Part 1910 is revised to read as follows:

Authority: Secs. 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Orders 12–71 (36 FR 8754), 8–76 (41 FR 25059), 9–83 (48 FR 35736), 1–90 (55 FR 9033), or 6–96 (62 FR 111), as applicable; and 29 CFR part 1911.

11. Section 1910.252 is amended by revising paragraphs (c)(4)(ii), (c)(4)(iii), (c)(7)(iii), (c)(9)(i), and (c)(10) as follows:

§ 1910.252 General requirements.

* * * * *

(c) * * *

(4) * * *

(ii) *Airline respirators.* In circumstances for which it is impossible to provide such ventilation, airline respirators or hose masks approved for this purpose by the National Institute for Occupational Safety and Health (NIOSH) under 42 CFR part 84 must be used.

(iii) *Self-contained units.* In areas immediately hazardous to life, a full-facepiece, pressure-demand, self-contained breathing apparatus or a combination full-facepiece, pressure-demand supplied-air respirator with an auxiliary, self-contained air supply approved by NIOSH under 42 CFR part 84 must be used.

* * * * *

(7) * * *

(iii) *Local ventilation.* In confined spaces or indoors, welding or cutting operations involving metals containing lead, other than as an impurity, or

metals coated with lead-bearing materials, including paint, must be done using local exhaust ventilation or airline respirators. Such operations, when done outdoors, must be done using respirators approved for this purpose by NIOSH under 42 CFR part 84. In all cases, workers in the immediate vicinity of the cutting operation must be protected by local exhaust ventilation or airline respirators.

* * * * *

(9) * * *

(i) *General.* In confined spaces or indoors, welding or cutting operations involving cadmium-bearing or cadmium-coated base metals must be done using local exhaust ventilation or airline respirators unless atmospheric tests under the most adverse conditions show that employee exposure is within the acceptable concentrations specified by 29 CFR 1910.1000. Such operations, when done outdoors, must be done using respirators, such as fume respirators, approved for this purpose by NIOSH under 42 CFR part 84.

* * * * *

(10) *Mercury.* In confined spaces or indoors, welding or cutting operations involving metals coated with mercury-bearing materials, including paint, must be done using local exhaust ventilation or airline respirators unless atmospheric tests under the most adverse conditions show that employee exposure is within the acceptable concentrations specified by 29 CFR 1910.1000. Such operations, when done outdoors, must be done using respirators approved for this purpose by NIOSH under 42 CFR part 84.

* * * * *

Subpart R—[Amended]

12. The authority citation for Subpart R of Part 1910 is revised as follows:

Authority: Sections 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Orders 12–71 (36 FR 8754), 8–76 (41 FR 25059), 9–83 (48 FR 35736), 1–90 (55 FR 9033), or 6–96 (62 FR 111), as applicable; and 29 CFR part 11.

Sections 1910.261, 1910.262, 1910.265 through 1910.269, 1910.274, and 1910.275 also issued under 29 CFR part 1911.

13. Section 1910.261 is amended by revising paragraphs (b)(2), (g)(10), (h)(2)(iii), and (h)(2)(iv) as follows:

§ 1910.261 Pulp, paper, and paperboard mills.

* * * * *

(b) * * *

(2) *Personal protective clothing and equipment.* Foot protection, shin guards, hard hats, noise-attenuation devices, and other personal protective clothing and equipment must be worn when the extent of the hazard warrants their use. Such equipment must be worn when specifically required by other paragraphs of this section, and must be maintained in accordance with applicable American National Standards Institute standards. Respirators, goggles, protective masks, rubber gloves, rubber boots, and other such equipment must be cleaned and disinfected before being used by another employee. Required eye, head, and ear protection must conform to American National Standards Institute standards Z24.22–1957, Z87.1–1968, and Z89.1–1969. Respiratory protection must conform to the requirements of 29 CFR 1910.134.

* * * * *

(g) * * *

(10) *Gas masks (digester building).* Gas masks must be available, and they must furnish adequate protection against sulfurous acid and chlorine gases and be inspected and repaired in accordance with 29 CFR 1910.134.

* * * * *

(h) * * *

(2) * * *

(iii) Gas masks must be provided for emergency use in accordance with 29 CFR 1910.134.

(iv) For emergency and rescue operations, the employer must provide employees with self-contained breathing apparatuses or supplied-air respirators, and ensure that employees use these respirators, in accordance with the requirements of 29 CFR 1910.134.

* * * * *

Subpart Z—[Amended]

14. The general authority citation for Subpart Z of 29 CFR Part 1910 is revised to read as follows:

Authority: Secs. 4, 6, and 8 of the Occupational Safety and Health Act (29 U.S.C. 653, 655, and 657); Secretary of Labor's Orders 12–71 (36 FR 8754), 8–76 (41 FR 25059), 9–83 (48 FR 35736), 1–90 (55 FR 9033), or 6–96 (62 FR 111), as applicable; and 29 CFR Part 1911.

* * * * *

15. Section 1910.1001 is amended by removing Appendix C and revising paragraph (g), to read as follows:

§ 1910.1001 Asbestos.

* * * * *

(g) *Respiratory protection.* (1) *General.* For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this paragraph. Respirators must be used during:

(i) Periods necessary to install or implement feasible engineering and work-practice controls.

(ii) Work operations, such as maintenance and repair activities, for which engineering and work-practice controls are not feasible.

(iii) Work operations for which feasible engineering and work-practice controls are not yet sufficient to reduce employee exposure to or below the TWA and/or excursion limit.

(iv) Emergencies.

(2) *Respirator program.* (i) The employer must implement a respiratory protection program in accordance with 29 CFR 1910.134 (b) through (d) (except (d)(1)(iii)), and (f) through (m).

(ii) The employer must provide a tight-fitting, powered, air-purifying respirator instead of any negative-pressure respirator specified in Table 1 of this section when an employee chooses to use this type of respirator and the respirator provides adequate protection to the employee.

(iii) No employee must be assigned to tasks requiring the use of respirators if, based on their most recent medical examination, the examining physician determines that the employee will be unable to function normally using a respirator, or that the safety or health of the employee or other employees will be impaired by the use of a respirator. Such employees must be assigned to another job or given the opportunity to transfer to a different position, the duties of which they can perform. If such a transfer position is available, the position must be with the same employer, in the same geographical area, and with the same seniority, status, and rate of pay the employee had just prior to such transfer.

(3) *Respirator selection.* The employer must select and provide the appropriate respirator from Table 1 of this section.

TABLE 1.—RESPIRATORY PROTECTION FOR ASBESTOS FIBERS

Airborne concentration of asbestos or conditions of use	Required respirator
Not in excess of 1 f/cc (10 X PEL)	Half-mask air purifying respirator other than a disposable respirator, equipped with high efficiency filters.

TABLE 1.—RESPIRATORY PROTECTION FOR ASBESTOS FIBERS—Continued

Airborne concentration of asbestos or conditions of use	Required respirator
Not in excess of 5 f/cc (50 X PEL)	Full facepiece air-purifying respirator equipped with high efficiency filters.
Not in excess of 10 f/cc (100 X PEL)	Any powered air-purifying respirator equipped with high efficiency filters or any supplied air respirator operated in continuous flow mode.
Not in excess of 100 f/cc (1,000 X PEL)	Full facepiece supplied air respirator operated in pressure demand mode.
Greater than 100 f/cc (1,000 X PEL) or unknown concentration.	Full facepiece supplied air respirator operated in pressure demand mode, equipped with an auxiliary positive pressure self-contained breathing apparatus.

NOTE: a. Respirators assigned for high environmental concentrations may be used at lower concentrations, or when required respirator use is independent of concentration.

b. A high efficiency filter means a filter that is at least 99.97 percent efficient against mono-dispersed particles of 0.3 micrometers in diameter or larger.

* * * * *

16. Section 1910.1003 is amended by revising paragraphs (c)(4)(iv) and (d)(1) as follows:

§ 1910.1003 13 Carcinogens (4-Nitrobiphenyl, etc.).

* * * * *

(c) * * *

(4) * * *

(iv) Employees engaged in handling operations involving the carcinogens addressed by this section must be provided with, and required to wear and use, a half-face filter-type respirator for dusts, mists, and fumes. A respirator affording higher levels of protection than this respirator may be substituted.

* * * * *

(d) * * *

(1) *Respirator program*. The employer must implement a respiratory protection program in accordance with 29 CFR 1910.134 (b), (c), (d) (except (d)(1)(iii) and (iv), and (d)(3)), and (e) through (m).

* * * * *

17. Section 1910.1017 is amended by revising paragraph (g) to read as follows:

§ 1910.1017 Vinyl chloride.

* * * * *

(g) *Respiratory protection*. (1) *General*. For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this paragraph.

(2) *Respirator program*. The employer must implement a respiratory protection program in accordance with 29 CFR 1910.134 (b) through (d) (except (d)(1)(iii), and (d)(3)(iii)(B)(*1*) and (*2*)), and (f) through (m).

(3) *Respirator selection*. (i) Respirators must be selected from the following table:

Atmospheric concentration of vinyl chloride	Required apparatus
(i) Unknown, or above 3,600 p/m	Open-circuit, self-contained breathing apparatus, pressure demand type, with full facepiece.
(ii) Not over 3,600 p/m	(A) Combination type C supplied air respirator, pressure demand type, with full or half facepiece, and auxiliary self-contained air supply; or
(iii) Not over 1,000 p/m	(B) Combination type, supplied air respirator continuous flow type, with full or half facepiece, and auxiliary self-contained air supply. Type C, supplied air respirator, continuous flow type, with full or half facepiece, helmet or hood.
(iv) Not over 100 p/m	(A) Combination type C supplied air respirator demand type, with full facepiece, and auxiliary self-contained air supply; or (B) Open-circuit self-contained breathing apparatus with full facepiece, in demand mode; or Type (C) supplied air respirator, demand type, with full facepiece.
(v) Not over 25 p/m	(A) A powered air-purifying respirator with hood, helmet, full or half facepiece, and a canister which provides a service life of at least 4 hours for concentrations of vinyl chloride up to 25 p/m, or (B) Gas mask, front- or back-mounted canister which provides a service life of at least 4 hours for concentrations of vinyl chloride up to 25 p/m.
(vi) Not over 10 p/m	(A) Combination type C supplied-air respirator, demand type, with half facepiece, and auxiliary self-contained air supply; or (B) Type C supplied-air respirator, demand type, with half facepiece; or (C) Any chemical cartridge respirator with an organic vapor cartridge which provides a service life of at least 1 hour for concentrations of vinyl chloride up to 10 p/m.

(ii) When air-purifying respirators are used:

(A) Air-purifying canisters or cartridges must be replaced prior to the expiration of their service life or the end of the shift in which they are first used, whichever occurs first.

(B) A continuous-monitoring and alarm system must be provided when concentrations of vinyl chloride could reasonably exceed the allowable concentrations for the devices in use. Such a system must be used to alert employees when vinyl chloride concentrations exceed the allowable concentrations for the devices in use.

(iii) Respirators specified for higher concentrations may be used for lower concentrations.

* * * * *

18. Section 1910.1018 is amended by revising paragraph (h) to read as follows:

§ 1910.1018 Inorganic arsenic.

* * * * *

(h) *Respiratory protection*. (1) General. For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this paragraph. Respirators must be used during:

(i) Periods necessary to install or implement feasible engineering or work-practice controls.

(ii) Work operations, such as maintenance and repair activities, for which the employer establishes that

engineering and work-practice controls are not feasible.

(iii) Work operations for which engineering and work-practice controls are not yet sufficient to reduce employee exposures to or below the permissible exposure limit.

(iv) Emergencies.

(2) *Respirator program.* (i) The employer must implement a respiratory protection program in accordance with 29 CFR 1910.134 (b) through (d) (except (d)(1)(iii)), and (f) through (m).

(ii) If an employee exhibits breathing difficulty during fit testing or respirator use, they must be examined by a physician trained in pulmonary medicine to determine whether they can use a respirator while performing the required duty.

(3) *Respirator selection.* (i) The employer must use Table I of this section to select the appropriate respirator or combination of respirators for inorganic arsenic compounds without significant vapor pressure, and Table II of this section to select the appropriate respirator or combination of respirators for inorganic arsenic compounds that have significant vapor pressure.

(ii) When employee exposures exceed the permissible exposure limit for inorganic arsenic and also exceed the relevant limit for other gases (for example, sulfur dioxide), an air-purifying respirator provided to the employee as specified by this section must have a combination high-efficiency filter with an appropriate gas sorbent. (See footnote in Table 1 of this section.)

(iii) Employees required to use respirators may choose, and the employer must provide, a powered air-purifying respirator if it will provide proper protection. In addition, the employer must provide a combination dust and acid-gas respirator to employees who are exposed to gases over the relevant exposure limits.

TABLE I.—RESPIRATORY PROTECTION FOR INORGANIC ARSENIC PARTICULATE EXCEPT FOR THOSE WITH SIGNIFICANT VAPOR PRESSURE

Concentration of inorganic arsenic (as As) or condition of use	Required respirator
(i) Unknown or greater or lesser than 20,000 μg/m(3) (20 mg/m(3)) or firefighting.	(A) Any full facepiece self-contained breathing apparatus operated in positive pressure mode.
(ii) Not greater than 20,000 μg/m(3) (20 mg/m(3)).	(A) Supplied air respirator with full facepiece, hood, or helmet or suit and operated in positive pressure mode.
(iii) Not greater than 10,000 μg/m(3) (10 mg/m(3)).	(A) Powered air-purifying respirators in all inlet face coverings with high efficiency filters [1].
	(B)Half-mask supplied air respirators operated in positive pressure mode.
(iv) Not greater than 500 μg/m(3)	(A) Full facepiece air-purifying respirator equipped with high-efficiency filter [1].
	(B) Any full facepiece supplied air respirator.
	(C) Any full facepiece self-contained breathing apparatus.
(v) Not greater than 100 μg/m(3)	(A) Half-mask air-purifying respirator equipped with high-efficiency filter [1].
	(B) Any half-mask supplied air respirator.

[1] High-efficiency filter-99.97 pct efficiency against 0.3 micrometer monodisperse diethyl-hexyl phthalate (DOP) particles.

TABLE II.—RESPIRATORY PROTECTION FOR INORGANIC ARSENICALS (SUCH AS ARSENIC TRICHLORIDE [2] AND ARSENIC PHOSPHIDE) WITH SIGNIFICANT VAPOR PRESSURE

Concentration of inorganic arsenic (as As) or condition of use	Required respirator
(i) Unknown or greater or lesser than 20,000 μg/m(3) (20 mg/m(3)) or firefighting.	(A) Any full facepiece self-contained breathing apparatus operated in positive pressure mode.
(ii) Not greater than 20,000 μg/m(3) (20 mg/m(3)).	(A) Supplied air respirator with full facepiece, hood, or helmet or suit and operated in positive pressure mode.
(iii) Not greater than 10,000 μg/m(3) (10 mg/m(3)).	(A) Half-mask [2] supplied air respirator operated in positive pressure mode.
(iv) Not greater than 500 μg/m(3)	(A) Front or back mounted gas mask equipped with high-efficiency filter [1] and acid gas canister.
	(B) Any full facepiece supplied air respirator.
	(C) Any full facepiece self-contained breathing apparatus.
(v) Not greater than 100 μg/m(3)	(A) Half-mask air-purifying respirator equipped with high efficiency filter [1] and acid gas cartridge.
	(B) Any half-mask supplied air respirator.

[1] High-efficiency filter-99.97 pct efficiency against 0.3 micrometer monodisperse diethyl-hexyl phthalate (DOP) particles.
[2] Half-mask respirators shall not be used for protection against arsenic trichloride, as it is rapidly absorbed through the skin.

* * * * *

19. Section 1910.1025 is amended by revising paragraph (f); revising the second and fourth paragraphs of Section IV to Appendix B; removing the sixth paragraph of Section IV to Appendix B; and removing Appendix D, as follows:

§ 1910.1025 Lead.

* * * * *

(f) *Respiratory protection.* (1) *General.* For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this paragraph. Respirators must be used during:

(i) Periods necessary to install or implement engineering or work-practice controls, except that no employer can require an employee to use a respirator longer than 4.4 hours per day.

(ii) Work operations for which engineering and work-practice controls are not sufficient to reduce employee exposures to or below the permissible exposure limit.

(iii) Periods when an employee requests a respirator.

(2) *Respirator program.* (i) The employer must implement a respiratory protection program in accordance with 29 CFR 1910.134 (b) through (d) (except (d)(1)(iii)), and (f) through (m).

(ii) If an employee has breathing difficulty during fit testing or respirator use, the employer must provide the employee with a medical examination in accordance with paragraph (j)(3)(i)(C) of this section to determine whether or not the employee can use a respirator while performing the required duty.

TABLE II.—RESPIRATORY PROTECTION FOR LEAD AEROSOLS

Airborne concentration of lead or condition of use	Required respirator
Not in excess of 0.5 mg/m³ (10X PEL)	Half-mask, air-purifying respirator equipped with high efficiency filters.[2 3]
Not in excess of 2.5 mg/m³ (50X PEL)	Full facepiece, air-purifying respirator with high efficiency filters.[3]
Not in excess of 50 mg/m³ (1000X PEL)	(1) Any powered, air-purifying respirator with high efficiency filters[3]; or (2) Half-mask supplied-air respirator operated in positive-pressure mode.[2]
Not in excess of 100 mg/m³ (2000XPEL)	Supplied-air respirators with full facepiece, hood, helmet, or suit, operated in positive pressure mode.
Greater than 100 mg/m³, unknown concentration or fire fighting.	Full facepiece, self-contained breathing apparatus operated in positive-pressure mode.

[1] Respirators specified for high concentrations can be used at lower concentrations of lead.
[2] Full facepiece is required if the lead aerosols cause eye or skin irritation at the use concentrations.
[3] A high efficiency particulate filter means 99.97 percent efficient against 0.3 micron size particles.

(3) *Respirator selection.* (i) The employer must select the appropriate respirator or combination of respirators from Table II of this section.

(ii) The employer must provide a powered air-purifying respirator instead of the respirator specified in Table II of this section when an employee chooses to use this type of respirator and such a respirator provides adequate protection to the employee.

* * * * *

Appendix B to § 1910.1025—Employee Standard Summary

* * * * *

IV. Respiratory Protection—Paragraph (f)

* * * * *

Your employer is required to select respirators from the seven types listed in Table II of the Respiratory Protection section of the standard (§ 1910.1025(f)). Any respirator chosen must be approved by the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 42 CFR part 84. This respirator selection table will enable your employer to choose a type of respirator that will give you a proper amount of protection based on your airborne lead exposure. Your employer may select a type of respirator that provides greater protection than that required by the standard; that is, one recommended for a higher concentration of lead than is present in your workplace. For example, a powered air-purifying respirator (PAPR) is much more protective than a typical negative pressure respirator, and may also be more comfortable to wear. A PAPR has a filter, cartridge, or canister to clean the air, and a power source that continuously blows filtered air into your breathing zone. Your employer might make a PAPR available to you to ease the burden of having to wear a respirator for long periods of time. The standard provides that you can obtain a PAPR upon request.

* * * * *

Your employer must ensure that your respirator facepiece fits properly. Proper fit of a respirator facepiece is critical to your protection from airborne lead. Obtaining a proper fit on each employee may require your employer to make available several different types of respirator masks. To ensure that your respirator fits properly and that facepiece leakage is minimal, your employer must give you either a qualitative or quantitative fit test as specified in Appendix A of the Respiratory Protection standard located at 29 CFR 1910.134.

* * * * *

20. Section 1910.1027 is amended by removing and reserving Appendix C and revising paragraph (g) to read as follows:

§ 1910.1027 Cadmium.

* * * * *

(g) *Respiratory protection.* (1) *General.* For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this paragraph. Respirators must be used during:

(i) Periods necessary to install or implement feasible engineering and work-practice controls when employee exposure levels exceed the PEL.

(ii) Maintenance and repair activities, and brief or intermittent operations, for which employee exposures exceed the PEL and engineering and work-practice controls are not feasible or are not required.

(iii) Activities in regulated areas specified in paragraph (e) of this section.

(iv) Work operations for which the employer has implemented all feasible engineering and work-practice controls and such controls are not sufficient to reduce employee exposures to or below the PEL.

(v) Work operations for which an employee is exposed to cadmium at or above the action level, and the employee requests a respirator.

(vi) Work operations for which an employee is exposed to cadmium above the PEL and engineering controls are not required by paragraph (f)(1)(ii) of this section.

(vii) Emergencies.

(2) *Respirator program.* (i) The employer must implement a respiratory protection program in accordance with 29 CFR 1910.134 (b) through (d) (except (d)(1)(iii)), and (f) through (m).

(ii) No employees must use a respirator if, based on their most recent medical examination, the examining physician determines that they will be unable to continue to function normally while using a respirator. If the physician determines that the employee must be limited in, or removed from, their current job because of their inability to use a respirator, the limitation or removal must be in accordance with paragraphs (l) (11) and (12) of this section.

(iii) If an employee has breathing difficulty during fit testing or respirator use, the employer must provide the employee with a medical examination in accordance with paragraph (l)(6)(ii) of this section to determine if the employee can use a respirator while performing the required duties.

(3) *Respirator selection.* (i) The employer must select the appropriate respirator from Table 2 of this section.

TABLE 2.—RESPIRATORY PROTECTION FOR CADMIUM

Airborne concentration or condition of use [a]	Required respirator type [b]
10 X or less	A half mask, air-purifying equipped with a HEPA [c] filter.[d]
25 X or less	A powered air-purifying respirator (“PAPR”) with a loose-fitting hood or helmet equipped with a HEPA filter, or a supplied-air respirator with a loose-fitting hood or helmet facepiece operated in the continuous flow mode.
50 X or less	A full facepiece air-purifying respirator equipped with a HEPA filter, or a powered air-purifying respirator with a tight-fitting half mask equipped with a HEPA filter, or a supplied-air respirator with a tight-fitting half mask operated in the continuous flow mode.
250 X or less	A powered air-purifying respirator with a tight fitting full facepiece equipped with a HEPA filter, or a supplied-air respirator with a tight-fitting full facepiece operated in the continuous flow mode.
1000 X or less	A supplied air respirator with half mask or full facepiece operated in the pressure demand or other positive pressure mode.
>1000 X or unknown concentrations	A self-contained breathing apparatus with a full facepiece operated in the pressure demand or other positive pressure mode, or a supplied-air respirator with a full facepiece operated in the pressure demand or other positive pressure mode and equipped with an auxiliary escape type self-contained breathing apparatus operated in the pressure demand mode.
Fire fighting	A self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

[a] Concentrations expressed as multiple of the PEL.
[b] Respirators assigned for higher environmental concentrations may be used at lower exposure levels. Quantitative fit testing is required for all tight-fitting air purifying respirators where airborne concentration of cadmium exceeds 10 times the TWA PEL (10 X 5 ug/m(3) = 50 ug/m(3)). A full facepiece respirator is required when eye irritation is experienced.
[c] HEPA means High-efficiency Particulate Air.
[d] Fit testing, qualitative or quantitative, is required.
SOURCE: Respiratory Decision Logic, NIOSH, 1987.

(ii) The employer must provide an employee with a powered air-purifying respirator instead of a negative-pressure respirator when an employee who is entitled to a respirator chooses to use this type of respirator and such a respirator provides adequate protection to the employee.

* * * * *

21. Section 1910.1028 is amended by removing Appendix E and revising paragraph (g) to read as follows:

§ 1910.1028 Benzene.

* * * * *

(g) *Respiratory protection.* (1) *General.* For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this paragraph. Respirators must be used during:

(i) Periods necessary to install or implement feasible engineering and work-practice controls.

(ii) Work operations for which the employer establishes that compliance with either the TWA or STEL through the use of engineering and work-practice controls is not feasible; for example, some maintenance and repair activities, vessel cleaning, or other operations for which engineering and work-practice controls are infeasible because exposures are intermittent and limited in duration.

(iii) Work operations for which feasible engineering and work-practice controls are not yet sufficient, or are not required under paragraph (f)(1)(iii) of this section, to reduce employee exposure to or below the PELs.

(iv) Emergencies.

(2) *Respirator program.* (i) The employer must implement a respiratory protection program in accordance with 29 CFR 1910.134 (b) through (d) (except (d)(1)(iii), (d)(3)(iii)(b)(1), and (2)), and (f) through (m).

(ii) For air-purifying respirators, the employer must replace the air-purifying element at the expiration of its service life or at the beginning of each shift in which such elements are used, whichever comes first.

(iii) If NIOSH approves an air-purifying element with an end-of-service-life indicator for benzene, such an element may be used until the indicator shows no further useful life.

(3) *Respirator selection.* (i) The employer must select the appropriate respirator from Table 1 of this section.

(ii) Any employee who cannot use a negative-pressure respirator must be allowed to use a respirator with less breathing resistance, such as a powered air-purifying respirator or supplied-air respirator.

TABLE 1.—RESPIRATORY PROTECTION FOR BENZENE

Airborne concentration of benzene or condition of use	Respirator type
(a) Less than or equal to 10 ppm	(1) Half-mask air-purifying respirator with organic vapor cartridge.
(b) Less than or equal to 50 ppm	(1) Full facepiece respirator with organic vapor cartridges. (1) Full facepiece gas mask with chin style canister.[1]
(c) Less than or equal to 100 ppm	(1) Full facepiece powered air-purifying respirator with organic vapor canister.[1]
(d) Less than or equal to 1,000 ppm	(1) Supplied air respirator with full facepiece in positive-pressure mode.
(e) Greater than 1,000 ppm or unknown concentration.	(1) Self-contained breathing apparatus with full facepiece in positive pressure mode. (2) Full facepiece positive-pressure supplied-air respirator with auxiliary self-contained air supply.
(f) Escape	(1) Any organic vapor gas mask; or (2) Any self-contained breathing apparatus with full facepiece.

TABLE 1.—RESPIRATORY PROTECTION FOR BENZENE—Continued

Airborne concentration of benzene or condition of use	Respirator type
(g) Firefighting	(1) Full facepiece self-contained breathing apparatus in positive pressure mode.

[1] Canisters must have a minimum service life of four (4) hours when tested at 150 ppm benzene, at a flow rate of 64 LPM, 25 deg. C, and 85% relative humidity for non-powered air purifying respirators. The flow rate shall be 115 LPM and 170 LPM respectively for tight fitting and loose fitting powered air-purifying respirators.

* * * * *

22. Section 1910.1029 is amended by revising paragraph (g) to read as follows:

§ 1910.1029 Coke oven emissions.

* * * * *

(g) *Respiratory protection.* (1) *General.* For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this paragraph. Compliance with the permissible exposure limit may not be achieved by the use of respirators except during:

(i) Periods necessary to install or implement feasible engineering and work-practice controls.

(ii) Work operations, such as maintenance and repair activity, for which engineering and work-practice controls are technologically not feasible.

(iii) Work operations for which feasible engineering and work-practice controls are not yet sufficient to reduce employee exposure to or below the permissible exposure limit.

(iv) Emergencies.

(2) *Respirator program.* The employer must implement a respiratory protection program in accordance with 29 CFR 1910.134 (b) through (d) (except (d)(1)(iii)), and (f) through (m).

(3) *Respirator selection.* The employer must select appropriate respirators or combination of respirators from Table I of this section.

TABLE I.—RESPIRATORY PROTECTION FOR COKE OVEN EMISSIONS

Airborne concentration of coke oven emissions	Required respirator
(a) Any concentration	(1) A Type C supplied air respirator operated in pressure demand or other positive pressure or continuous flow mode; or (2) A powered air-purifying particulate filter respirator for dust and mist or (3) A powered air-purifying particulate filter respirator or combination chemical cartridge and particulate filter respirator for coke oven emissions.
(b) Concentrations not greater than 1500 ug/m^3	(1) Any particulate filter respirator for dust and mist except single-use respirator; or (2) Any particulate filter respirator or combination chemical cartridge and particulate filter respirator for coke oven emissions; or (3) Any respirator listed in paragraph (g)(3)(a) of this section.

* * * * *

23. Section 1910.1043 is amended by revising paragraph (f) to read as follows:

§ 1910.1043 Cotton dust.

* * * * *

(f) *Respiratory protection.* (1) *General.* For employees who are required to use respirators by this section, the employer must provide respirators that comply with the requirements of this paragraph. Respirators must be used during:

(i) Periods necessary to install or implement feasible engineering and work-practice controls.

(ii) Maintenance and repair activities for which engineering and work-practice controls are not feasible.

(iii) Work operations for which feasible engineering and work-practice controls are not yet sufficient to reduce employee exposure to or below the permissible exposure limits.

(iv) Work operations specified under paragraph (g)(1) of this section.

(v) Periods for which an employee requests a respirator.

(2) *Respirator program.* (i) The employer must implement a respiratory protection program in accordance with 29 CFR 1910.134 (b) through (d) (except (d)(1)(iii)), and (f) through (m).

(ii) Whenever a physician determines that an employee who works in an area in which the cotton-dust concentration exceeds the PEL is unable to use a respirator, including a powered air-purifying respirator, the employee must be given the opportunity to transfer to an available position, or to a position that becomes available later, that has a cotton-dust concentration at or below the PEL. The employer must ensure that such employees retain their current wage rate or other benefits as a result of the transfer.

(3) *Respirator selection.* (i) The employer must select the appropriate respirator from Table I of this section.

TABLE I

Cotton dust concentration	Required respirator
Not greater than:	
(a) 5 × the applicable permissible exposure limit (PEL).	A disposable respirator with a particulate filter.
(b) 10 × the applicable PEL	A quarter or half-mask respirator, other than a disposable respirator, equipped with particulate filters.
(c) 100 × the applicable PEL	A full facepiece respirator equipped with high-efficiency particulate filters.
(d) Greater than 100 × the applicable PEL	A powered air-purifying respirator equipped with high-efficiency particulate filters.

Notes:

1. A disposable respirator means the filter element is an inseparable part of the respirator.
2. Any respirators permitted at higher environmental concentrations can be used at lower concentrations.

3. Self-contained breathing apparatus are not required respirators but are permitted respirators.
4. Supplied air respirators are not required but are permitted under the following conditions: Cotton dust concentration not greater than 10X the PEL—Any supplied air respirator; not greater than 100X the PEL—Any supplied air respirator with full facepiece, helmet or hood; greater than 100X the PEL—A supplied air respirator operated in positive pressure mode.

(ii) Whenever respirators are required by this section for cotton-dust concentrations that do not exceed the applicable permissible exposure limit by a multiple of 100 (100 X), the employer must, when requested by an employee, provide a powered air-purifying respirator with a high-efficiency particulate filter instead of the respirator specified in paragraphs (a), (b), or (c) of Table I of this section.

* * * * *

24. Section 1910.1044 is amended by revising paragraph (h) to read as follows:

§ 1910.1044 1,2-Dibromo-3-chloropropane.

* * * * *

(h) *Respiratory protection.* (1) *General.* For employees who are required to use respirators by this section, the employer must provide respirators that comply with the requirements of this paragraph. Respirators must be used during:

(i) Periods necessary to install or implement feasible engineering and work-practice controls.

(ii) Maintenance and repair activities for which engineering and work-practice controls are not feasible.

(iii) Work operations for which feasible engineering and work-practice controls are not yet sufficient to reduce employee exposure to or below the permissible exposure limit.

(iv) Emergencies.

(2) *Respirator program.* The employer must implement a respiratory protection program in accordance with 29 CFR 1910.134 (b) through (d) (except (d)(1)(iii)), and (f) through (m).

(3) *Respirator selection.* The employer must select the appropriate respirator from Table 1 of this section.

TABLE 1.—RESPIRATORY PROTECTION FOR DBCP

Airborne concentration of DBCP or condition of use	Respirator type
(a) Less than or equal to 10 ppb	(1) Any supplied-air respirator; or (2) any self-contained breathing apparatus.
(b) Less than or equal to 50 ppb	(1) Any supplied-air respirator with full facepiece, helmet, or hood; or (2) any self-contained breathing apparatus with full facepiece.
(c) Less than or equal to 1,000 ppb	(1) A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous flow mode.
(d) Less than or equal to 2,000 ppb	(1) A Type C supplied-air respirator with full facepiece operated in pressure-demand or other positive pressure mode, or with full facepiece, helmet, or hood operated in continuous flow mode.
(e) Greater than 2,000 ppb or entry and escape from unknown concentrations.	(1) A combination respirator which includes a Type C supplied-air respirator with full facepiece operated in pressure-demand or other positive pressure or continuous flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or positive pressure mode; or (2) a self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive pressure mode.
(f) Firefighting	(1) A self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive pressure mode.

* * * * *

25. Section 1910.1045 is amended by revising paragraph (h) and the first paragraph of Section IV to Appendix A to read as follows:

§ 1910.1045 Acrylonitrile.

* * * * *

(h) *Respiratory protection.* (1) *General.* For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this paragraph. Respirators must be used during:

(i) Periods necessary to install or implement feasible engineering and work-practice controls.

(ii) Work operations, such as maintenance and repair activities or reactor cleaning, for which the employer establishes that engineering and work-practice controls are not feasible.

(iii) Work operations for which feasible engineering and work-practice controls are not yet sufficient to reduce employee exposure to or below the permissible exposure limits.

(iv) Emergencies.

(2) *Respirator program.* (i) The employer must implement a respiratory protection program in accordance with 29 CFR 1910.134 (b) through (d) (except (d)(1)(iii), (d)(3)(iii)(b)(1), and (2)), and (f) through (m).

(ii) If air-purifying respirators (chemical-cartridge or chemical-canister types) are used:

(A) The air-purifying canister or cartridge must be replaced prior to the expiration of its service life or at the completion of each shift, whichever occurs first.

(B) A label must be attached to the cartridge or canister to indicate the date and time at which it is first installed on the respirator.

(3) *Respirator selection.* The employer must select the appropriate respirator from Table I of this section.

TABLE I.—RESPIRATORY PROTECTION FOR ACRYLONITRILE (AN)

Concentration of AN or condition of use	Respirator type
(a) Less than or equal to 20 ppm	(1) Chemical cartridge respirator with organic vapor cartridge(s) and half-mask facepiece; or (2) Supplied air respirator with half-mask facepiece.
(b) Less than or equal to 100 ppm or maximum use concentration (MUC) of cartridges or canisters, whichever is lower.	(1) Full facepiece respirator with (A) organic vapor cartridges, (B) organic vapor gas mask chin-style, or (C) organic vapor gas mask canister, front-or back-mounted;

TABLE I.—RESPIRATORY PROTECTION FOR ACRYLONITRILE (AN)—Continued

Concentration of AN or condition of use	Respirator type
	(2) Supplied air respirator with full facepiece; or (3) Self-contained breathing apparatus with full facepiece.
(c) Less than or equal to 4,000 ppm	(1) Supplied air respirator operated in the positive pressure mode with full facepiece, helmet, suit, or hood.
(d) Greater than 4,000 ppm or unknown concentration.	(1) Supplied air and auxiliary self-contained breathing apparatus with full facepiece in positive pressure mode; or (2) Self-contained breathing apparatus with full facepiece in positive pressure mode.
(e) Firefighting	Self-contained breathing apparatus with full facepiece in positive pressure mode.
(f) Escape	(1) Any organic vapor respirator, or (2) Any self-contained breathing apparatus.

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Appendix A to § 1910.1045—Substance Safety Data Sheet for Acrylonitrile

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IV. Respirators and Protective Clothing

A. Respirators. You may be required to wear a respirator for nonroutine activities, in emergencies, while your employer is in the process of reducing acrylonitrile exposures through engineering controls, and in areas where engineering controls are not feasible. If respirators are worn, they must have a label issued by the National Institute for Occupational Safety and Health under the provisions of 42 CFR part 84 stating that the respirators have been approved for use with organic vapors. For effective protection, respirators must fit your face and head snugly. Respirators must not be loosened or removed in work situations where their use is required.

* * * * *

26. Section 1910.1047 is amended by removing table 1 following paragraph (h)(2) and revising paragraph (g) and the first paragraph of Section IV to Appendix A to read as follows:

§ 1910.1047 Ethylene oxide.

* * * * *

(g) *Respiratory protection and personal protective equipment.* (1) *General.* For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this paragraph. Respirators must be used during:

(i) Periods necessary to install or implement feasible engineering and work-practice controls.

(ii) Work operations, such as maintenance and repair activities and vessel cleaning, for which engineering and work-practice controls are not feasible.

(iii) Work operations for which feasible engineering and work-practice controls are not yet sufficient to reduce employee exposure to or below the TWA.

(iv) Emergencies.

(2) *Respirator program.* The employer must implement a respiratory protection program in accordance with 29 CFR 1910.134 (b) through (d) (except (d)(1)(iii)), and (f) through (m).

(3) *Respirator selection.* The employer must select the appropriate respirator from Table 1 of this section.

TABLE 1.—MINIMUM REQUIREMENTS FOR RESPIRATORY PROTECTION FOR AIRBORNE ETO

Condition of use or concentration of airborne EtO (ppm)	Minimum required respirator
Equal to or less than 50	(a) Full facepiece respirator with EtO approved canister, front-or back-mounted.
Equal to or less than 2,000	(a) Positive-pressure supplied air respirator, equipped with full facepiece, hood, or helmet, or (b) Continuous-flow supplied air respirator (positive pressure) equipped with hood, helmet or suit.
Concentration above 2,000 or unknown concentration (such as in emergencies).	(a) Positive-pressure self-contained breathing apparatus (SCBA), equipped with full facepiece, or (b) Positive-pressure full facepiece supplied air respirator equipped with an auxiliary positive-pressure self-contained breathing apparatus.
Firefighting	(a) Positive pressure self-contained breathing apparatus equipped with full facepiece.
Escape	(a) Any respirator described above.

Note. Respirators approved for use in higher concentrations are permitted to be used in lower concentrations.

(4) *Protective clothing and equipment.* When employees could have eye or skin contact with EtO or EtO solutions, the employer must select and provide, at no cost to the employee, appropriate protective clothing or other equipment in accordance with 29 CFR 1910.132 and 1910.133 to protect any area of the employee's body that may come in contact with the EtO or EtO solution, and must ensure that the employee wears the protective clothing and equipment provided.

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Appendix A to § 1910.1047—Substance Safety Data Sheet for Ethylene Oxide (Non-mandatory)

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IV. Respirators and Protective Clothing

A. Respirators. You may be required to wear a respirator for nonroutine activities, in emergencies, while your employer is in the process of reducing EtO exposures through engineering controls, and in areas where engineering controls are not feasible. As of the effective date of this standard, only air-supplied, positive-pressure, full-facepiece respirators are approved for protection against EtO. If air-purifying respirators are worn in the future, they must have a label issued by the National Institute for Occupational Safety and Health under the provisions of 42 CFR part 84 stating that the respirators have been approved for use with ethylene oxide. For effective protection, respirators must fit your face and head snugly. Respirators must not be loosened or removed in work situations where their use is required.

* * * * *

27. Section 1910.1048 is amended by removing Appendix E and revising paragraph (g) to read as follows:

§ 1910.1048 Formaldehyde.

* * * * *

(g) *Respiratory protection.* (1) *General.* For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this paragraph. Respirators must be used during:

(i) Periods necessary to install or implement feasible engineering and work-practice controls.

(ii) Work operations, such as maintenance and repair activities or vessel cleaning, for which the employer establishes that engineering and work-practice controls are not feasible.

(iii) Work operations for which feasible engineering and work-practice controls are not yet sufficient to reduce employee exposure to or below the PELs.

(iv) Emergencies.

(2) *Respirator program.* (i) The employer must implement a respiratory protection program in accordance with 29 CFR 1910.134 (b) through (d) (except (d)(1)(iii), (d)(3)(iii)(b)(1), and (2)), and (f) through (m).

(ii) If air-purifying chemical-cartridge respirators are used, the employer must:

(A) Replace the cartridge after three (3) hours of use or at the end of the workshift, whichever occurs first, unless the cartridge contains a NIOSH-approved end-of-service-life indicator (ESLI) to show when breakthrough occurs.

(B) Unless the canister contains a NIOSH-approved ESLI to show when breakthrough occurs, replace canisters used in atmospheres up to 7.5 ppm (10xPEL) every four (4) hours and industrial-sized canisters used in atmospheres up to 75 ppm (100xPEL) every two (2) hours, or at the end of the workshift, whichever occurs first.

(3) *Respirator selection.* (i) The employer must select appropriate respirators from Table 1 in this section.

TABLE 1.—MINIMUM REQUIREMENTS FOR RESPIRATORY PROTECTION AGAINST FORMALDEHYDE

Condition of use or formaldehyde concentration (ppm)	Minimum respirator required [1]
Up to 7.5 ppm. (10 x PEL)	Full facepiece with cartridges or canisters specifically approved for protection against formaldehyde.[2]
Up to 75 ppm. (100 x PEL)	Full-face mask with chin style or chest or back mounted type, with industrial size canister specifically approved for protection against formaldehyde. Type C supplied air respirator, demand type, or continuous flow type, with full facepiece, hood, or helmet.
Above 75 ppm or unknown. (emergencies). (100 x PEL).	Self-contained breathing apparatus (SCBA) with positive pressure full facepiece. Combination supplied-air, full facepiece positive pressure respirator with auxiliary self-contained air supply.
Firefighting	SCBA with positive pressure in full face-piece.
Escape	SCBA in demand or pressure demand mode. Full-face mask with chin style or front or back mounted type industrial size canister specifically approved for protection against formaldehyde.

[1] Respirators specified for use at higher concentrations may be used at lower concentrations.
[2] A half-mask respirator with cartridges specifically approved for protection against formaldehyde can be substituted for the full facepiece respirator providing that effective gas-proof goggles are provided and used in combination with the half-mask respirator.

(ii) The employer must provide a powered air-purifying respirator adequate to protect against formaldehyde exposure to any employee who has difficulty using a negative-pressure respirator.

* * * * *

28. Section 1910.1050 is amended by revising paragraph (h) and the first paragraph of Section III to Appendix A to read as follows:

§ 1910.1050 Methylenedianiline.

* * * * *

(h) *Respiratory protection.* (1) *General.* For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this paragraph. Respirators must be used during:

(i) Periods necessary to install or implement feasible engineering and work-practice controls.

(ii) Work operations for which the employer establishes that engineering and work-practice controls are not feasible.

(iii) Work operations for which feasible engineering and work-practice controls are not yet sufficient to reduce employee exposure to or below the PEL.

(iv) Emergencies.

(2) *Respirator program.* The employer must implement a respiratory protection program in accordance with 29 CFR 1910.134 (b) through (d) (except (d)(1)(iii)), and (f) through (m).

(3) *Respirator selection.* (i) The employer must select, and ensure that employees use, the appropriate respirator from Table 1 in this section.

TABLE 1.—RESPIRATORY PROTECTION FOR MDA

Airborne concentration of MDA or condition of use	Respirator type
a. Less than or equal to 10 × PEL	(1) Half-Mask Respirator with HEPA [1] Cartridge.[2]
b. Less than or equal to 50 × PEL	(1) Full facepiece Respirator with HEPA [1] Cartridge or Canister.[2]
c. Less than or equal to 1000 × PEL	(1) Full facepiece powered air-purifying respirator with HEPA [1] cartridges.[2]
d. Greater than 1000 × PEL or unknown concentrations.	(1) Self-contained breathing apparatus with full facepiece in positive pressure mode. (2) Full facepiece positive pressure demand supplied-air respirator with auxiliary self-contained air supply.
e. Escape	(1) Any full facepiece air-purifying respirator with HEPA [1] cartridges; [2] (2) Any positive pressure or continuous flow self-contained breathing apparatus with full facepiece or hood.
f. Firefighting	(1) Full facepiece self-contained breathing apparatus in positive pressure demand mode.

Note: Respirators assigned for higher environmental concentrations may be used at lower concentrations.

[1] High Efficiency Particulate in Air filter (HEPA) means a filter that is at least 99.97 percent efficient against mono-dispersed particles of 0.3 micrometers or larger.
[2] Combination HEPA/Organic Vapor Cartridges shall be used whenever MDA in liquid form or a process requiring heat is used.

(ii) Any employee who cannot use a negative-pressure respirator must be given the option of using a positive-pressure respirator, or a supplied-air respirator operated in the continuous-flow or pressure-demand mode.

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Appendix A to § 1910.1050—Substance Safety Data Sheet for 4,4'–Methylenedianiline

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III. Protective Clothing and Equipment

A. Respirators. Respirators are required for those operations in which engineering controls or work-practice controls are not adequate or feasible to reduce exposure to the permissible limit. If respirators are worn, they must have a label issued by the National Institute for Occupational Safety and Health under the provisions of 42 CFR part 84 stating that the respirators have been approved for this purpose, and cartridges and canisters must be replaced in accordance with the requirements of 29 CFR 1910.134. If you experience difficulty breathing while wearing a respirator, you can request a positive-pressure respirator from your employer. You must be thoroughly trained to use the assigned respirator, and the training must be provided by your employer.

* * * * *

29. Section 1910.1051 is amended by removing and reserving Appendix E and revising paragraph (h) to read as follows:

§ 1910.1051 1,3–Butadiene.

* * * * *

(h) *Respiratory protection.* (1) *General.* For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this paragraph. Respirators must be used during:

(i) Periods necessary to install or implement feasible engineering and work-practice controls.

(ii) Non-routine work operations that are performed infrequently and for which employee exposures are limited in duration.

(iii) Work operations for which feasible engineering and work-practice controls are not yet sufficient to reduce employee exposures to or below the PELs.

(iv) Emergencies.

(2) *Respirator program.* (i) The employer must implement a respiratory protection program in accordance with 29 CFR 1910.134 (b) through (d) (except (d)(1)(iii), (d)(3)(iii)(B)(1), and (2)), and (f) through (m).

(ii) If air-purifying respirators are used, the employer must replace the air-purifying filter elements according to the replacement schedule set for the class of respirators listed in Table 1 of this section, and at the beginning of each work shift.

(iii) Instead of using the replacement schedule listed in Table 1 of this section, the employer may replace cartridges or canisters at 90% of their expiration service life, provided the employer:

(A) Demonstrates that employees will be adequately protected by this procedure.

(B) Uses BD breakthrough data for this purpose that have been derived from tests conducted under worst-case conditions of humidity, temperature, and air-flow rate through the filter element, and the employer also describes the data supporting the cartridge-or canister-change schedule, as well as the basis for using the data in the employer's respirator program.

(iv) A label must be attached to each filter element to indicate the date and time it is first installed on the respirator.

(v) If NIOSH approves an end-of-service-life indicator (ESLI) for an air-purifying filter element, the element may be used until the ESLI shows no further useful service life or until the element is replaced at the beginning of the next work shift, whichever occurs first.

(vi) Regardless of the air-purifying element used, if an employee detects the odor of BD, the employer must replace the air-purifying element immediately.

(3) *Respirator selection.* (i) The employer must select appropriate respirators from Table 1 of this section.

TABLE 1.—MINIMUM REQUIREMENTS FOR RESPIRATORY PROTECTION FOR AIRBORNE BD

Concentration of airborne BD (ppm) or condition of use	Minimum required respirator
Less than or equal to 5 ppm (5 times PEL)	(a) Air-purifying half mask or full facepiece respirator equipped with approved BD or organic vapor cartridges or canisters. Cartridges or canisters shall be replaced every 4 hours.
Less than or equal to 10 ppm (10 times PEL) ...	(a) Air-purifying half mask or full facepiece respirator equipped with approved BD or organic vapor cartridges or canisters. Cartridges or canisters shall be replaced every 3 hours.
Less than or equal to 25 ppm (25 times PEL) ...	(a) Air-purifying full facepiece respirator equipped with approved BD or organic vapor cartridges or canisters. Cartridges or canisters shall be replaced every 2 hours. (b) Any powered air-purifying respirator equipped with approved BD or organic vapor cartridges. PAPR cartridges shall be replaced every 2 hours. (c) Continuous flow supplied air respirator equipped with a hood or helmet.
Less than or equal to 50 ppm (50 times PEL) ...	(a) Air-purifying full facepiece respirator equipped with approved BD or organic vapor cartridges or canisters. Cartridges or canisters shall be replaced every (1) hour. (b) Powered air-purifying respirator equipped with a tight-fitting facepiece and an approved BD or organic vapor cartridges. PAPR cartridges shall be replaced every (1) hour.
Less than or equal to 1,000 ppm (1,000 times PEL).	(a) Supplied air respirator equipped with a half mask of full facepiece and operated in a pressure demand or other positive pressure mode.
Greater than 1000 ppm unknown concentration, or firefighting.	(a) Self-contained breathing apparatus equipped with a full facepiece and operated in a pressure demand or other positive pressure mode. (b) Any supplied air respirator equipped with a full facepiece and operated in a pressure demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure demand or other positive pressure mode.
Escape from IDLH conditions	(a) Any positive pressure self-contained breathing apparatus with an appropriate service life.

TABLE 1.—MINIMUM REQUIREMENTS FOR RESPIRATORY PROTECTION FOR AIRBORNE BD—Continued

Concentration of airborne BD (ppm) or condition of use	Minimum required respirator
	(b) A air-purifying full facepiece respirator equipped with a front or back mounted BD or organic vapor canister.

NOTES: Respirators approved for use in higher concentrations are permitted to be used in lower concentrations. Full facepiece is required when eye irritation is anticipated.

(ii) Air-purifying respirators must have filter elements approved by NIOSH for organic vapors or BD.

(iii) When an employee whose job requires the use of a respirator cannot use a negative-pressure respirator, the employer must provide the employee with a respirator that has less breathing resistance than the negative-pressure respirator, such as a powered air-purifying respirator or supplied-air respirator, when the employee is able to use it and if it provides the employee adequate protection.

* * * * *

30. Section 1910.1052 is amended by revising paragraph (g) to read as follows:

§ 1910.1052 Methylene chloride.

* * * * *

(g) *Respiratory protection.* (1) *General.* For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this paragraph. Respirators must be used during:

(i) Periods when an employee's exposure to MC exceeds the 8-hour TWA, PEL, or STEL (for example, when an employee is using MC in a regulated area).

(ii) Periods necessary to install or implement feasible engineering and work-practice controls.

(iii) A few work operations, such as some maintenance operations and repair activities, for which the employer demonstrates that engineering and work-practice controls are infeasible.

(iv) Work operations for which feasible engineering and work-practice controls are not sufficient to reduce employee exposures to or below the PELs.

(v) Emergencies.

(2) *Respirator program.* (i) The employer must implement a respiratory protection program in accordance with 29 CFR 1910.134 (b) through (m) (except (d)(1)(iii)).

(ii) Employers who provide employees with gas masks with organic-vapor canisters for the purpose of emergency escape must replace the canisters after any emergency use and before the gas masks are returned to service.

(3) *Respirator selection.* The employer must select appropriate atmosphere-supplying respirators from Table 2 of this section.

TABLE 2.—MINIMUM REQUIREMENTS FOR RESPIRATORY PROTECTION FOR AIRBORNE METHYLENE CHLORIDE

Methylene chloride airborne concentration (ppm) or condition of use	Minimum respirator required [1]
Up to 625 ppm (25 X PEL)	(1) Continuous flow supplied-air respirator, hood or helmet.
Up to 1250 ppm (50 X 8–TWA PEL)	(1) Full facepiece supplied-air respirator operated in negative pressure (demand) mode. (2) Full facepiece self-contained breathing apparatus (SCBA) operated in negative pressure (demand) mode.
Up to 5000 ppm (200 X 8–TWA PEL)	(1) Continuous flow supplied-air respirator, full facepiece. (2) Pressure demand supplied-air respirator, full facepiece. (3) Positive pressure full facepiece SCBA.
Unknown concentration, or above 5000 ppm (Greater than 200 X 8–TWA PEL).	(1) Positive pressure full facepiece SCBA. (2) Full facepiece pressure demand supplied-air respirator with an auxiliary self-contained air supply.
Fire fighting	Positive pressure full facepiece SCBA.
Emergency escape	(1) Any continuous flow or pressure demand SCBA. (2) Gas mask with organic vapor canister.

[1] Respirators assigned for higher airborne concentrations may be used at lower concentrations.

(4) *Medical evaluation.* Before having an employee use a supplied-air respirator in the negative-pressure mode, or a gas mask with an organic-vapor canister for emergency escape, the employer must:

(i) Have a physician or other licensed health-care professional (PLHCP) evaluate the employee's ability to use such respiratory protection.

(ii) Ensure that the PLHCP provides their findings in a written opinion to the employee and the employer.

* * * * *

PART 1926—[AMENDED]

Subpart D—[Amended]

31. The authority citation for Subpart D of Part 1926 is revised to read as follows:

Authority: Sec. 107, Contract Work Hours and Safety Standards Act (Construction Safety Act) (40 U.S.C. 333); secs. 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Orders 12–71 (36 FR 8754), 8–76 (41 FR 25059), 9–83 (48 FR 35736), 1–90 (55 FR 9033), or 6–96 (62 FR 111), as applicable; and 29 CFR Part 11.

Secs. 1926.58, 1926.59, 1926.60, and 1926.65 of 29 CFR, also issued under 5 U.S.C. 553, and 29 CFR Part 1911.

Sec. 1926.62 of 29 CFR, also issued under sec. 1031 of the Housing and Community Development Act of 1992 (42 U.S.C. 4853).

Sec. 1926.65 of 29 CFR, also issued under sec. 126 of the Superfund Amendments and Reauthorization Act of 1986, as amended (29 U.S.C. 655 note), and 5 U.S.C. 553.

32. Section 1926.57 is amended by revising paragraphs (f)(1)(ii), (f)(5)(i) and (iii), (f)(6), (h)(6)(iii)(A), and (i)(9)(vi) to read as follows:

§ 1926.57 Ventilation.

* * * * *

(f) * * *

(1) * * *

(ii) *Abrasive-blasting respirator.* A respirator constructed so that it covers the wearer's head, neck, and shoulders to protect the wearer from rebounding abrasive.

* * * * *

(5) *Personal protective equipment.* (i) Employers must use only respirators approved by NIOSH under 42 CFR part 84 for protecting employees from dusts produced during abrasive-blasting operations.

* * * * *

(iii) Properly fitted particulate-filter respirators, commonly referred to as dust-filter respirators, may be used for short, intermittent, or occasional dust exposures such as cleanup, dumping of dust collectors, or unloading shipments of sand at a receiving point when it is not feasible to control the dust by enclosure, exhaust ventilation, or other means. The respirators used must be approved by NIOSH under 42 CFR part 84 for protection against the specific type of dust encountered.

* * * * *

(6) *Air supply and air compressors.* Air for abrasive-blasting respirators must be free of harmful quantities of dusts, mists, or noxious gases, and must meet the requirements for supplied-air quality and use specified in 29 CFR 1910.134(i).

* * * * *

(h) * * *

(6) * * *

(iii)(A) When an operator is in a booth downstream of the object being sprayed, an air-supplied respirator or other type of respirator approved by NIOSH under 42 CFR Part 84 for the material being sprayed should be used by the operator.

* * * * *

(i) * * *

(9) * * *

(vi) When, during the emergencies specified in paragraph (i)(11)(v) of this section, employees must be in areas where concentrations of air contaminants are greater than the limits set by paragraph (i)(2)(iii) of this section or oxygen concentrations are less than 19.5 percent, they must use respirators that reduce their exposure to a level below these limits or that provide adequate oxygen. Such respirators must also be provided in marked, quickly-accessible storage compartments built for this purpose when the possibility exists of accidental release of hazardous concentrations of air contaminants. Respirators must be approved by NIOSH under 42 CFR part 84, selected by a competent industrial hygienist or other technically-qualified source, and used in accordance with 29 CFR 1926.103.

* * * * *

33. Section 1926.60 is amended by removing Appendix E and revising paragraph (i) to read as follows:

§ 1926.60 Methylenedianiline.

* * * * *

(i) *Respiratory protection.* (1) *General.* For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this paragraph. Respirators must be used during:

(i) Periods necessary to install or implement feasible engineering and work-practice controls.

(ii) Work operations, such as maintenance and repair activities and spray-application processes, for which engineering and work-practice controls are not feasible.

(iii) Work operations for which feasible engineering and work-practice controls are not yet sufficient to reduce employee exposure to or below the PELs.

(iv) Emergencies.

(2) *Respirator program.* The employer must implement a respiratory protection program in accordance with 29 CFR 1910.134 (b) through (d) (except (d)(1)(iii), and (f) through (m).

(3) *Respirator selection.* (i) The employer must select the appropriate respirator from Table 1 of this section.

TABLE 1.—RESPIRATORY PROTECTION FOR MDA

Airborne concentration of MDA or condition of use	Respirator type
a. Less than or equal to 10 × PEL	(1) Half-Mask Respirator with HEPA[1] Cartridge.[2]
b. Less than or equal to 50 × PEL	(1) Full facepiece Respirator with HEPA[1] Cartridge or Canister.[2]
c. Less than or equal to 1000 × PEL	(1) Full facepiece powered air-purifying respirator with HEPA[1] cartridge.[2]
d. Greater than 1000 × PEL or unknown concentration.	(1) Self-contained breathing apparatus with full facepiece in positive pressure mode.
	(2) Full facepiece positive pressure demand supplied-air respirator with auxiliary self-contained air supply.
e. Escape	(1) Any full facepiece air-purifying respirator with HEPA[1] cartridges.[2]
	(2) Any positive pressure or continuous flow self-contained breathing apparatus with full facepiece or hood.
f. Firefighting	(1) Full facepiece self-contained breathing apparatus in positive pressure demand mode.

NOTE: Respirators assigned for higher environmental concentrations may be used at lower concentrations.

[1] High Efficiency Particulate in Air filter (HEPA) means a filter that is at least 99.97 percent efficient against mono-dispersed particles of 0.3 micrometers or larger.

[2] Combination HEPA/Organic Vapor Cartridges shall be used whenever MDA in liquid form or a process requiring heat is used.

(ii) An employee who cannot use a negative-pressure respirator must be given the option of using a positive-pressure respirator, or a supplied-air respirator operated in the continuous-flow or pressure-demand mode.

* * * * *

34. Section 1926.62 is amended by revising paragraph (f); revising the second and fourth paragraphs of Section IV to Appendix B; removing the sixth paragraph of Section IV to Appendix B; and removing Appendix D, as follows:

§ 1926.62 Lead.

* * * * *

(f) *Respiratory protection.* (1) *General.* For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this paragraph. Respirators must be used during:

(i) Periods when an employee's exposure to lead exceeds the PEL.

(ii) Work operations for which engineering and work-practice controls are not sufficient to reduce employee exposures to or below the PEL.

(iii) Periods when an employee requests a respirator.

(iv) Periods when respirators are required to provide interim protection of employees while they perform the

operations specified in paragraph (d)(2) of this section.

(2) *Respirator program.* (i) The employer must implement a respiratory protection program in accordance with 29 CFR 1910.134 (b) through (d) (except (d)(1)(iii)), and (f) through (m).

(ii) If an employee has breathing difficulty during fit testing or respirator use, the employer must provide the employee with a medical examination in accordance with paragraph (j)(3)(i)(B) of this section to determine whether or not the employee can use a respirator while performing the required duty.

(3) *Respirator selection.* (i) The employer must select the appropriate respirator or combination of respirators from Table I of this section.

(ii) The employer must provide a powered air-purifying respirator when an employee chooses to use such a respirator and it will provide adequate protection to the employee.

TABLE 1.—RESPIRATORY PROTECTION FOR LEAD AEROSOLS

Airborne concentration of lead or condition of use	Required respirator [1]
Not in excess of 500 ug/m^3	½ mask air purifying respirator with high efficiency filters.[2 3] ½ mask supplied air respirator operated in demand (negative pressure) mode.
Not in excess of 1,250 ug/m^3	Loose fitting hood or helmet powered air purifying respirator with high efficiency filters.[3] Hood or helmet supplied air respirator operated in a continuous-flow mode—e.g., type CE abrasive blasting respirators operated in a continuous-flow mode.
Not in excess of 2,500 ug/m^3	Full facepiece air purifying respirator with high efficiency filters.[3] Tight fitting powered air purifying respirator with high efficiency filters.[3] Full facepiece supplied air respirator operated in demand mode. ½ mask or full facepiece supplied air respirator operated in a continuous-flow mode. Full facepiece self-contained breathing apparatus (SCBA) operated in demand mode.
Not in excess of 50,000 ug/m^3	½ mask supplied air respirator operated in pressure demand or other positive-pressure mode.
Not in excess of 100,000 ug/m^3	Full facepiece supplied air respirator operated in pressure demand or other positive-pressure mode—e.g., type CE abrasive blasting respirators operated in a positive-pressure mode.
Greater than 100,000 ug/m^3 unknown concentration, or fire fighting.	Full facepiece SCBA operated in pressure demand or other positive-pressure mode.

[1] Respirators specified for higher concentrations can be used at lower concentrations of lead.
[2] Full facepiece is required if the lead aerosols cause eye or skin irritation at the use concentrations.
[3] A high efficiency particulate filter (HEPA) means a filter that is a 99.97 percent efficient against particles of 0.3 micron size or larger.

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Appendix B to § 1926.62—Employee Standard Summary

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IV. Respiratory Protection—Paragraph (f)

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Your employer is required to select respirators from the types listed in Table I of the Respiratory Protection section of the standard (§ 1926.62 (f)). Any respirator chosen must be approved by the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 42 CFR part 84. This respirator selection table will enable your employer to choose a type of respirator that will give you a proper amount of protection based on your airborne lead exposure. Your employer may select a type of respirator that provides greater protection than that required by the standard; that is, one recommended for a higher concentration of lead than is present in your workplace. For example, a powered air-purifying respirator (PAPR) is much more protective than a typical negative pressure respirator, and may also be more comfortable to wear. A PAPR has a filter, cartridge, or canister to clean the air, and a power source that continuously blows filtered air into your breathing zone. Your employer might make a PAPR available to you to ease the burden of having to wear a respirator for long periods of time. The standard provides that you can obtain a PAPR upon request.

* * * * *

Your employer must ensure that your respirator facepiece fits properly. Proper fit of a respirator facepiece is critical to your protection from airborne lead. Obtaining a proper fit on each employee may require your employer to make available several different types of respirator masks. To ensure that your respirator fits properly and that facepiece leakage is minimal, your employer must give you either a qualitative or quantitative fit test as specified in Appendix A of the Respiratory Protection standard located at 29 CFR 1910.134.

* * * * *

Subpart E—[Amended]

35. The authority citation for Subpart E of Part 1926 is revised to read as follows:

Authority: Sec. 107, Contract Work Hours and Safety Standards Act (Construction Safety Act) (40 U.S.C. 333); secs. 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Orders 12–71 (36 FR 8754), 8–76 (41 FR 25059), 9–83 (48 FR 35736), 1–90 (55 FR 9033), or 6–96 (62 FR 111), as applicable; and 29 CFR part 11.

36. Section 1926.103 is revised to read as follows:

§ 1926.103 Respiratory protection.

Note: The requirements applicable to construction work under this section are identical to those set forth at 29 CFR 1910.134 of this chapter.

Subpart S—[Amended]

37. The authority citation for Subpart S of Part 1926 is revised to read as follows:

Authority: Sec. 107, Contract Work Hours and Safety Standards Act (40 U.S.C. 333); secs. 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Orders 12–71 (36 FR 8754), 8–76 (41 FR 25059), 9–83 (48 FR 35736), 1–90 (55 FR 9033), or 6–96 (62 FR 111), as applicable.

38. Section 1926.800 is amended by revising paragraph (g)(2) as follows:

§ 1926.800 Underground construction.

* * * * *

(g) * * *

(2) *Self-rescuers.* The employer must provide self-rescuers approved by the National Institute for Occupational Safety and Health under 42 CFR part 84. The respirators must be immediately available to all employees at work stations in underground areas where employees might be trapped by smoke or gas. The selection, issuance, use, and care of respirators must be in accordance with 29 CFR 1926.103.

* * * * *

Subpart Z—[Amended]

39. The authority citation for Subpart Z of Part 1926 is revised to read as follows:

Authority: Secs. 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Orders 12–71 (36 FR 8754), 8–76 (41 FR 25059), 9–83 (48 FR 35736), 1–90 (55 FR 9033), or 6–96 (62 FR 111), as applicable; and 29 CFR part 11.

Section 1926.1102 of 29 CFR not issued under 29 U.S.C. 655 or 29 CFR part 1911; also issued under 5 U.S.C. 553.

40. Section 1926.1101 is amended by removing and reserving Appendix C and revising paragraph (h) to read as follows:

§ 1926.1101 Asbestos.

* * * * *

(h) *Respiratory protection.* (1) *General.* For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this paragraph. Respirators must be used during:

(i) Class I asbestos work.

(ii) Class II asbestos work when ACM is not removed in a substantially intact state.

(iii) Class II and III asbestos work that is not performed using wet methods, except for removal of ACM from sloped roofs when a negative-exposure assessment has been conducted and ACM is removed in an intact state.

(iv) Class II and III asbestos work for which a negative-exposure assessment has not been conducted.

(v) Class III asbestos work when TSI or surfacing ACM or PACM is being disturbed.

(vi) Class IV asbestos work performed within regulated areas where employees who are performing other work are required to use respirators.

(vii) Work operations covered by this section for which employees are exposed above the TWA or excursion limit.

(viii) Emergencies.

(2) *Respirator program.* (i) The employer must implement a respiratory protection program in accordance with 29 CFR 1910.134 (b) through (d) (except (d)(1)(iii)), and (f) through (m).

(ii) No employee shall be assigned to asbestos work that requires respirator use if, based on their most recent medical examination, the examining physician determines that the employee will be unable to function normally while using a respirator, or that the safety or health of the employee or other employees will be impaired by the employee's respirator use. Such employees must be assigned to another job or given the opportunity to transfer to a different position that they can perform. If such a transfer position is available, it must be with the same employer, in the same geographical area, and with the same seniority, status, rate of pay, and other job benefits the employee had just prior to such transfer.

(3) *Respirator selection.* (i) The employer must select the appropriate respirator from Table 1 of this section.

TABLE 1.—RESPIRATORY PROTECTION FOR ASBESTOS FIBERS

Airborne concentrations of asbestos or conditions of use	Required respirator
Not in excess of 1 f/cc (10 X PEL), or otherwise as required independent of exposure pursuant to paragraph (h)(2)(iv) of this section.	Half-mask air purifying respirator other than a disposable respirator, equipped with high efficiency filters.
Not in excess of 5 f/cc (50 X PEL)	Full facepiece air-purifying respirator equipped with high efficiency filters.
Not in excess of 10 f/cc (100 X PEL)	Any powered air-purifying respirator equipped with high efficiency filter or any supplied air respirator operated in continuous flow mode.
Not in excess of 100 f/cc (1,000 X PEL) or unknown concentration.	Full facepiece supplied air respirator operated in pressure demand mode.
Greater than 100 f/cc (1,000 X PEL) or unknown concentration.	Full facepiece supplied air respirator operated in pressure demand mode, equipped with an auxiliary positive pressure self-contained breathing apparatus.

NOTE: a. Respirators assigned for high environmental concentrations may be used at lower concentrations, or when required respirator use is independent of concentration.

b. A high efficiency filter means a filter that is at least 99.97 percent efficient against mono-dispersed particles of 0.3 micrometers in diameters in diameter or larger.

(ii) The employer must provide an employee with a tight-fitting, powered air-purifying respirator instead of a negative-pressure respirator from Table 1 when the employee chooses to use this type of respirator and such a respirator will provide adequate protection to the employee.

(iii) The employer must provide a half-mask air-purifying respirator, other than a disposable respirator, that is equipped with high-efficiency filters when the employee performs:

(A) Class II and III asbestos work and a negative-exposure assessment has not been conducted by the employer.

(B) Class III asbestos work when TSI or surfacing ACM or PACM is being disturbed.

(iv) The employer must provide employees with a full-facepiece supplied-air respirator operated in the pressure-demand mode and equipped with an auxiliary, positive-pressure self-contained breathing apparatus when the employees are in a regulated area where Class I work is being performed and the employer has not conducted a negative-exposure assessment.

* * * * *

41. Section 1926.1127 is amended by removing and reserving Appendix C and revising paragraph (g) to read as follows:

§ 1926.1127 Cadmium.

* * * * *

(g) *Respirator protection.* (1) *General.* For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this paragraph. Respirators must be used during:

(i) Periods necessary to install or implement feasible engineering and work-practice controls when employee exposures exceed the PEL.

(ii) Maintenance and repair activities, and brief or intermittent work operations, for which employee exposures exceed the PEL and engineering and work-practice controls are not feasible or are not required.

(iii) Work operations in the regulated areas specified in paragraph (e) of this section.

(iv) Work operations for which the employer has implemented all feasible engineering and work-practice controls, and such controls are not sufficient to reduce employee exposures to or below the PEL.

(v) Work operations for which an employee, who is exposed to cadmium at or above the action level, requests a respirator.

(vi) Work operations for which engineering controls are not required by paragraph (f)(1)(ii) of this section to reduce employee exposures that exceed the PEL.

(vii) Emergencies.

(2) *Respirator program.* (i) The employer must implement a respiratory protection program in accordance with 29 CFR 1910.134 (b) through (d) (except (d)(1)(iii)), and (f) through (m).

(ii) If an employee exhibits breathing difficulty during fit testing or respirator use, the employer must provide the employee with a medical examination in accordance with paragraph (l)(6)(ii) of this section to determine if the employee can use a respirator while performing the required duties.

(iii) No employee must use a respirator when, based on their most recent medical examination, the examining physician determines that the employee will be unable to continue to function normally while using a respirator. If the physician determines the employee must be limited in, or removed from, their current job because of the employee's inability to use a respirator, the job limitation or removal must be conducted in accordance with paragraphs (l) (11) and (12) of this section.

(3) *Respirator selection.* (i) The employer must select the appropriate respirator from Table 1 of this section.

TABLE 1.—RESPIRATORY PROTECTION FOR CADMIUM

Airborne concentration or condition of use [a]	Required respirator type [b]
10 X or less	A half mask, air-purifying equipped with a HEPA [c] filter.[d]
25 X or less	A powered air-purifying respirator ("PAPR") with a loose-fitting hood or helmet equipped with a HEPA filter, or a supplied-air respirator with a loose-fitting hood or helmet facepiece operated in the continuous flow mode.
50 X or less	A full facepiece air-purifying respirator equipped with a HEPA filter, or a powered air-purifying respirator with a tight-fitting half mask equipped with a HEPA filter, or a supplied-air respirator with a tight-fitting half mask operated in the continuous flow mode.
250 X or less	A powered air-purifying respirator with a tight fitting full facepiece equipped with a HEPA filter, or a supplied-air respirator with a tight-fitting full facepiece operated in the continuous flow mode.
1000 X or less	A supplied air respirator with half mask or full facepiece operated in the pressure demand or other positive pressure mode.
>1000 X or unknown concentrations	A self-contained breathing apparatus with a full facepiece operated in the pressure demand or other positive pressure mode, or a supplied-air respirator with a full facepiece operated in the pressure demand or other positive pressure mode and equipped with an auxiliary escape type self-contained breathing apparatus operated in the pressure demand mode.
Firefighting	A self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

[a] Concentrations expressed as multiple of the PEL.
[b] Respirators assigned for higher environmental concentrations may be used at lower exposure levels. Quantitative fit testing is required for all tight-fitting air purifying respirators where airborne concentration of cadmium exceeds 10 times the TWA PEL (10 X 5 ug/m(3) = 50 ug/m(3)). A full facepiece respirator is required when eye irritation is experienced.
[c] HEPA means High-efficiency Particulate Air.
[d] Fit testing, qualitative or quantitative, is required.
SOURCE: Respiratory Decision Logic, NIOSH, 1987.

(ii) The employer must provide a powered air-purifying respirator instead of a negative-pressure respirator when an employee entitled to a respirator chooses to use this type of respirator and such a respirator will provide adequate protection to the employee.

* * * * *

Note: The following table will not appear in the Code of Federal Regulations.

REDESIGNATION TABLE FOR ACTIONS ON SPECIFIC STANDARDS

Old section	New section
1910.94:	
(a)(1)(ii)	Revised.
(a)(5)(i)	Revised.
(a)(5)(iii)	Revised.
(a)(5)(iv)	Revised.
(a)(6)	Revised.
(c)(6)(iii)(a)	Revised.
(d)(9)(vi)	Revised.
1910.111:	
(a)(2)(x)	Revised.
(b)(10)(ii)	Revised.

REDESIGNATION TABLE FOR ACTIONS ON SPECIFIC STANDARDS—Continued

Old section	New section
1910.156:	
(f)(1)(i)	Revised.
(f)(1)(v)	Revised.
1910.252:	
(c)(4)(ii)	Revised.
(c)(4)(iii)	Revised.
(c)(7)(iii)	Revised.
(c)(9)(i)	Revised.
(c)(10)	Revised.
1910.261:	
(b)(2)	Revised.
(g)(10)	Revised.
(h)(2)(iii)	Revised.
(h)(2)(iv)	Revised.
1910.1001:	
(g)(1)	Revised.
(g)(2)(i)	Revised; (g)(3).
(g)(2)(ii)	Revised; (g)(2)(ii).
(g)(3)(i)	Revised; (g)(2)(i).
(g)(3)(ii)	Removed.
(g)(3)(iii)	Removed.
(g)(3)(iv)	Revised; (g)(2)(iii).
(g)(4)	Removed.

REDESIGNATION TABLE FOR ACTIONS ON SPECIFIC STANDARDS—Continued

Old section	New section
Appendix C	Removed.
1910.1003:	
(c)(4)(iv)	Revised.
(d)(1) [Reserved]	Revised.
1910.1017:	
(g)(1)	Revised.
(g)(2)	Removed.
(g)(3)	Revised; (g)(2).
(g)(4)	Revised; (g)(3)(i).
(g)(5)	Removed.
(g)(6) (i) and (ii)	Revised; (g)(3)(ii).
(g)(7)	Revised; (g)(3)(iii).
1910.1018:	
(h)(1)	Revised.
(h)(2)(i)	Revised; (h)(3)(i).
(h)(2)(ii)	Revised; (h)(3)(ii).
(h)(2)(iii)	Removed.
(h)(3)(i), (ii), and (iii).	Removed.
(h)(3)(iv)	Revised; (h)(2)(ii).
(h)(4)(i)	Revised; (h)(2)(i).
(h)(4) (ii) and (iii)	Removed.
(h)(5) (i) and (ii)	Removed.

REDESIGNATION TABLE FOR ACTIONS ON SPECIFIC STANDARDS—Continued

Old section	New section
(h)(5)(iii)	Revised; (h)(4)(iii).
1910.1025:	
(f)(1) and (f)(1)(i)	Revised.
(f)(2)(i)	Revised; (f)(3)(i).
(f)(2)(ii)	Revised; (f)(3)(ii).
(f)(2)(iii)	Removed.
(f)(3)(i) and (ii)	Removed.
(f)(3)(iii)	Revised; (f)(2)(ii).
(f)(4)(i)	Revised; (f)(2)(i).
(f)(4) (ii) and (iii)	Removed.
Appendix B, Section IV.	Revised second and fourth paragraphs; removed sixth paragraph.
Appendix D	Removed.
1910.1027:	
(g)(1)	Revised.
(g)(2)(i)	Revised; (f)(3)(i).
(g)(2)(ii)	Revised; (f)(3)(ii).
(g)(3)(i)	Revised; (f)(2)(i).
(g)(3) (ii) and (iii)	Removed.
(g)(3)(iv)	Revised; (g)(2)(iii).
(g)(3)(v)	Revised; (g)(2)(ii).
(g)(4)	Removed.
Appendix C	Removed.
1910.1028:	
(g)(1)	Revised.
(g)(2)(i)	Revised; (g)(3)(i).
(g)(2)(ii)	Removed.
(g)(2)(iii)	Revised; (g)(3)(ii).
(g)(3)	Revised; (g)(2).
(g)(4)(i)	Revised; (g)(2)(ii).
(g)(4)(ii)	Revised; (g)(2)(iii).
(g)(4)(iii)	Removed.
(g)(5)	Removed.
Appendix E	Removed.
1910.1029:	
(g)(1)(i)	Revised.
(g)(1)(ii)	Removed.
(g)(2)(i)	Revised; (g)(3).
(g)(2)(ii) and (iii)	Removed.
(g)(3)	Revised; (g)(2).
(g)(4)	Removed.
1910.1043:	
(f)(1)	Revised.
(f)(2)(i)	Revised; (f)(3)(i).
(f)(2)(ii)	Removed.
(f)(2)(iii)	Revised; (f)(3)(ii).
(f)(2)(iv)	Revised; (f)(2)(ii).
(f)(3)	Revised; (f)(2)(i).
(f)(4)	Removed.
1910.1044:	
(h)(1)	Revised.
(h)(2)(i)	Revised; (h)(3).
(h)(2)(ii)	Removed.
(h)(3)(i)	Revised; (h)(3).
(h)(3)(ii)	Removed.
1910.1045:	
(h)(1)	Revised.
(h)(2)(i)	Revised; (h)(3).
(h)(2)(ii)	Removed.

REDESIGNATION TABLE FOR ACTIONS ON SPECIFIC STANDARDS—Continued

Old section	New section
(h)(3)(i)	Revised; (h)(2)(i).
(h)(3)(ii)	Revised; (h)(2)(ii).
(h)(3)(iii)	Removed.
(h)(3)(iv)	Removed.
Appendix A, Section IV.	Revised first paragraph.
1910.1047:	
(g)(1)	Revised.
(g)(2)(i)	Revised; (g)(3).
(g)(2)(ii)	Removed.
(g)(3)	Revised; (g)(2).
(g)(4)	Revised; (g)(4).
Appendix A, Section IV.	Revised first paragraph.
1910.1048:	
(g)(1)	Revised.
(g)(2)(i)	Revised; (g)(3)(i).
(g)(2)(ii)	Revised; (g)(3)(ii).
(g)(3)(i)	Revised; (g)(2)(i).
(g)(3)(ii)	Removed.
(g)(3)(iii)	Revised; (g)(2)(ii)(A).
(g)(3)(iv)	Revised; (g)(2)(ii)(B).
(g)(3)(v)	Removed.
Appendix E	Removed.
1910.1050:	
(h)(1)	Revised.
(h)(2)(i)	Revised; (h)(3)(i).
(h)(2)(ii)	Removed.
(h)(2)(iii)	Revised; (h)(3)(ii).
(h)(3)	Revised; (h)(2).
(h)(4)	Removed.
(h)(5)	Removed.
Appendix A, Section III.	Revised first paragraph.
Appendix E	Removed.
1910.1051:	
(h)(1)	Revised.
(h)(2)(i)	Revised; (h)(3)(i).
(h)(2)(ii)	Revised; (h)(3)(ii).
(h)(2)(iii)	Revised; (h)(3)(iii).
(h)(3)	Revised; (h)(2)(i).
(h)(4)(i)	Revised; (h)(2)(ii).
(h)(4)(ii)	Revised; (h)(2)(iii).
(h)(4)(iii)	Revised; (h)(2) (iv) and (vi).
(h)(4)(iv)	Revised; (h)(2) (vi) and (vi).
(h)(4)(v)	Removed.
(h)(5)	Removed.
Appendix E	Removed.
1910.1052:	
(g)(1)	Revised.
(g)(2)	Revised; (g)(4).
(g)(3)	Revised; (g)(3).
(g)(4)	Revised; (g)(2)(i).
(g)(5)	Removed.
(g)(6)	Revised; (g)(2)(ii).
(g)(7)	Removed.
1926.57:	
(f)(1)(ii)	Revised.
(f)(5)(i)	Revised.

REDESIGNATION TABLE FOR ACTIONS ON SPECIFIC STANDARDS—Continued

Old section	New section
(f)(5)(iii)	Revised.
(f)(6)	Revised.
(f)(6)(i), (ii), and (iii)	Removed.
(h)(6)(iii)(A)	Revised.
(i)(9)(vi)	Revised.
1926.60:	
(i)(1)	Revised.
(i)(2)(i)	Revised; (i)(3)(i).
(i)(2)(ii)	Removed.
(i)(2)(iii)	Revised; (i)(3)(ii).
(i)(3)	Revised; (i)(2).
(i)(4)	Removed.
(i)(5)	Removed.
Appendix E	Removed.
1926.62:	
(f)(1)	Revised.
(f)(2)(i)	Revised; (f)(3)(i).
(f)(2)(ii)	Revised; (f)(3)(ii).
(f)(2)(iii)	Removed.
(f)(3)(i)	Removed.
(f)(3)(ii)	Removed.
(f)(3)(iii)	Revised; (f)(2)(ii).
(f)(4)(i)	Revised; (f)(2)(i).
(f)(4) (ii) and (iii)	Removed.
Appendix B, Section IV.	Revised second and fourth paragraphs; removed sixth paragraph.
Appendix D	Removed.
1926.103:	
All	Revised to a single provision.
1926.800:	
(g)(2)	Revised.
1926.1101:	
(h)(1)	Revised.
(h)(2)(i)	Revised; (h)(3)(i).
(h)(2)(ii)	Removed.
(h)(2)(iii)	Revised; (h)(3)(ii).
(h)(2)(iv)	Revised; (h)(3)(iii).
(h)(2)(v)	Revised; (h)(3)(iv).
(h)(3)(i)	Revised; (h)(2)(i).
(h)(3)(ii)	Removed.
(h)(3)(iii)	Removed.
(h)(3)(iv)	Revised; (h)(2)(ii).
(h)(4)	Removed.
Appendix C	Removed.
1926.1127:	
(g)(1)	Revised.
(g)(2)(i)	Revised; (g)(3)(i).
(g)(2)(ii)	Revised; (g)(3)(ii).
(g)(3)(i)	Revised; (g)(2)(i).
(g)(3)(ii) and (iii)	Removed.
(g)(3)(iv)	Revised; (g)(2)(ii).
(g)(3)(v)	Revised; (g)(2)(iii).
(g)(4)	Removed.
Appendix C	Removed.

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provide acceptable fit for their employees (Exs. 54–389, 54–150, 54–161), although others provided only one or two sizes of a particular model (Exs. 54–139, 54–38, 54–22, 54–163, 54–196). Some rulemaking commenters stated that mandating that respirators from two manufacturers be available would be costly and burdensome for small employers (Exs. 54–161, 54–295), would not provide any tangible improvement in the respirator program (Ex. 54–154), and would complicate training and inventory functions (Ex. 54–156).

In the case of SCBAs, participants pointed out that buying and storing two brands for fitting would be extremely costly, would create congested storage areas, and would pose the risk that parts could inadvertently be interchanged (Exs. 54–208, 54–209, 54–214, 54–250, 54–300, 54–233, 54–331, 54–348, 54–45, 54–458). Even the AFL–CIO, which generally supported the requirement that employers have respirators from different manufacturers available, stated that requiring a multi-manufacturer assortment was not feasible for SCBAs (Ex. 54–428).

OSHA concludes that providing a wide selection of sizes and models of respirators will improve both fit and acceptability, and most commenters agreed. In light of the comments, however, OSHA is making the final rule's provision more performance-oriented, and is not requiring a specific number of types and sizes. As ANSI noted, larger employers are more likely to need a larger variety of respirators to fit their employee population (Tr. 1426). Concomitantly, this change will reduce the burden on smaller employers who will not need to maintain such a wide array of respirator choices. OSHA believes therefore that employers are in the best position to determine whether their employee population is so diverse as to require the availability of respirators from more than one manufacturer. OSHA encourages employers to offer employees as wide a choice as practical when performing fit tests.

In addition to the general requirement of assuring that employers consider employee acceptability, some commenters requested that OSHA require employers to offer PAPRs to employees ''who wear respirators for long periods of time.'' These commenters stated that PAPRs are cooler, more comfortable, and offer less breathing resistance than negative pressure respirators (Exs. 54–387, 54–23). OSHA has included such provisions in various substance-specific standards based on evidence in those records that proper respirator use is likely to be increased if more comfortable respirators are available (See, e.g., Ex. 330 in Docket H–033C, Asbestos in Construction standard, discussed at 51 FR 22719, June 20, 1986). For example, OSHA stated in the preamble to the Lead standard (43 FR at 52933, Nov. 14, 1978) that ''PAPRs provide greater protection to individuals, especially those who cannot obtain a good face fit on a negative pressure respirator, and will provide greater comfort when a respirator needs to be worn for long periods of time. OSHA believes employees will have a greater incentive to wear respirators if discomfort is minimized.''

OSHA continues to believe that under some circumstances PAPRs provide superior acceptability. These include situations where employees wear respirators for full shifts, where employees frequently readjust their negative pressure respirators to achieve what they consider a more comfortable or tighter fit, and where the air flow provided by a PAPR reduces the employee's psychological and physiological discomfort. However, where ambient temperatures are extremely high or low, PAPRs are often unacceptable because of the temperature of the airstream in the facepiece (See preamble to Coke Oven standard, 41 FR at 46774).

OSHA's experience in enforcing standards that contain a provision requiring PAPRs to be supplied is that the provision is rarely invoked by employees, and even less rarely cited. The Agency continues to believe that it is good industrial hygiene practice to provide a respirator that the employee considers acceptable. Fit testing protocols require that employees have an opportunity to reject respirator facepieces that they consider unacceptable (See Appendix A).

However, this record does not provide a sufficient basis for the Agency to require PAPRs upon employee request in all situations where the standard applies. For example, Popendorf et al. (Ex. 64–513) reported results from a survey of respirator users in indoor swine production, poultry production, and grain handling facilities. ''Acceptability among four classes of respirators (disposable, quarter-mask, half-mask and powered air-purifying helmets), varied among the three user groups. * * * Powered helmets were rated best for breathing ease, communication ease, skin comfort and in-mask temperature and humidity, while disposables were rated best for weight and convenience.'' OSHA emphasizes, however, that if the medical evaluation required by this standard finds that an employee's health may be impaired by using a negative pressure respirator, the employer must provide a PAPR (See paragraph (e)(6)(ii)).

Paragraph (d)(2)—Respirators for IDLH Atmospheres

Paragraph (d)(2) covers respirators for use in atmospheres that are immediately dangerous to life or health (IDLH). The comparable provision in the proposal was paragraph (d)(10), which several commenters stated was not clearly written (Exs. 54–38, 54–167, 54–213, 54–280, 54–297, 54–309, 54–455). OSHA has rewritten and reorganized the provision so that paragraph (d)(2) of the final rule covers all IDLH atmospheres, and paragraph (d)(3) covers all non-IDLH atmospheres.

The standard requires that the most protective and reliable respirators be used for ILDH atmospheres: either a full facepiece pressure demand SCBA certified for a minimum service life of thirty minutes, or a combination full facepiece pressure demand supplied-air respirator with an auxiliary self-contained air supply (paragraph (d)(2)(i)). The proposal would have imposed the same requirement, except for the addition of the requirement for a minimum service life in the final rule.

OSHA has determined, as have most respirator authorities, that IDLH atmospheres require the highest level of respiratory protection and reliability. These atmospheres, by definition, are the most dangerous environments in which respirators may be used. As OSHA explains in the summary and explanation for the definition of ''IDLH,'' the term includes atmospheres that pose an immediate threat to life or health, would cause irreversible adverse health effects, or would impair an employee's ability to escape. In these atmospheres there is no tolerance for respirator failure. This record supported OSHA's preamble statement that IDLH atmospheres ''require the most protective types of respirators for workers'' (59 FR 58896). Commenters and authorities, including NIOSH, ANSI, and both labor and management, agree that, for these atmospheres, the most highly protective respirators, with escape capability, should be required (See the NIOSH Respirator Decision Logic, pg. 10; ANSI Z88.2–1992, clause 7.3.2; Ex. 54–38).

Paragraph (d)(2)(ii) requires employers to select respirators that are to be used exclusively for escape from IDLH atmospheres from those certified by NIOSH for escape from the atmosphere in which they will be used.

This provision addresses the selection of escape-only respirators from IDLH atmospheres involving different substances and situations. For example, under current 29 CFR 1910.1050, the standard covering exposure to methylenedianiline (MDA), escape respirators may be any full facepiece air-purifying respirator equipped with HEPA cartridges, or any positive pressure or continuous flow self-contained breathing apparatus with full facepiece or hood; for formaldehyde exposure, escape respirators may be a full facepiece with chin style, front, or back-mounted industrial canister approved against formaldehyde (29 CFR 1910.1048).

Paragraph (d)(2)(iii) requires employers to consider all oxygen-deficient atmospheres to be IDLH atmospheres. An oxygen-deficient atmosphere is defined in paragraph (b) of the standard as one that contains less than 19.5 percent oxygen. Below this level, employers are required to use the same respirators as are required for IDLH atmospheres, i.e., a full facepiece pressure-demand supplied-air respirator with auxiliary SCBA or pressure-demand SCBA. This paragraph contains an exception to permit employers to use any supplied-air respirator, provided that the employer demonstrates that oxygen levels in the work area can be maintained within the ranges specified in Table II of the final rule, i.e., between 19.5 percent and a lower value that corresponds to an altitude-adjusted oxygen partial pressure equivalent to 16 percent oxygen by volume at sea level. The language of paragraph (d)(2)(iii), along with the exception, reflects the same requirement as that proposed, but avoids the potential confusion associated with having separate definitions and requirements for oxygen-deficient, and oxygen-deficient IDLH, atmospheres, as originally proposed. The language used in the final rule also reinforces OSHA's belief that all atmospheres containing less than 19.5 oxygen must be considered IDLH unless the employer has good information that oxygen levels cannot fall to dangerously low levels; in atmospheres below this level but falling within the ranges showin in Table II, a SAR must be provided.

In the preamble discussion for paragraph (b), OSHA provided several reasons for the selection of the 19.5 percent cutoff to define oxygen deficiency. First, OSHA believes that consistency with the Agency's confined space standard is essential because most oxygen-deficient atmospheres will be associated with work in confined spaces. In the preamble to the permit-required confined space standard, 29 CFR 1910.146(b), OSHA used the term ''asphyxiating atmosphere'' when referring to an atmosphere containing less than 19.5 percent oxygen (58 FR 4466, January 14, 1993). In the confined space standard itself, OSHA included ''atmospheric oxygen concentrations [of] less than 19.5 percent'' within the standard's definition of ''hazardous atmosphere.'' Using the same 19.5 percent cutoff point for defining an IDLH oxygen-deficient atmosphere in this respiratory protection standard will reduce the potential for confusion. In addition, OSHA's use of a 19.5 percent cutoff is consistent with the requirement that Grade D breathing air contain a minimum of 19.5 percent oxygen (See paragraph (i)).

OSHA believes that employers will only rarely have occasion to avail themselves of the exception in paragraph (d)(2)(iii), which allows the use of any supplied-air respirator (SAR) if oxygen levels can be maintained within the ranges shown in Table II. Except for confined spaces, there were no examples in the record of work operations being routinely conducted in well-controlled atmospheres where oxygen levels are below 19.5 percent. Most atmospheres with oxygen content between 16 and 19.5 percent are not well-controlled, and a drop in oxygen content could have severe consequences. OSHA's review of enforcement data also confirms that, except for confined spaces, such atmospheres are uncommon, although they occasionally occur when work is conducted in basements, open pits, and other enclosed spaces. If an employer can meet the difficult evidentiary burden of showing that the oxygen content can be controlled reliably enough to remain within the ranges specified in Table II, the atmosphere is not considered IDLH under this standard, and the employer may provide any SAR.

The low end of the ranges of oxygen concentrations in Table II are the same as those used to define oxygen-deficient IDLH atmospheres in the proposal: 16 percent oxygen by volume for altitudes from sea level to 3,000, and 19.5% oxygen content for altitudes above 8,001 feet. For altitudes from 3,001 to 8,000 feet, the listed oxygen concentrations correspond to an oxygen partial pressure of 100 mm mercury (Hg). OSHA explained in the proposal (59 FR at 58906) that these values are consistent with those in ANSI's Z88.2–1980 standard and with ANSI's definition of ''oxygen deficiency—immediately dangerous to life or health'' as a partial pressure of 100 mm Hg at sea level.

ANSI's more recent 1992 standard permits lower oxygen concentrations before classifying an atmosphere as IDLH, provided that the employer has determined that the source of the oxygen reduction is understood and controlled. OSHA noted in the proposal that IDLH oxygen deficiency is now defined by ANSI as an oxygen content at sea level that is equivalent to less than 12.5% oxygen (i.e., an atmosphere with an oxygen partial pressure of 95 mm Hg or less). However, there is general agreement that employees could be seriously and rapidly debilitated if their supplied-air respirators should fail in a 12.5% oxygen atmosphere. OSHA stated in the proposal that that level represents the ''bare minimum safety factor.'' By choosing such a low oxygen partial pressure as the ''floor'' for oxygen-deficient IDLH atmospheres, the ANSI standard effectively removes any safety margin (59 FR 58905). ANSI representatives (Tr. 1289) agreed with OSHA during the hearing that OSHA's proposal offered a greater safety buffer than the 1992 ANSI standard. In addition, ANSI itself acknowledged in Table A–1 of its Z88.2–1992 standard (pg. 22, Ex. 54–50) that an oxygen level of 12.5% at sea level would produce effects such as ''Very poor judgment and coordination * * * impaired respiration that may cause permanent heart damage * * * nausea and vomiting.'' OSHA considers these effects unacceptable and intends this standard to prevent their occurrence. The ANSI table also states that a 16% oxygen level would produce effects such as ''Increased pulse and breathing rates * * * impaired thinking and attention * * * reduced coordination,'' and at an oxygen level of 14% effects would include ''Abnormal fatigue upon exertion * * * emotional upset * * * faulty coordination * * * poor judgment.'' All of these effects are potentially incompatible with the safe performance of duties.

The ANSI table shows that the adverse health effects of oxygen deficiency become significant at the 16% oxygen level, and that these effects increase in severity as the oxygen level decreases. ANSI chose the 12.5% level because that level represents the point below which significant reductions in blood oxygen levels occur. As ANSI stated in clause A.5.2 of the Z88.2–1992 standard ''[t]his rapid rate of change then can present an unforgiving situation to an unprotected worker where debilitating physiological symptoms can appear suddenly, without warning, after only relatively

small changes in ambient oxygen levels.''

The ANSI standard anticipates that all atmospheres with reduced oxygen levels would be treated as IDLH unless the source of the oxygen reduction is understood and controlled (Clause 7.3.1 ANSI Z88.2–1992). OSHA found that situations with controlled reduced-oxygen atmospheres (below 16% oxygen by volume) are rare and are already treated as an IDLH atmosphere by employers. Outside of confined spaces, such as in a pit or a basement, a reduced-oxygen atmosphere is rarely stable. Reduced-oxygen atmosphere situations may result as a byproduct of dynamic processes such as oxygen-consuming operations caused by the combustion of fuels or the digestion of organic matter. OSHA considers all confined spaces with atmospheric concentrations of less than 19.5% oxygen hazardous, and does not permit an oxygen level below 19.5% for occupied confined spaces (See 29 CFR 1910.146(b)), because it is difficult to ensure that, in a confined space, oxygen levels will not drop precipitously with little or no warning. The work being performed can itself reduce the oxygen levels, due to displacement of air by asphyxiants or through consumption of oxygen by work processes or by employees performing the work. Such sources of variability in oxygen content, even in workplaces where employers are attempting to stabilize the atmospheric oxygen content, can cause oxygen levels to drop to a lower level, placing workers at risk. Furthermore, the accurate monitoring of oxygen levels can be difficult, since sampling instruments test a limited number of areas, and pockets of lower oxygen content can exist inside a confined space or in a basement that can cause a worker to be overcome. Thus, OSHA has chosen an oxygen level of 16% by volume as the level at which SCBA or an airline respirator with auxiliary air supply must be used because that is the level below which severe symptoms from oxygen deprivation first appear, because maintenance of oxygen levels below 16% is difficult, and because employees who are not protected risk their lives if an employer mistakenly believes oxygen content can be controlled.

OSHA's determination that, at altitudes of up to 3,000 feet, atmospheres containing less than 16% oxygen must be considered IDLH was based on evidence that NIOSH submitted to the preproposal docket (See 59 FR at 58905). NIOSH showed that in an oxygen concentration of less than 16% at sea level, employees may experience impaired attention, thinking and coordination. The American Thoracic Society (Ex. 54–92) questioned whether allowing work to be performed in an atmosphere with as little as 16% oxygen, with no supplemental oxygen supply, at altitudes below 3000 feet is sufficiently protective and suggested that mandatory medical examinations might be necessary in such circumstances to avoid pulmonary or cardiac disease complications. OSHA believes that this comment reflects some of the confusion among rulemaking participants concerning the proposed language covering oxygen deficiency. OSHA wishes to make clear that, in both the proposed and the final rules, employees are not permitted to work in atmospheres containing less than 19.5 percent oxygen without the use of a supplied-air respirator. In the majority of these cases, employers will be obligated to provide highly protective respirators that can be used in IDLH conditions. In a few cases, employers may be able to justify use of any supplied-air respirator. In either case, employees will be provided a supplemental source of breathing air when working in oxygen-deficient atmospheres.

OSHA has not adopted NIOSH's recommendations that the IDLH concentration of oxygen be increased to a concentration above 19.5% for work above 8,001 feet. OSHA's experience confirms the record evidence that most work at higher altitudes is performed by fully acclimated workers (Exs. 54–6, 54–208). These provisions will allow acclimated workers to continue to perform their work without oxygen-supplying respirators, at any altitude up to 14,000 feet altitude, as long as the ambient oxygen content remains above 19.5% and the employee has no medical condition that would require the use of supplemental oxygen.

As noted above, oxygen deficiency frequently occurs in atmospheres that are not well controlled, and OSHA's decision to consider all oxygen-deficient atmospheres as IDLH except under certain strict conditions is appropriate for work conducted in such dangerous conditions. The requirement to use the most protective and reliable respirators for IDLH atmospheres is proper to protect workers from the dire consequences of exposure to these atmospheres.

Paragraph (d)(3)—Respirators for Atmospheres That Are Not IDLH

Paragraph (d)(3) sets out criteria and requirements for choosing respirators for all non-IDLH atmospheres. These provisions supplement the general requirements in paragraph (d)(1). This paragraph has been reordered from the parallel paragraph of the proposed standard.

Paragraph (d)(3)(i) requires the employer to provide a respirator that is adequate to reduce the exposure of the respirator wearer under all conditions of use, including in reasonably foreseeable emergencies. Employers must also provide respirators that will ensure compliance with all other statutory and regulatory requirements, such as the permissible exposure limits (PELs) for substances in 29 CFR 1910.1000, substance-specific standards, and other OSHA standards. For example, 29 CFR 1910.120 (g)(2) of OSHA's Hazardous Waste Operations and Emergency Response standard has additional exposure limits that apply to hazardous waste sites and emergency response operations. In addition, the general duty clause (Sec. 5(a)(1)) of the OSH Act may require employers to protect their employees from substances that are not regulated but that are known to be hazardous at the exposure levels encountered in the workplace. However, as was discussed at length in the ''Definitions'' section of this summary and explanation, the final standard does not use the term ''hazardous exposure levels,'' in part because the proposal was widely misunderstood to require compliance with ACGIH's TLVs or NIOSH's RELs in the absence of an OSHA standard. Moreover, as also noted above, this rulemaking does not address the hierarchy of exposure controls in paragraph (a)(1). Thus, employers may not rely on respirators to control exposures when feasible engineering controls are available and are sufficient to reduce exposures.

As explained earlier, OSHA intends to address the issue of assigned protection factors (APFs) and their impact on respirator selection in a subsequent phase of this rulemaking. OSHA noted in the proposal (59 FR 58901) that APFs are ''a recognition of the fact that different types of equipment provide different degrees of protection, and equipment limitations must be considered in selecting respirators.'' A respirator with a higher APF will provide more protection than a respirator with a lower APF. Considerable information on APFs has developed since OSHA adopted its existing standard in 1971. OSHA intends to promulgate APF provisions in the future. Accordingly, paragraphs (d)(3)(i) (A) and (B) are reserved at this time and will be addressed in the next phase of this rulemaking. In the interim, OSHA expects employers to take the best available information into account

in selecting respirators. As it did under the previous standard, OSHA itself will continue to refer to the NIOSH APFs in cases where it has not made a different determination in a substance-specific standard. In addition, where OSHA has specific compliance interpretations for certain respirators, e.g., respirators used for abrasive blasting (such as for lead), these should be followed.

Based on the Agency's enforcement experience with the previous standard, OSHA does not believe that differences in the APFs set by NIOSH and ANSI will have a serious impact on respirator selection, because the major differences in NIOSH and ANSI APFs occur with respirators having APFs of 25 or greater, and most overexposures involve exposures at relatively small multiples of the PELs. An analysis of OSHA's Integrated Management Information System (IMIS) data showed that only 2 percent of the measurements taken by OSHA exceeded the PEL by more than 10 times.

Paragraph (d)(3)(ii) of the final standard provides that the respirators selected must protect employees against the physical state and chemical form of the particular contaminant or contaminants present in the workplace. For air-purifying respirator selection, the form of the contaminant is a critical factor. Different types of air filtration respirators are needed for dusts and gases, for example, and, among gases, different types are needed for acid gases and for carbon monoxide. If the respirator is not equipped with a filter suitable for the form of the contaminant to which a worker is exposed, then the worker has no protection against that contaminant. No commenter opposed this requirement. ANSI's standard acknowledges that this information is critical to appropriate respirator selection (ANSI Z 88.2–1992, clause 4.5.4.(b)).

Paragraph (d)(3)(iii) covers respirator selection for protection against gases and vapors. OSHA's primary intent in this paragraph is to ensure that air-purifying respirators are not used in situations where a chemical cartridge or canister becomes saturated such that the gas or vapor contaminant can ''break through'' the filter's sorbent element and enter the respirator and the worker's breathing zone. If this happens, even correctly fitting, well-maintained respirators provide no protection to their users. This breakthrough problem is avoided entirely by the use of atmosphere-supplying respirators. Such respirators do not rely on filter sorbents and instead deliver clean outside air to the wearer's respirator.

This paragraph establishes the requirements for selecting respirators for protection against gas and vapor contaminants. Paragraph (d)(3)(iii)(A) allows the use of atmosphere-supplying respirators against any gas or vapor, and paragraph (d)(3)(iii)(B) specifies the conditions under which air-purifying respirators may be used. These conditions protect users against the gas or vapor contaminant breaking through the canister/cartridge filter. Thus, this paragraph allows an air-purifying respirator to be used if it is equipped with a NIOSH-approved end-of-service life indicator (ESLI) (paragraph (d)(3)(iii)(B)(*1*)) or if the employer enforces a sorbent change schedule based on reliable information and data on the service life of cartridges and canisters used by the employer (paragraph (d)(3)(iii)(B)(*2*)).

These provisions differ significantly from those in the proposal. In proposed paragraphs (d)(8) and (d)(9), OSHA would have allowed air-purifying respirator use for gases and vapors with ''adequate warning properties,'' such as odor or irritation, and would not have imposed additional conditions on their use. A substance would have been considered to have adequate warning properties if the threshold for detection was no higher than three times the hazardous exposure level. For contaminants having poor warning properties, the standard as proposed would have required employers to use an ESLI or develop a cartridge/canister change schedule that would ensure replacement of the sorbent element before 80 percent of its useful service life had expired.

Commenters expressed significant dissatisfaction with the proposed provisions, and some asked OSHA to reevaluate them in major respects (Exs. 54–414, 54–249, 54–374). Many rulemaking participants urged OSHA to rely much more heavily on end-of-service-life indicators (ESLIs) or appropriate cartridge or canister change schedules for air-purifying respirators, and some suggested that OSHA require NIOSH-certified ESLIs on these respirators (Exs. 54–387, 54–443). Other commenters opposed limiting the use of air-purifying respirators equipped with ESLIs or reliable change out schedules to situations where the odor/irritation threshold was less than three times the PEL. However, the Occidental Chemical Corporation (Ex. 54–346) stated that adopting this restriction would prohibit the use of air-purifying respirators for benzene exposures in excess of 3 ppm unnecessarily, and ''counter 10 years of effective employee protection that industry has provided.''

Many other participants criticized the proposal's reliance on sensory thresholds such as odor and irritation to indicate when a respirator's filtering capacity is exhausted, stating that there is too much variation between individuals, that there is no good screening mechanism to identify persons with sensory receptor problems, and that the proposal would have allowed employees to be overexposed to hazardous air contaminants (Exs. 54–151, 54–153, 54–165, 54–202, 54–206, 54–214, 54–414, 54–280, 54–386, 54–410, 54–427). Still other commenters suggested that the kind of respirator required should depend on the severity of the harm resulting from overexposure, with exposure to more serious hazards requiring supplied-air respirators (Exs. 54–202, 54–212, 54–347). Finally, some commenters interpreted the proposed provision as prohibiting the use of air-purifying respirators against particulates ''without adequate warning properties'' (Ex. 54–309). This, according to the Associated Builders and Contractors (Ex. 54–309), would require, for example, a ''pipefitter who is torch cutting metal with a galvanized coating to use an air-supplied respirator or SCBA—even when working outdoors * * * [and] could add one more item to the array of electrical power cords, pneumatic lines, and fall-protection devices already attached to or trailing many construction workers.''

ORC testified (Tr. 2164–65) that in general, the experience of most of its member companies is that most toxic substances do not have appropriate sensory warning properties. Indeed, in the preamble to its proposed Glycol Ethers standard, OSHA noted that reported values for the odor threshold of any substance vary widely, both because of differences between individuals' ability to perceive a particular odor and because of the methodology employed in conducting the odor threshold determination (58 FR 15526).

NIOSH's ''Guide to Industrial Respiratory Protection—Appendix C'' reports that on average, 95% of a population will have a personal odor threshold that lies within the range from about one-sixteenth to sixteen times the reported mean odor threshold for a substance. As stated by Amoore and Hautala(1983):

> [t]he interpretation of these data * * * will depend markedly on the individual circumstances. The threshold data * * * are based on averages for samples of the population, presumably in good health. Individuals can differ quite markedly from the population average in their smell sensitivity, due to any of a variety of innate,

chronic, or acute physiological conditions * * * Continuing exposure to an odor usually results in a gradual diminution or even disappearance of the smell sensation. This phenomenon is known as olfactory adaption or smell fatigue. If the adaption has not been too severe or too prolonged, sensitivity can often be restored by stepping aside for a few moments to an uncontaminated atmosphere, if available. Unfortunately, workers chronically exposed to a strong odor can develop a desensitization which persists up to two weeks or more after their departure from the contaminated atmosphere * * * Hydrogen sulfide and perhaps other dangerous gases can very quickly lose their characteristic odor at high concentrations * * * Certain commercial diffusible odor masking or suppressing agents may reduce the perceptibility of odors, without removing the chemical source.

Other commenters agreed that odor threshold levels are so variable that it is ''virtually impossible'' to set general rules for uniform application (Moldex-Metric, Ex. 54–153; See also Phillips Petroleum, Ex. 54–165 and Ex. 54–151). OSHA notes that NIOSH, in its 1987 Respirator Decision Logic (Ex. 9 at pg. 3) stated that ''[w]hen warning properties must be relied on as part of a respiratory protection program, the employer should accurately, validly, and reliably screen each prospective wearer for the ability to detect the warning properties of the hazardous substance(s) at exposure levels that are less than the exposure limits for the substance(s).''

In light of this evidence, OSHA has reconsidered the conditions under which air-purifying respirators may be used. The final standard requires the use of ESLIs where they are available and appropriate for the employer's workplace, whether or not warning properties exist for a contaminant. If there is no ESLI available, the employer is required to develop a cartridge/canister change schedule based on available information and data that describe the service life of the sorbent elements against the contaminant present in the employer's workplace and that will ensure that sorbent elements are replaced before they are exhausted. Reliance on odor thresholds and other warning properties is no longer explicitly permitted in the final rule as the sole basis for determining that an air-purifying respirator will afford adequate protection against exposure to gas and vapor contaminants.

To date, only five contaminant-specific ESLIs have been granted the NIOSH approval necessary to allow them to be used. To the extent that NIOSH certified end-of-service life indicators are available, OSHA finds that there are considerable benefits to their use. As a representative of the Mine Safety Appliances Company (MSA) testified (Tr. 821), ''ESLIs * * * simplify administration of the respirator program. The idea of trying to administer control on the change out schedule for these cartridges leads to human error or could lead to human error. Where the end-of-service-life indicator is a more active indicator for the actual respirator user that his cartridge needs replacement, it takes the guesswork out of the respirator program and change out schedule.''

NIOSH has established rigorous testing criteria for end-of-service life indicators. An applicant must supply NIOSH with data ''demonstrating that the ESLI is a reliable indicator of sorbent depletion (equal to or less than 90% of service life). These shall include a flow-temperature study at low and high temperatures, humidities, and contaminant concentrations which are representative of actual workplace conditions where a given respirator will be used * * *. Additional data concerning desorption of impregnating agents used in the indicator, on the effects of industrial interferences commonly found, on reaction products, and which predict the storage life of the indicator'' are also required (NIOSH 1987, Ex. 9 at 45–46). Other criteria cover the durability of an ESLI, and whether it interferes with respirator performance or otherwise constitutes a health or safety hazard to the wearer.

OSHA finds that these rigorous testing requirements will ensure that employers who can rely on ESLIs can be confident that their employees are adequately protected while using air-purifying respirators against gas and vapor contaminants, and is therefore requiring their use in the final rule. One commenter pointed out that the use of cartridges with moisture-dependent end-of-service life indicators will allow dangerously high exposures in dry atmospheres (Ex. 54–455). However, the final rule requires the use of cartridges and canisters equipped with an ESLI only if its use is appropriate for the conditions of the employer's workplace. Thus, employers would not be required to rely on an ESLI if the employer could demonstrate that its use presents a hazard to employees.

There was much agreement in the record that it would not be possible or feasible to require replacement of cartridges and canisters before 80 percent of the useful service life of the sorbent element had expired, primarily due to the lack of data available to employers to make this determination (Exs. 54–6, 54–48, 54–165, 54–178, 54–181, 54–226, 54–231, 54–289, 54–374). To implement this requirement as it was proposed, the employer would need quantitative information that describes how long a cartridge or canister would last when challenged with a specific concentration of a gas or vapor. Such studies are called ''breakthrough studies'' and require the use of elaborate instrumentation and rigid test protocols. Several published breakthrough studies of a few dozen commonly used industrial chemicals are available in the literature (See, for example, Exs. 21–5, 21–7, 21–8, 21–10, 38–13, 38–14, 38–15). OSHA recently used breakthrough data to develop a general cartridge and canister change schedule for air-purifying respirators used against 1,3-butadiene (61 FR 56817). Under Section 5 of the Toxic Substances Control Act (TSCA), EPA's Office of Pollution Prevention and Toxics (OPPT) requires manufacturers and importers of new chemicals to conduct breakthrough studies and develop cartridge/canister change schedules based on this service life testing.

As described above, however, comments to the record indicate that breakthrough test data are not likely to be available for many hazardous gases or vapors encountered in American workplaces. For example, one commenter agreed that, although there is a need to protect employees against contaminant breakthrough, it disagreed with relying on employer-devised schedules because there has not been enough breakthrough testing (Laidlaw Environmental Services, Ex. 54–178). The American Electric Power Service Corporation asked OSHA to provide needed guidance on how to assess the useful life of gas and vapor cartridges under widely varying conditions (Ex. 54–181).

The record shows clearly that respirator manufacturers, chemical manufacturers, and even NIOSH must provide more information about how long respirator cartridges and canisters can be expected to provide protection for employees, as well as additional tools to assess whether the cartridges are still functioning. NIOSH's certification process does not require respirator manufacturers to provide information on the maximum or expected life span for gas and vapor cartridges. Nor do chemical manufacturers written specifications routinely include this information. The certification process tests only for minimum service life, which for most cartridges is 25 to 50 minutes, and for most canisters is 12 minutes (42 CFR part 84, Tables 6, 11). Also, as stated by Cohen and Garrison of the University of Michigan (Ex. 64–

207, at 486), ''(c)urrent certification by NIOSH involves testing respirator cartridges containing activated carbon against carbon tetrachloride in the presence of water vapor. Testing cartridges with carbon tetrachloride cannot predict how other organic vapors will be adsorbed.''

Alternatives to OSHA's proposal that were suggested by rulemaking participants included adopting the ANSI requirement to develop and implement a cartridge change schedule based on cartridge service data (which would require the use of breakthrough test data) and information on expected exposure and respirator use patterns (Ex. 54–273), or following manufacturers' recommendations for cartridge and canister use (Ex. 54–6). Therefore, in the final rule, OSHA is not retaining the proposed requirement for employers to ensure that chemical cartridges and canisters be replaced before 80 percent of their useful life. Instead, OSHA is requiring that employers develop cartridge/canister change schedules based on available data or information that can be relied upon to ensure that cartridges and canisters are changed before the end of their useful service life. Such information may include either information based on breakthrough test data or reliable use recommendations from the employer's respirator and/or chemical suppliers.

Unlike the proposal, the requirement in the final rule would not require the employer to search for and analyze breakthrough test data, but instead permits the employer to obtain information from other sources who have the expertise and knowledge to be able to assist the employer to develop change schedules. OSHA has revised the final rule from the proposal in this manner to recognize that there may be instances in which specific breakthrough test data are not available for a particular contaminant, but manufacturers and suppliers may nevertheless still be able to provide guidance to an employer to develop an adequate change schedule. If the employer is unable to obtain such data, information, or recommendations to support the use of air-purifying respirators against the gases or vapors encountered in the employer's workplace, the final rule requires the employer to rely on atmosphere-supplied respirators because the employer can have no assurance that air-purifying respirators will provide adequate protection.

Ideally, change schedules should be based on tests of cartridge/canister breakthrough that were conducted under worst-case conditions of contaminant concentration, humidity, temperature and air flow rate through the filter element. One such protocol is described in the EPA Interim Recommendations for Determining Organic Vapor Cartridge Service Life for NIOSH Approved Respirators (dated May 1, 1991), as revised in May 1994. This protocol requires breakthrough testing at three different concentrations at 80 and 20 percent relative humidity. Additional testing is required if it is determined that the substance may be used in workplaces where there are elevated temperatures, or where breakthrough is evident at lower humidity. The protocol also requires manufacturers to develop change schedules that incorporate a safety factor of 60 percent of the measured service life.

OSHA emphasizes that a conservative approach is recommended when evaluating service life testing data. Temperature, humidity, air flow through the filter, the work rate, and the presence of other potential interfering chemicals in the workplace all can have a serious effect on the service life of an air-purifying cartridge or canister. High temperature and humidity directly impact the performance of the activated carbon in air-purifying filters. OSHA believes that, in establishing a schedule for filter replacement, it is important to base the schedule on worst-case conditions found in the workplace, since this will provide the greatest margin for safety in using air-purifying respirators with gases and vapors. Thus, to the extent that change schedules are based on test data that were not obtained under similar worst-case conditions, OSHA recommends that employers provide an additional margin of safety to ensure that breakthrough is not likely to occur during respirator use. OSHA encourages respirator and chemical manufacturers to perform their own tests to provide appropriate breakthrough test data to employers, particularly to small companies with limited resources, for those situations where the data are not already publicly available.

If breakthrough data are not available, the employer may seek other information on which to base a reliable cartridge/canister change schedule. OSHA believes that the most readily available alternative is for employers to rely on recommendations of their respirator and/or chemical suppliers. To be reliable, such recommendations should consider workplace-specific factors that are likely to affect cartridge/canister service life, such as concentrations of contaminants in the workplace air, patterns of respirator use (i.e., whether use is intermittent or continuous throughout the shift), and environmental factors including temperature and humidity. Such recommendations must be viewed by the employer in light of the employer's own past experience with respirator use. For example, reports by employees that they can detect the odor of vapors while respirators are being used suggest that cartridges or canisters should be changed more frequently.

Another potential approach involves the use of mathematical models that have been developed to describe the physical and chemical interactions between the contaminant and sorbent material. Theoretical modeling has been conducted to determine the effect of contaminant concentration on breakthrough time and other similar relationships. It is generally agreed, however, that the relationships between contaminant concentrations, exposure durations, breathing rates, and breakthrough times are complex and heavily dependent upon assumptions concerning several factors, including environmental conditions (See references 1–8 in Ex. 64–331). As a result, predictive models are probably not likely to present an acceptable alternative for most employers, and their use would require that a considerable margin of safety be incorporated into any change schedule developed from such estimation techniques.

Research is also underway to develop a field method for evaluating the service lives of organic vapor cartridges using a small carbon-filled tube to sample air from the work environment. The principal investigator for this research stated in 1991 that ''(a) field evaluation of the method is currently underway. It is expected to be the final step in evaluating and validating the method for predicting the service lives of organic vapor respirator cartridges in workplace environments' (Ex. 64–208 at 42). Although OSHA cannot at this time evaluate the utility of this method because results of the field testing of this device have not been reported, the development of such tools to assist employers to better estimate cartridge/canister service times is encouraged, and their use would be permitted under the standard providing that the reliability of such a method had been appropriately demonstrated.

Representatives of CMA testified in favor of requiring the employer to provide some written documentation for determining service life or a change out schedule (Tr. 1736–1737). OSHA agrees that it is important for the employer to

document the basis for establishing the change schedule and has included in paragraph (d)(3)(iii)(B)(*2*) a requirement for the employer to do so as part of his or her written respiratory protection program. The written respirator program is the proper place for employers to document change schedules, since the written program is the place where employers give specific directions on workplace-related operations and procedures for their employees to follow. The written program also documents the exposure measurements or reasonable estimates that were made, which form the basis of the calculations used to make the filter change schedules. Developing a filter change schedule involves a number of decisions. The employer must evaluate the hazardous exposure level, the performance capacity of the filters being used, and the duration of employee use of the respirator, which impact on the service life calculations. OSHA believes that including the basis for the change schedule in the written program will cause employers to better evaluate the quality and reliability of the underlying information, and will prompt the employer to obtain additional information, ask additional questions of their suppliers, or seek competent professional help to develop a change schedule that will ensure adequate performance of cartridges and canisters used in the employer's workplace.

OSHA proposed in paragraph (d)(3)(ii) that, as part of the required selection evaluation, the employer evaluate the physical properties of the relevant contaminant and, in the preamble, listed ''the particle size for dusts'' as a factor affecting respirator selection (59 FR 58900). ANSI recommended in its 1992 standard particle size/filter selection criteria as follows: if the contaminant is an aerosol, with an unknown particle size or a size less than 2 µm, use a high efficiency filter; if the contaminant is a fume, use a filter approved for fumes or a high efficiency filter; and if the contaminant is an aerosol, with a particle size greater than 2 µm, use any filter type (ANSI Z88.2–1992, clause 7.2.2.2.j, k, and l).

NIOSH agreed with ANSI's recommendations insofar as particulate filtering respirators certified under former 30 CFR 11 are concerned. However, NIOSH expressed particular concern about very small particles: ''Laboratory research beginning in the early 1970s, and continuing into the 1990s, demonstrated that some, but not all, members of the Dust Mist (DM) and Dust Fume Mist (DFM) filter classes allow significant penetration of submicron-sized particles. Additionally submicron particulates present special medical concerns because they can diffuse throughout the respiratory system * * *'' In NIOSH's new 42 CFR part 84, classes of particulate filters now certified as filter series N, R, and P may be used against any size particulate in the workplace (Ex. 54–437).

Based on this evidence, OSHA has determined that where employees are exposed to submicron particles of a respiratory hazard, OSHA will enforce paragraph (d)(3)(iv) as limiting the use of DM and DFM filters certified under former 30 CFR 11 to employers who can demonstrate that exposure in their workplace is limited to particulates that have a mass median aerodynamic diameter of 2 µm or larger. OSHA notes that employers have alternative choices to using HEPA filters where the sizes of particles are unknown or are less than 2 µm. The new filter media certified by NIOSH under new 42 CFR part 84 as series N, R and P, may be used for any size particulate; however, where another OSHA standard requires the use of HEPA-filtered respirators, the employer may only use HEPA filters defined under 30 CFR 11 or N100, R100, or P100 filters defined under 42 CFR part 84.

Paragraph (e)—Medical Evaluation

Medical evaluation to determine whether an employee is able to use a given respirator is an important element of an effective respiratory protection program and is necessary to prevent injuries, illnesses, and even, in rare cases, death from the physiological burden imposed by respirator use. The previous standard stated, at 29 CFR 1910.134(b)(10), that employees should not be assigned to tasks requiring the use of respirators unless it has been determined that they are physically able to perform the work while using the respiratory equipment. That standard also provided that ''the local physician shall determine what health and physical conditions are pertinent,'' but listed no specific medical or workplace conditions to consider when making such a determination. The previous standard also stated that regular reviews of the medical status of respirator users should be undertaken, and suggested that a once yearly evaluation would be appropriate. Employers are thus aware of the need for medical evaluations of respirator users and have been conducting such evaluations as part of their respiratory protection programs for years.

OSHA believes that, to ensure employee protection, medical evaluations for respirator use must be conducted before initial respirator use, and that such evaluations must consist of effective procedures and methods. Accordingly, the final standard's medical evaluation requirements for respirator use identify who is to be evaluated, and address the frequency and content of these evaluations. It authorizes licensed health care professionals, both physicians and nonphysicians, to evaluate employees for respirator use to the extent authorized by the scope of their state licensure, and to conduct follow-up medical evaluations based on specific indicators of need.

In the proposal, OSHA described three alternative approaches to medical evaluation for respirator users. The first proposed alternative in the regulatory text would have required employers annually to obtain a physician's written opinion for every employee using a respirator for more than five hours in any work week. The physician's opinion was to inform the employer whether or not a medical examination of the employee was necessary and, if so, was to specify the content of the medical examination.

The second proposed alternative required a mandatory medical history and examination, using questions and procedures similar to those contained in the ANSI standard on physical qualifications for respirator use, ANSI Z88.6–1984 (Ex. 38–4). This alternative would have applied only to employees using a respirator for more than five hours during any work week. Medical evaluation was to be performed annually and whenever an employee experienced breathing difficulty while being fitted for, or using, a respirator. The medical evaluation was to be conducted by a physician or a health care professional supervised by a physician, who, in arriving at a decision regarding the employee's medical ability for respirator use, was to consider a number of respirator and workplace conditions (e.g., type of respirator used, duration and frequency of respirator use, substances to which the employee is exposed, work effort and type of work, need for protective clothing, and special environmental conditions (e.g., heat, confined spaces)) that could affect the health and safety of respirator users. The resulting medical opinion, which was to be written by a physician, was to recommend any medical limitation on respirator use, and was to be provided to both the employer and employee. This proposed alternative contained an exemption for employees who had received a comparable medical history and examination within the previous year for the same respirator and conditions of respirator use. OSHA proposed a nonmandatory Appendix C

with this alternative that specified the elements of the medical evaluation.

The third proposed alternative would have required that a medical questionnaire be administered to every respirator user, regardless of the duration of respirator use. The medical questionnaires could be administered by health professionals or other personnel who had been trained in medical administration by a physician. If the answers to the medical questionnaire showed that a medical examination was needed, the employee had to be provided such an examination (see 59 FR 58911). Medical examinations were to be mandatory for employees who would be required to use SCBAs when assigned to emergency or rescue operations. Medical examinations were to be conducted by physicians or physician-supervised health care professionals. The medical opinion was to be written by a physician; consider the same respirator and workplace conditions specified for the second alternative; specify any medical limitations on respirator use; and be provided to both the employer and employee.

In addition to proposing three medical evaluation alternatives, the proposal requested comments on medical removal protection, including the need to provide alternative respirators or job assignments to employees found to be medically unable to use the required respirator.

Overview of the Final Rule's Provisions

The provisions of paragraph (e) in the final Respiratory Protection standard are based on an extensive review of the comments received on the proposal, especially comments regarding the three proposed medical evaluation alternatives. Final paragraph (e)(1) specifies that every employee must be medically evaluated prior to fit testing and initial use of a respirator. Paragraph (e)(2) states that employers must select a physician or other licensed health care professional (PLHCP) to conduct the medical evaluation, which must consist either of the administration of a medical questionnaire or an initial medical examination. Mandatory Appendix C contains the medical questionnaire to be administered to employees if the medical questionnaire approach is taken.

Paragraph (e)(3) requires the employer to provide a follow-up medical examination to an employee who answers ''yes'' to any question among questions 1 through 8 in Section 2, Part A of the medical questionnaire in Appendix C. The follow-up medical examination is to consist of any tests, consultations, or diagnostic procedures that the PLHCP deems necessary.

Paragraph (e)(4) specifies that the medical questionnaire and examinations shall be administered confidentially and at a time and place, during working hours, that is convenient to the employee, and that the employee understands the content of the questionnaire.

Paragraph (e)(5) requires the employer to provide the PLHCP with specific information needed to make an informed decision about whether the employee is able to use a respirator. The information includes descriptions of the respirator to be used and workplace conditions that may impose physiological burdens on respirator users, or that may interact with an existing medical condition to increase the risk that respirator use will adversely affect the employee's health.

Final paragraph (e)(6) requires the employer to obtain a written recommendation from the PLHCP on whether or not the employee is medically able to use a respirator. The recommendation must identify any limitations on the employee's use of the respirator, as well as the need for follow-up medical evaluations to assist the PLHCP in determining the effects of respirator use on the employee's health. The employee must receive a copy of the PLHCP's written recommendation. The last provision of paragraph (e)(6) requires that a powered air-purifying respirator (PAPR) be provided to an employee when information from the medical evaluation shows that the employee can use a PAPR but not a negative pressure respirator. If the PLHCP determines at a subsequent time that the employee is able to use a negative pressure respirator, the employer is no longer required to provide a PAPR to that employee.

Paragraph (e)(7) specifies circumstances that require the employer to provide additional medical evaluations to respirator users. Medical reevaluations must be provided under the following conditions: when the employee reports signs or symptoms that are relevant to the employee's ability to use a respirator; when a PLHCP, supervisor, or respirator program administrator informs the employer that an employee needs to be reevaluated; when information from the respirator program, including observations made during fit testing or program evaluation, indicates a need for employee reevaluation; or if a change in workplace conditions occurs that may result in a substantial increase in the physiological burden that respirator use places on the employee. The following paragraphs describe the comments received in connection with each medical evaluation requirement, and discuss OSHA's reasons for including each requirement in the final rule.

Introduction

OSHA is including an introduction to the regulatory text that provides a brief rationale for requiring employers to implement a medical evaluation program as part of their overall respiratory protection program. The introduction is provided for informational purposes, and does not impose regulatory obligations on employers.

The purpose of a medical evaluation program is to ensure that any employee required to use a respirator can tolerate the physiological burden associated with such use, including the burden imposed by the respirator itself (e.g., its weight and breathing resistance during both normal operation and under conditions of filter, canister, or cartridge overload); musculoskeletal stress (e.g., when the respirator to be worn is an SCBA); limitations on auditory, visual, and odor sensations; and isolation from the workplace environment (Exs. 113, 22–1, 64–427). Certain job and workplace conditions in which a respirator is used can also impose a physiological load on the user; factors to be considered include the duration and frequency of respirator use, the level of physical work effort, the use of protective clothing, and the presence of temperature extremes or high humidity. Job- and workplace-related stressors may interact with respirator characteristics to increase the physiological stress experienced by employees (Exs. 113, 64–363). For example, being required to wear protective clothing while performing work that imposes a heavy workload can be highly stressful.

Specific medical conditions can compromise an employee's ability to tolerate the physiological burdens imposed by respirator use, thereby placing the employee at increased risk of illness, injury, and even death (Exs. 64–363, 64–427). These medical conditions include cardiovascular and respiratory diseases (e.g., a history of high blood pressure, angina, heart attack, cardiac arrhythmias, stroke, asthma, chronic bronchitis, emphysema), reduced pulmonary function caused by other factors (e.g., smoking or prior exposure to respiratory hazards), neurological or musculoskeletal disorders (e.g., ringing in the ears, epilepsy, lower back pain), and impaired sensory function (e.g., a perforated ear drum, reduced olfactory

function). Psychological conditions, such as claustrophobia, can also impair the effective use of respirators by employees and may also cause, independent of physiological burdens, significant elevations in heart rate, blood pressure, and respiratory rate that can jeopardize the health of employees who are at high risk for cardiopulmonary disease (Ex. 22–14). One commenter (Ex. 54–429) emphasized the importance of evaluating claustrophobia and severe anxiety, noting that these conditions are often detected during respirator training.

The introduction states that the medical evaluation requirements in paragraph (e) of the final rule are minimal requirements that OSHA believes are necessary to protect the health of respirator users.

Paragraph (e)(1)—General

This paragraph requires that employees required to wear a respirator, or those voluntarily wearing a negative pressure air purifying respirator, be medically evaluated, and that a determination be made that they are able to use the respirators selected by the employer. A medical evaluation must be performed on every employee required to use a respirator, regardless of the duration and frequency of respirator use. In addition, as discussed above in connection with paragraph (c)(2), employers must provide a medical evaluation to any employee who elects to use a respirator that may place a physiological burden on the user, e.g., a negative pressure air-purifying respirator. By medically evaluating employees prior to respirator use, employers will avoid exposing employees to the physiological stresses associated with such use. Paragraph (e)(1) is similar to a provision in the American National Standards Institute (ANSI) consensus standard Z88.2–1992 (''American National Standard for Respiratory Protection) that states: ''any medical conditions [of an employee] that would preclude the use of respirators shall be determined.''

Commenters (Exs. 54–21, 54–307, 54–361, 54–419, 54–420, 54–421, 54–441) generally agreed that medical evaluation should precede initial respirator use, i.e., should take place before fit testing and first time use of the respirator in the workplace. For example, the International Brotherhood of Electrical Workers (Ex. 54–441) stated, ''The physical fitness of respirator users must be known prior to them donning a respirator, not after they become injured.'' Three other commenters (Exs. 54–419, 54–420, 54–421) agreed, without elaboration, that medical evaluations should be performed before respirator use. One commenter (Ex. 54–21) recommended that employees receive medical evaluations after fit testing but before actual use so that difficulties with respirator use during fit testing could be reported to the PLHCP, and two other commenters (Exs. 54–307, 54–361) also suggested that the medical evaluation be conducted prior to fit testing.

OSHA believes that the initial medical evaluation must be conducted prior to fit testing to identify those employees who have medical conditions that contraindicate even the limited amount of respirator use associated with fit testing. If medical problems are observed during fit testing, the employee must be medically reevaluated (see final paragraph (e)(7)).

Final paragraph (e)(1) requires the medical evaluation of employees who use respirators, regardless of duration of use. This final requirement differs from proposed alternatives 1 and 2, which would have exempted from medical evaluation those employees who used a respirator for five or fewer hours during any work week. The overwhelming majority of commenters stated that the exemption should be eliminated entirely or be limited only to those employees who are exposed to minimal physiological stresses or workplace hazards. These comments can be grouped, and are summarized, as follows:

(1) If the five-hours-per-week threshold were used, employers would avoid the proposed medical evaluation requirement by rotating employees who use respirators into jobs not requiring respirators just short of the five-hour limit (Exs. 54–5, 54–165, 54–178, 54–419);

(2) Employees who use respirators frequently for periods of less than five hours per work week, or who use respirators for more than five hours per work week but do so infrequently, are still at risk of the adverse health effects potentially associated with respirator use and, therefore, they should also be medically evaluated (Exs. 54–163, 54–178, 54–308, 54–345);

(3) The five-hour exemption should not apply to respirator use that is known to be physiologically burdensome (e.g., use of SCBAs by emergency responders) or to use under the job or working conditions (including hazardous exposures) that impose a significant physiological burden on employees (Exs. 54–5, 54–68, 54–92, 54–107, 54–137, 54–153, 54–158, 54–159, 54–187, 54–194, 54–195, 54–206, 54–208, 54–213, 54–224, 54–247, 54–264, 54–265, 54-275, 54–283, 54–290, 54–327, 54–342, 54–348, 54–363, 54–395, 54–415, 54–427, 54–429, 54–453);

(4) The five-hour exemption would be too difficult for OSHA to enforce or could not be administered effectively and efficiently by employers (Exs. 54–70, 54–136, 54–167, 54–196, 54-244, 54–250, 54–267, 54–327, 54–348, 54–443);

(5) The health of employees with preexisting medical problems would be endangered because these problems may go undetected until the five-hour limit is reached (and, in some cases, may never be detected if employees ''self-select'' into jobs with little respirator use because of their medical problems) (Exs. 54–92, 54–159, 54–247, 54–415, 54–441, 54–455); and

(6) The five-hour exemption is not appropriate because every employee who uses a respirator should have a medical evaluation (Exs. 54–6, 54–46, 54–79, 54–196, 54–202, 54–208, 54–214, 54–218, 54–233, 54–272, 54–275, 54–287, 54–289, 54–295, 54–357, 54–394, 54–420, 54–424, 54–430, 54–434, 54–453), or the exemption is arbitrary, has no scientific basis, or would increase an employer's risk of liability (Exs. 54–188, 54–434).

Several commenters recommended that medical evaluation not be required for SCBA users (Exs. 54–68, 54–320, 54–331, 54–353); that medical evaluations for emergency responders be contingent on respirator use exceeding five hours per year (Ex. 54–429); or that emergency responders be exempted from medical evaluation requirements that are unique to employees who use airline respirators or SCBAs (Ex. 54–420).

Some commenters recommended adopting the five hours per week exemption (Exs. 54–14, 54–80, 54–91, 54–182, 54–220, 54–223, 54–224, 54–252, 54–283, 54–319) to achieve cost savings and improve the efficiency of the respiratory protection program. Two commenters (Exs. 54–177, 54–402) stated that the five-hour limit represented the point at which the effects of job-related physical stress should be medically evaluated. Although generally endorsing the provision, several commenters (Exs. 54–168, 54–206, 54–209, 54–295, 54–357, 54–366) found the phrase ''during any work week'' to be vague, confusing, or in need of being defined.

Several commenters wanted the five hours per week limit revised upwards. One commenter (Ex. 54–300) recommended that the limit be raised to 10 hours per week, while another commenter (Ex. 54–249) endorsed a limit of 30 days per year. A third commenter (Ex. 54–116) stated that the limit could be increased, without

danger, to 10 hours per week for firefighters who use SCBAs, but presented no data to support this position, while three other commenters (Exs. 54–209, 54–254, 54–454) stated that a 10 or 15-hour per week limit could be tolerated without stress by most employees who use respirators. One commenter (Ex. 54–435) believed that the exemption should be broadened to cover seasonal employees because medical evaluations are too difficult to administer to these employees. Another commenter (Ex. 54–263) opposed any requirement for the medical evaluation of employees who use respirators.

One commenter recommended that medical evaluations not be required for employees who use disposable half-mask or dust mask respirators, regardless of workplace exposure conditions (Ex. 54–329). A number of commenters suggested eliminating medical evaluations if employers choose to provide respirators to their employees (i.e., if they are not required by OSHA to provide such respirators) (Exs. 54–69, 54–91, 54–265, 54–287, 54–295, 54–320, 54–327, 54–339, 54–346, 54–421); two of these commenters (Exs. 54–69, 54–339) expressed the concern that employers may stop offering respirators to their employees if medical evaluation is required in these cases.

The final standard, as noted above, provides an exception from the requirement that employees who use dust masks on a voluntary-use basis, as defined in paragraph (c), must be medically evaluated. OSHA based the decision to require medical evaluation for all employees required to use respirators, and for those employees voluntarily using negative pressure respirators, on a number of scientific studies, discussed below, which demonstrated that adverse health effects can result, in some cases, even from short duration use of respirators. Several experimental studies in the record show that even healthy individuals using what is generally believed to be a ''low risk'' respirator for short periods can experience adverse physiological and psychomotor effects. In one experiment (Ex. 64–388), 12 individuals using low resistance, disposable half-mask respirators under heavy workloads (using a treadmill apparatus) for only five minutes experienced statistically significant elevations in heart and respiratory rates, systolic and diastolic blood pressure, and body temperatures compared with these measures in the same individuals under control (i.e., no respirator use) conditions. Some of these effects were observed while the study participants were working at light and moderate workloads. For two of these individuals, the study's author classified blood pressure changes at heavy workload levels as ''clinically important.'' These results suggest that in an individual with cardiac insufficiency, such physiological stress could cause fatal arrhythmia.

In another study (Ex. 64–444), 15 individuals used a full facepiece respirator while performing light, moderate, and heavy workloads on a bicycle ergometer for 15 minutes. Immediately following the 15 minute exercise period, the ability of the individuals to maintain their equilibrium (i.e., postural stability) was assessed using a special platform designed for this purpose. Under every workload condition, respirator use resulted in significantly increased heart rates and impaired equilibrium compared to conditions when the individuals did not use respirators.

A third study (Ex. 64–490) involved 12 individuals, each of whom exercised for 30 minutes on a bicycle ergometer at a light-to-moderate workload while using one of three types of respirators, i.e., disposable half-mask, negative pressure half-mask, and full facepiece airline respirators. After taking a 10 minute rest, the study participants repeated the procedure until each respirator type had been tested. Compared to the control condition in which the subjects exercised without respirators, the individuals were found to consume more oxygen while exercising with the negative pressure half-mask and full facepiece airline respirators, and to have higher systolic and diastolic blood pressures while using the full facepiece airline respirator. Under the test conditions of this study, therefore, negative pressure half-mask and full facepiece airline respirators imposed significant physiological stress on the respirator users.

Louhevaara (Ex. 164, Attachment D), after reviewing the available research literature on respirator physiology, concluded that the major physiological effects of negative pressure respirators and supplied-air respirators, as well as SCBAs, are ''alterations in breathing patterns, hypoventilation, retention of carbon dioxide, and [an] increase in the work of breathing,'' and that these effects are worse under conditions of increased filter resistance, poor respirator maintenance, and heavy physical work. Sulotto et al. (Ex. 164, Attachment D) found that negative pressure respirators resulted in higher breathing resistances as physical workload on a bicycle ergometer increased, leading to substantially reduced breathing frequency, ventilation rate, oxygen uptake, and carbon dioxide production.

One study (Ex. 164, Attachment D, Beckett) that reviewed the scientific literature on the medical effects of respirator-imposed breathing resistance among healthy young men noted that ''[t]hese and other studies indicate no clinically significant impairment of normal respiratory function at submaximal workloads with the loads imposed by currently approved, properly maintained, negative pressure respiratory protective devices.'' This reviewer stated further, however, that ''[r]elatively less is known about the use of respirators by those with abnormal physiology (for example, obstructive or restrictive pulmonary diseases) and about the use of respirators whose resistance characteristics are altered by excessively long use, such that inspiratory resistance is increased by the deposition of matter within the filter or absorptive elements of the canister.''

The Agency finds that these studies demonstrate the potential for adverse health effects resulting from respirator use, even for healthy employees using respirators designed for low breathing resistance and used for short durations. The Agency believes, therefore, that respirator use would impose a substantial risk of material impairment to the health of employees who have preexisting respiratory and cardiovascular impairments. As the earlier discussion of final paragraph (e)(1) indicates, the record contains overwhelming support for requiring medical evaluation of respirator users; many employers who provided comments to the record have established medical evaluation programs for all employees who use respirators (see, e.g., comments by Organization Resources Counselors, Inc., Ex. 54–424). Consequently, OSHA finds, consistent with the results of these studies and the entire record, that the use of any respirator requires a prior medical evaluation to determine fitness.

Other considerations that have caused OSHA to make this decision are the potential impairment of health that may occur among employees with preexisting medical problems if these problems are not detected before respirator use; the need to identify medical problems that can arise even from short term use of respirators of the types known to impose severe physical stress on employees (e.g., SCBAs); and the administrative difficulties and inefficiencies that employers would experience if OSHA adopted a provision that required medical evaluations only of some respirator users, i.e., those using certain types of respirators or those

using them for a specified number of hours per week.

OSHA specifically disagrees with those commenters who stated that no medical evaluations are needed for employees who only occasionally use SCBAs. SCBAs create the highest cardiovascular stress of any type of respirator because of their weight, and they are often used in high physical stress situations, such as fires and other emergencies. This combination of stressors makes medical evaluation necessary to avoid myocardial infarction in susceptible individuals; at least 40 million people in the United States have some form of heart disease (Levy, in 54 FR 2541).

One commenter (Ex. 54–284) recommended that the required medical evaluations should be discontinued after an employee stops using respirators. OSHA agrees with this recommendation, and has revised final paragraph (e)(1) accordingly.

Paragraph (e)(2)—Medical Evaluation Procedures

Paragraph (e)(2)(i). This final paragraph requires the employer to identify a physician or other licensed health care professional (PLHCP) to perform medical evaluations using a medical questionnaire or medical examination. Two major issues were raised in the rulemaking record: (1) What must be done to evaluate employees, and (2) who must perform the evaluation. Proposed paragraphs (e)(1) and (e)(3) would have required physician involvement in the medical evaluation process, with nonphysician health care professionals permitted to review the employee's medical status only under the supervision of a licensed physician. The final rule allows the evaluation to be performed either by a physician or other licensed health care professional (e.g., nurse practitioners, physician assistants, occupational health nurses), provided that their license permits them to perform such evaluations.

Many commenters, representing labor, management, occupational nurses, nurse practitioners, and physician assistants, recommended that OSHA permit the use of nonphysician health care professionals (usually nurse practitioners, physician assistants, occupational health nurses, or registered nurses) to take medical histories, conduct physical examinations (including pulmonary function tests), and administer and review employee responses to medical questionnaires, provided that they do so under the supervision of a licensed physician (Exs.54–6, 54–7, 54–21, 54–134, 54–153, 54–157, 54–171, 54–176, 54–185, 54–187, 54–205, 54–239, 54–240, 54–244, 54–245, 54–251, 54–267, 54–273, 54–304, 54–357, 54–363, 54–381, 54–387, 54–389, 54–396, 54–424, 54–432, 54–443, 54–453). Some commenters stated that nonphysician health care professionals are competent to conduct medical assessments, while physician supervision or involvement would guarantee that quality control was maintained over the assessment process (Exs. 54–273, 54–363, 54–381, 54–443, 54–453). Two of these commenters (Exs. 54–278, 54–430) noted that any health care professional could review medical questionnaires without physician supervision, but that physicians should conduct or supervise any medical examinations conducted on the basis of answers to the medical questionnaires.

Many other commenters, representing labor, management, and physicians, preferred that only physicians be involved in medical evaluation programs (Exs. 54–14, 54–46, 54–70, 54–101, 54–107, 54–150, 54–151, 54–165, 54–175, 54–180, 54–186, 54–189, 54–199, 54–217, 54–219, 54–220, 54–249, 54–271, 54–295, 54–313, 54–352, 54–455). This preference was usually based on the prior or current practices of these commenters. For example, the American College of Occupational and Environmental Medicine (ACOEM) (Ex. 54–453) stated that the health status of employees in a respiratory protection program should be reviewed by physicians with specific training and experience in occupational medicine because these medical specialists have knowledge of the physical demands of respirator use needed to make valid decisions regarding an employee's medical ability for the program. A similar recommendation was made by the Service Employees International Union (Ex. 54–455).

Some commenters recommended that the employee's medical ability to use a respirator be evaluated solely by nonphysician health care professionals (Exs. 54–16, 54–19, 54–25, 54–32, 54–79, 54–159, 54–184, 54–213, 54–222, 54–226, 54–253, 54–265, 54–272, 54–278, 54–397). Most of these commenters cited their favorable experiences with nonphysician health care professionals, and pointed to the cost savings of using nonphysicians (Exs. 54–19, 54–79, 54–184, 54–226, 54–253). Several of these commenters provided additional justifications. For example, one commenter (Ex. 54–184) stated that ''physician assistants, by education, training, and state regulation, are well qualified and legally able to perform all aspects of a medical evaluation,'' and argued that the scope of practice with regard to medical evaluations should remain the prerogative of state licensing boards.

Another commenter (Ex. 54–213) noted that ''many physicians are not familiar with occupational health risks as they relate to respiratory exposures, types of respiratory protection available, and work requirements.'' This commenter stated further that ''nurse[s] or other qualified health care professional[s], operating within their licensed scope of practice, [have] clinical expertise and knowledge of the work environment and can best evaluate the physical requirements placed on the user of respiratory protective equipment'' and that ''[u]se of qualified health care professionals other than physicians is cost-beneficial to employers, particularly [in] small business settings'' (Ex. 54–213).

The American Thoracic Society (Ex. 54–92), which recommended the use of medical questionnaires rather than medical examinations, stated that ''there is no demonstration that [physician-based] examinations actually predict who will develop difficulties with respirator use'' because ''[v]ery few physicians have in-depth knowledge of respiratory protection and workplace hazards sufficient to render a fully reasoned view.''

None of the commenters, including those who used nonphysician health care professionals to conduct medical evaluations as part of their respiratory protection programs, cited any data or experience showing that the type of PLHCP qualification and licensure, or the manner in which PLHCPs are involved in the medical evaluation process, had compromised the medical evaluation process or had resulted in faulty medical evaluations.

After reviewing the entire record, OSHA decided to allow any PLHCP to evaluate an employee's medical ability to use a respirator, providing that the PLHCP is authorized to do so by his or her state license, certification, or registration. Although OSHA agrees that physicians with training and experience in occupational medicine are highly qualified to conduct medical evaluations for respirator use, an insufficient number (slightly more than 2,000 nationally) of these specialists are available for this purpose (personal communication, American Board of Medical Specialties, to Vanessa Holland, M.D., 5/29/97). In addition, in circumstances where questions arise as to the employee's physical condition and capability, OSHA believes that the PLHCP can be relied on to consult with an appropriate specialist or physician.

After a review of the licensing provisions of the 50 states and Puerto Rico, OSHA concludes that state licensing laws often require some physician involvement in conducting the medical evaluations required by the final standard. For example, the majority of states require that nurse practitioners perform their medical functions under a formal written agreement with a physician. Only six states (i.e., Montana, New Mexico, North Dakota, Oregon, Vermont, and Washington) and Puerto Rico allow licensed nurse practitioners to function independently of physician supervision. Even these jurisdictions, however, require licensed nurse practitioners to refer patients to a physician for further evaluation and treatment when a medical problem beyond the nurse practitioner's level of expertise arises. OSHA believes that the states are best suited to judge the medical competencies of those PLHCPs who practice within their jurisdictions, and to regulate the scope of practice of these individuals.

To summarize, the final rule allows any PLHCP to administer the medical questionnaire or to conduct the medical examination if doing so is within the scope of the PLHCP's license. The basis for this decision includes the following:

(1) The record (Exs. 54–19, 54–79, 54–92, 54–184, 54–253) generally supports the position that properly qualified PLHCPs, regardless of the type of health care specialization, are competent to assess the medical ability of employees to use respirators using accepted medical questionnaires or medical examinations;

(2) Evidence in the record that employers who operate respiratory protection programs have successfully used PLHCPS, including nonphysicians, to conduct medical evaluations and to make medical ability recommendations, shows that nonphysicians have done so safely and efficaciously (Exs. 54–213, 54–240, 54–389);

(3) Providing employers with ready access, at reasonable cost, to the basic medical assessment skills required to perform at least the initial phases of employee medical evaluation for respirator use contributes to the efficient and effective allocation health care resources; and

(4) The lack of record support for a requirement allowing medical evaluations to be performed only by physicians. The record (Exs. 54–6, 54–7, 54–21, 54–134, 54–153, 54–157, 54–171, 54–176, 54–185, 54–187, 54–205, 54–239, 54–240, 54–244, 54–245, 54–251, 54–267, 54–273, 54–304, 54–357, 54–363, 54–381, 54–387, 54–389, 54–396, 54–424, 54–432, 54–443, 54–453) indicates that medical evaluations performed independently by nonphysician health care professionals, as defined by this section, are effective for at least the initial phases of an employer's medical evaluation program (i.e., evaluating the medical questionnaire or conducting an initial medical examination), and protect employee health as well as medical evaluations conducted only by physicians or with physician oversight. Employers are free, however, to select any PLHCP they wish to satisfy this requirement, provided that the PLHCP is qualified by license to do so. In some cases, the medical condition of the employee or the conditions of respirator use may warrant physician involvement, and OSHA is confident that LHCPs faced with such situations will seek such medical advice.

Paragraph (e)(2)(ii). Paragraph (e)(2)(i) requires employers to identify a PLHCP to perform the medical evaluations required by the final rule. It also specifies that employers may choose to use the medical questionnaire in Appendix C to conduct the initial medical evaluation or provide a medical examination that obtains the same information as the medical questionnaire. Employers are free to provide respirator users with a medical examination in lieu of the medical questionnaire if they choose to do so, but they are not required by the standard to administer a medical examination unless the employee gives a positive response to any question among questions 1 through 8 in Section 2, Part A of Appendix C (see paragraph (e)(3)).

The approach taken in the final rule thus resembles the third alternative proposed by OSHA in the NPRM: reliance on a medical questionnaire (with medical examination follow-up if positive responses are given to selected questions on the medical questionnaire). Those commenters (Exs. 54–3, 54–14, 54–46, 54–67, 54–107, 54–151, 54–168, 54–175, 54–180, 54–218, 54–220, 54–224, 54–226, 54–227, 54–240, 54–244, 54–264, 54–292, 54–294, 54–295, 54–324, 54–326, 54–327, 54–339, 54–346, 54–352, 54–366, 54–370, 54–210, 54–432, 54–434, 54–443, 54–445, 54–453) who preferred the other alternatives (i.e., medical history and medical examination for all respirator users, or medical examination and written opinion) supported their views with a variety of opinions.

A number of the commenters who recommended the medical history and examination alternative (Exs. 54–153, 54–165, 54–218, 54–226, 54–227, 54–263, 54–264, 54–294, 54–326, 54–327, 54–363, 54–443) favored this approach only in those cases when employees would be using SCBAs, while others (Exs. 54–16, 54–220) stated that medical questionnaires should be used only for employees who use dust masks, and that other respirator users should receive a medical history and examination regardless of the duration of respirator use. Another commenter (Ex. 54–101) recommended that medical questionnaires be administered to employees who use dust masks for fewer than five hours per week, while other employees should receive a medical history and examination. One commenter favored medical questionnaires only for respirator users who perform ''isolated operations,'' while recommending that respirator use in other employment settings require a medical history and/or examination (Ex. 54–46). Another commenter stated that employees using respirators under workplace exposure conditions exceeding an OSHA PEL should receive a medical history and examination, while respirator users exposed to other workplace atmospheres should only be required to complete a medical questionnaire (Ex. 54–339).

Those commenters (Exs. 54–7, 54–16, 54–21, 54–25, 54–32, 54–69, 54–91, 54–92, 54–101, 54–134, 54–142, 54–153, 54–154, 54–157, 54–158, 54–165, 54–170, 54–171, 54–172, 54–173, 54–176, 54–187, 54–190, 54–192, 54–154, 54–197, 54–205, 54–206, 54–208, 54–209, 54–213, 54–14, 54–219, 54–222, 54–223, 54–234, 54–239, 54–241, 54–242, 54–245, 54–251, 54–252, 54–253, 54–254, 54–262, 54–263, 54–265, 54–267, 54–269, 54–272, 54–273, 54–275, 54–278, 54–284, 54–286, 54–289, 54–296, 54–304, 54–309, 54–319, 54–320, 54–325, 54–330, 54–332, 54–334, 54–342, 54–350, 54–357, 54–361, 54–363, 54–381, 54–389, 54–396, 54–401, 54–421, 54–424, 54–426, 54–428, 54–429, 54–430, 54–441, 54–453, 54–455) recommending medical questionnaires (proposed alternative 3) objected to the medical examination and written opinion approaches because, in their view, medical examinations and opinions are difficult to obtain, have poor predictive value, and are expensive, especially for workplaces that have high employee turnover. Regarding costs, the American Iron and Steel Institute (Ex. 175) stated that the medical opinion required by alternative 1 would cost their industry $195 per employee, including $150 for the medical examination and opinion, and $45 in lost work time for the employee.

The record does not demonstrate that any of the three alternatives were

superior in detecting medical conditions that could potentially limit employee use of respirators. Testimony at the hearing by the United Steel Workers of America (USWA) (Tr. 1059 and following) in support of alternative 2 (medical history and examination) provided information on the ability of different medical assessment procedures to detect disqualifying medical conditions. This information showed that, among 126 employees, 16 were disqualified for respirator use because of various medical conditions. Medical histories identified six of the employees with these conditions, while a medical examination conducted by a physician identified the remaining 10 employees. The USWA attributed the reduced effectiveness of the medical histories in this instance to the lack of awareness among employees of the medical conditions that could potentially limit such use.

The United Steel Worker's testimony (Tr. 1059 and following) also described a study in which physician-administered medical examinations were found to be about 95 percent accurate and medical questionnaires were found to be 60 to 70 percent accurate in identifying specific medical problems. The final rule is designed to overcome this problem to some extent by requiring that employees be trained to recognize the medical signs and symptoms associated with the physiological burden imposed by respirator use; see paragraph (k)(1)(vi).

A number of commenters supported the medical questionnaire option on the grounds that this approach is more efficient and effective. The United States Air Force (Ex. 54–443G) stated, ''After working under the provisions of [proposed] alternative 2 for several years and comparing the Air Force's occupational health and cost savings by reducing unnecessary medical evaluations and freeing physician time under [proposed] alternative 3, the Air Force supports [proposed] alternative 3.'' Similarly, the CITGO Petroleum Corporation (Ex. 54–251) endorsed medical questionnaires as more cost-effective than medical examinations. CITGO administered medical examinations to a sample of 1634 employees in 1994 to detect respiratory disorders, a major medical concern for respiratory protection programs, and identified only one abnormal case that was confirmed after referral for follow-up medical examination.

An additional study involving validation of medical questionnaires was described by Organization Resources Counselors, Inc. (ORC) (Ex. 54–424). One of ORC's member companies, a large, diversified manufacturing organization, recently reviewed approximately 700 records of employee respirator medical examinations to determine the effectiveness of using a medical questionnaire as a screening tool. This company currently gives all respirator users a full medical examination in addition to having them fill out a medical questionnaire. The records review revealed that, out of 700 examinations, only 10 (less than 2%) required medical limitations on respirator use. These limitations were due to claustrophobia, asthma, and heavy smoking. All of these limitations would have been identified, in the company's view, by a medical questionnaire. The employees identified through the medical questionnaire could then have been given a complete medical examination. By using the medical questionnaire as a screening tool, this company believes it could have eliminated unnecessary examinations for 98% of its worker population.

A private physician and three management groups (Exs. 54–32, 54–424, 55–29, 155) submitted medical questionnaires to the record and expressed satisfaction with these medical questionnaires, in terms of both the medical conditions that were detected and the administrative efficiency of the process; these commenters, however, recommended that physicians be involved in reviewing the medical questionnaires. Several commenters (Exs. 54–70, 54–159, 54–215) endorsed the medical evaluation procedures specified in the American National Standard Institute's (ANSI) consensus standard Z88.6–1984, titled ''American National Standard for Respiratory Protection—Respirator Use—Physical Qualifications for Personnel.'' This ANSI standard recommends that a medical history questionnaire be administered to employees who are enrolled in respiratory protection programs, and that a physician review each employee's responses to the medical questionnaire to determine if additional medical examinations are required.

OSHA concludes that information in the record supports the use of medical questionnaires for detecting medical conditions that may disqualify employees from, or limit employee participation in, respiratory protection programs. OSHA believes that the ORC study (Ex. 54–424) provides support for the conclusion that medical questionnaires are an efficient and effective means of screening employees for subsequent medical examination. OSHA also believes that the training required by paragraph (k)(1) of the final rule, which requires that employees understand the limitations of respirator use and recognize the signs and symptoms of medical problems associated with respirator use, will increase employee awareness and overcome the problems that the USWA (Tr. 1059 and following) noted in its testimony. A number of commenters (Exs. 54–107, 54–151, 54–153, 54–165, 54–190, 54–218, 54–251, 54–253, 54–272, 54–339, 54–361, 54–401) stated that medical questionnaires had several advantages over the other alternatives, including simplicity and efficiency of use, completeness and accuracy of the medical information obtained, and adaptability (i.e., easily revised to accommodate new or different medical problems, different employee groups, and changing job, workplace, and respirator conditions). An additional advantage of medical questionnaires is lower cost, most notably in terms of development, administration, and analysis.

Employers are free to use medical examinations instead of medical questionnaires, but are not required by the standard to do so (see paragraph (e)(2) of the final standard). OSHA also recognizes that medical examinations are necessary in some cases, e.g., where the employee's responses to the medical questionnaire indicate the presence of a medical condition that could increase the risk of adverse health effects if a respirator is used. Examples of such cases are employees who report a history of smoking, pulmonary or cardiovascular symptoms or problems, eye irritation, nose, throat, or skin problems, vision or hearing problems (for employees who use full facepiece respirators), and musculoskeletal problems (for employees who use SCBAs). In addition, certain workplace conditions or job requirements, such as SCBA use, being an emergency responder or a member of a HAZMAT team, working in an IDLH atmosphere, wearing heavy protective clothing, or performing heavy physical work, may warrant a medical examination. In the future, however, OSHA may, on a case-by-case basis, require medical examinations to detect respirator-related conditions in its substance-specific standards, depending on the particular circumstances and physiological effects of the toxic substance being regulated.

The medical questionnaire in Appendix C of the final standard is based on the medical history questionnaire contained in ANSI Z88.6–1984, as well as medical questionnaires submitted to the record by commenters

(Exs. 54–32, 54–424, 55–29). The medical questionnaire is designed to identify general medical conditions that place employees who use respirators at risk of serious medical consequences, and includes questions addressing these conditions. These medical conditions include seizures, diabetes, respiratory disorders and chronic lung disease, and cardiovascular problems. As the discussion of the Introduction and paragraphs (e)(1) and (5) in this Summary and Explanation demonstrate, these conditions have been found to increase the risk of material impairment among employees who use respirators. A question asking about fear of tight or enclosed spaces was included in the medical questionnaire because claustrophobia and anxiety associated with such spaces were mentioned by a commenter as the most frequent medical problem detected during respirator training (Ex. 54–429); additionally, research submitted to the record (Ex. 164, Attachment D, Morgan) indicates that more than 10 per cent of ''normal'' young men experience dizziness, claustrophobia, or anxiety attacks while exercising during respirator use.

Questions 10 through 15 of the medical questionnaire in Appendix C must be answered only by employees who use a full facepiece respirator or SCBA. These questions ask about hearing and vision impairments, as well as back and other musculoskeletal problems. Employees who use full facepiece respirators, for example, must be asked about eye and hearing problems because the configuration of these respirators (e.g., helmets, hoods) can add to the limitations associated with existing visual and auditory impairments, resulting in an elevated risk of injury to employees with such impairments, as well as to other employees who may rely on the impaired employee to warn them of emergencies (Ex. 164, Attachment D, Beckett). The heavy weight and range-of-motion limitations of SCBAs may prevent employees who have existing problems in the lower back or upper or lower extremities from using these respirators.

A physician (Ex. 54–16) commented that an employee's medical history should be considered by the PLHCP in making a recommendation about the employee's ability to use respirators. This commenter specified a number of prior medical conditions, including those involving cardiovascular and respiratory health, psychological variables, neurological and sensory organ status, endocrine function, and the use of medications that would be useful to PLHCPs in arriving at a medical ability recommendation. OSHA believes that these variables, especially cardiovascular and respiratory fitness, are important determinants of respiratory fitness, and, therefore, included items specific to these medical conditions in the medical questionnaire. OSHA concludes that the employee's answers to the medical questionnaire will provide an adequate medical history for the PLHCP.

Two commenters (Exs. 54–222, 54–251) requested that OSHA define medical evaluation procedures and provided sample definitions. OSHA believes that the regulatory text of the final rule, which has been clarified and simplified since the proposal, provides clear guidance and that these definitions are, therefore, not necessary. As used in the final rule, ''medical evaluation'' means the use of subjective (e.g., medical questionnaires) or objective methods (e.g., medical examinations), as well as other available medical, occupational, and respirator information, to make a determination or recommendation about an employee's medical ability to use respirators; ''medical examination'' means the use of objective methods (i.e., manipulative, physiological, biochemical, or psychological devices, techniques, or procedures) to directly assess the employee's physical and mental status for the purpose of making a recommendation regarding the employee's medical ability to use the respirator.

Paragraph (e)(3)—Follow-up Medical Examination

Paragraph (e)(3) addresses follow-up medical examinations and states that the employer must provide such examinations to any employee who gives a positive response to any question among questions 1 through 8 in Section 2, part A in Appendix C. The PLHCP is free to include any medical tests, consultations, or diagnostic procedures that he or she determines to be necessary to assist him or her in making a final determination of the employee's ability to use a respirator. OSHA expects that the number of cases where PLHCPs will have to provide follow-up examinations will be small, because it is generally possible to recommend against respirator use, or determine the limitations to place on an employee's use of respirators, on the basis of responses to the medical questionnaire. However, where difficult medical issues are involved, such as the need to make a differential diagnosis or to assess an employee's ability to handle the physical stress imposed by an extra-hazardous job, a medical examination and involvement of a physician may be needed. Many commenters (Exs. 54–92, 54–101, 54–134, 54–171, 54–223, 54–278, 54–304, 54–363, 54–389) endorsed this requirement. Two commenters (Exs. 54–151, 54–189) stated that medical examinations should not be limited to answers on the medical questionnaire that indicate a need for medical examinations. A few commenters (Exs. 54–153, 54–176, 54–218) recommended that a mandatory medical examination requirement based on the employee's responses to the medical questionnaire is wasteful and unnecessary.

OSHA agrees that PLHCPs should be permitted to obtain any medical information they believe would be useful in arriving at a final medical recommendation, and they should not be limited to investigating problems associated only with answers on the medical questionnaire. Information from medical examinations may also be needed to validate an answer that a PLHCP believes is incorrect. Also, as recommended by ORC (Ex. 54–424), a PLHCP should be free to investigate through medical examination any medical conditions related to respirator use that may not have been addressed by the medical questionnaire or may not have been obtained from other sources.

Paragraph (e)(4)—Administration of the Medical Questionnaire and Examinations

Paragraph (e)(4)(i). This paragraph sets out the procedures employers must follow when administering the medical questionnaire or examinations required by paragraph (e)(2). Paragraph (e)(4)(i) requires employers to administer the required medical questionnaire or examinations in a manner that protects the confidentiality of the employee being evaluated. In addition, the evaluation must be administered during normal work hours or at a time and place convenient to the employee, and in a manner that ensures that the employee understands the questions on the medical questionnaire. Although this requirement was not specifically proposed, it is consistent with OSHA policy and with Section 6(b)(7) of the Act. OSHA has included similar requirements in a number of substance-specific health standards (see, e.g., the Cadmium standard, 29 CFR 1910.1027, the Lead standard, 29 CFR 1910.1025, and the Benzene standard, 29 CFR 1910.1043). If an employee must travel off-site for medical evaluation, travel arrangements must be made, and costs incurred paid or reimbursed, by the employer.

The final standard differs from the proposal in that it does not specify who

must supervise the administration of the medical questionnaire. Alternative 3 in the proposal would have required that the medical questionnaires be administered by ''a health professional or a person trained in administering the questionnaire by a physician.'' (See 59 FR 58911.) Commenters (Exs. 54–25, 54–69, 54–153, 54–165, 54–190, 54–218, 54–251, 54–253, 54–272, 54–339, 54–361, 54–401) recommended that persons performing this function have various qualifications, e.g., be a trained designee of the employer, a safety or health professional, a physician, or a nonphysician health care professional operating under the supervision of a physician. Some commenters (Exs. 54–25, 54–101, 54–214, 54–389, 54–421) recommended that a PLHCP be present during administration of the medical questionnaire to ensure the accuracy and validity of the employee's answers. Others (Exs. 54–69, 54–361) stated that the medical questionnaire should be designed so as to be easily comprehended by the employee and simple to administer, thereby requiring only minimal involvement by an employer. OSHA agrees with those commenters (Exs. 54–69, 54–361) who urged that the medical questionnaire be easy to understand, and has developed the medical questionnaire in Appendix C accordingly. OSHA does not believe that oversight is necessary because the standard requires that the medical questionnaire be understandable to the employee and that the employee be given an opportunity to ask questions of the PLHCP administering the questionnaire.

Although the OSHA medical questionnaire is designed to be easily comprehended by employees, paragraph (e)(4)(i) of the final standard specifically requires that employers ensure that employees understand the medical questionnaire. For employees who are not able to complete the medical questionnaire because of reading difficulty, or who speak a foreign language, OSHA requires that the employer take action to ensure that the employee understands the questions on the medical questionnaire. Language and comprehension deficits could invalidate the answers of such employees and result in inaccurate determinations. Under these circumstances, the PLHCP may assist the employee in completing the medical questionnaire (perhaps with the aid of an employer-supplied interpreter). The employer also may have the medical questionnaire translated into the employee's language or administer a physical examination that meets the requirements of paragraph (e)(2) of the final standard. In fulfilling this requirement, OSHA is not requiring employers to hire professional interpreters. Instead, employers may use an English-speaking employee who can translate the medical questionnaire into the questionnaire taker's native language, or other nonprofessional translators who can perform the same function (for example, a friend or family member of the test taker).

Paragraph (e)(4)(ii). This paragraph requires the employer to permit the employee to discuss the medical questionnaire results with a PLHCP. Employees who are uncertain of the significance of the questions asked will thus be able to obtain clarification. One commenter, Dr. Ross H. Ronish, Site Medical Director for the Hanford Environmental Health Foundation (Ex. 54–151), agreed that the opportunity for discussion between the PLHCP and the employee would improve the usefulness of the medical questionnaire. The standard does not require the employer to follow a specific procedure in providing employees with the opportunity to discuss the medical questionnaire with a PLHCP. Employers must, however, at least inform employees that a PLHCP is available to discuss the medical questionnaire with them and notify the employees how to contact the PLHCP. For example, the employer could post the PLHCP's name and telephone number in a conspicuous location, or include this information on a separate sheet with the medical questionnaire.

Paragraph (e)(5)—Supplemental Information for the PLHCP

Paragraph (e)(5)(i). The first requirement in this paragraph requires employers to provide the PLHCP with specific information for use in making a recommendation regarding the employee's ability to use a respirator. OSHA had proposed a similar requirement, stating that ''[i]n advance of the medical examination the employer shall provide the examining professional with [supplemental] information * * *'' OSHA received four comments (Exs. 54–181, 54–234, 54–330, 54–445) on this proposed requirement. These commenters stated that only supplemental information requested by the PLHCP should be provided because PLHCPs can best determine what information they need to make medical-ability recommendations; additionally, limiting the requirement to information requested by the PLHCP would lower the associated paperwork burden. The Boeing Company (Ex. 54–445), for example, stated, ''The employer should not be required to provide additional information unless requested to do so by the examining physician.'' Another commenter (Ex. 54–434) stated that the proposed supplemental information might not be meaningful to every PLHCP.

OSHA believes that the supplemental information specified is important to the PLHCP in making a recommendation regarding the employee's medical ability to use the respirator. However, as indicated in paragraph (e)(5)(ii) of the final standard, this information need only be provided once to the PLHCP unless the information differs from what was provided to the PLHCP previously, or a new PLHCP is conducting the medical evaluation.

With few exceptions, the supplemental information that must be provided by the employer to the PLHCP is the same information listed in the proposed regulatory language for alternative 3 (59 FR 58911, paragraphs (e)(vi) (A) to (G)). Three commenters (Exs. 54–160, 54–191, 54–287) endorsed the entire list of supplemental information items in the proposal. Most of the commenters who took exception to the proposed list disagreed with the item requiring that information be provided to the PLHCP on the substances to which the employee will be exposed (i.e., paragraph (e)(vi)(B) of proposed alternative 3); two commenters (Exs. 54–352, 54–453), however, believed it was important to specify these substances so that the PLHCP would be aware of the hazards in the workplace. One commenter (Ex. 54–339) stated that information on substance exposure would be useful to the program administrator for fit testing, but was not needed by the PLHCP. Another commenter (Ex. 54–208) stated that information about these substances was unnecessary because OSHA intended to propose a separate rule for medical surveillance, and one commenter (Ex. 54–273) wanted this item to be deleted and replaced by an item informing the PLHCP about the employee's use of impervious clothing because such clothing, if worn, may impose serious heat stress on the employee.

The record also contains an article by Dr. William S. Beckett advising occupational health professionals on medical evaluations for respirator use (Ex. 164, Attachment D). The article addressed the need to provide these professionals with exposure information: ''An employer's inability to provide this basic information [regarding employee exposure levels] on which a respirator choice has been

made should throw the adequacy of the respiratory protection program into serious doubt.'' Dr. Beckett explained that such information was necessary because preexisting lung impairments make some employees ''more sensitive to the effects of some occupational agents and [these employees] may thus suffer further impairment at exposure concentrations that would not affect a normal worker.'' In explaining these effects, Dr. Beckett stated that employees who have become ''sensitized immunologically to a workplace substance may not be able to attain protection factors using usual respirator precautions even though the same respirator might be adequate for individuals not sensitized to the substance.'' Dr. Beckett noted that ''the worker sensitized to toluene di-isocyanate (TDI) * * * will experience alterations in pulmonary function at an air concentration of 0.001 ppm TDI while normal individuals will not experience symptoms at 20 times this concentration.''

In response to these comments, OSHA has modified the proposed requirement specifically requiring employers to inform PLHCPs of the substances to which employees may be exposed. Under paragraph (e)(5)(iii) of the final rule, employers must provide the PLHCP with a copy of the written respiratory protection program. As required by paragraph (c)(1)(i) of the final rule, the written program must specify the procedures for selecting respirators for use in the workplace; accordingly, these procedures must describe the workplace exposure conditions that require respirator use. OSHA believes these descriptions will provide the necessary information, while imposing little additional burden on employers.

These requirement are necessary, the Agency concludes, because employees can have medical conditions that predispose them to respond adversely to the workplace substances to which they are exposed, and the resulting effects can impair an employee's ability to use some types of respirators. Consequently, providing PLHCPs with information about the workplace substances to which employees are exposed will assist the PLHCPs in determining if these substances may interact with preexisting medical conditions to impair an employee's ability to use the respirator. In addition, the Agency believes that knowledge about the substances to which employees are exposed will provide an indirect means of determining the effectiveness of the overall respiratory protection program. If employees experience signs and symptoms typically associated with exposure to the workplace substances documented in the written respiratory protection program, the PLHCP can alert the employer to these effects, and corrective action can be taken.

In response to the commenter who urged OSHA to include information on impervious clothing, OSHA notes that the final standard requires employers to provide information on other protective clothing and equipment to be worn by the employee. This item will provide information on impervious clothing, and, therefore, addresses the commenter's concerns regarding the heat stress imposed on employees by such clothing.

One commenter (Ex. 54–214) stated that descriptions of the type of work performed and physical work effort should be dropped from the list, while another commenter (Ex. 54–445) believed that information about the type of respirator would not be useful to the PLHCP. As noted in the discussion of final paragraph (e)(1) in this Summary and Explanation, cardiovascular and respiratory fitness are important variables in determining the ability of an employee to use a respirator. The physical work effort required by the employee's job, in combination with the characteristics of the respirator (e.g., weight, breathing resistance, interference with range of motion), are variables that must be considered by a PLHCP in making a recommendation regarding the employee's fitness to use the respirator.

A study conducted by NIOSH (Ex. 64–469) found that tolerance to work conditions, heart rate, and skin temperature were affected by three variables: the type of personal protective clothing worn, the weight of the respirator, and the level of physical work effort. In the NIOSH study, nine healthy young men who had prior experience with respirators and personal protective clothing (most of them were firefighters), exercised on a treadmill at low and high physical workloads under each of the following conditions: wearing light work clothing and using a low-resistance disposable half-mask respirator (LT condition); wearing light work clothing and using an SCBA (SCBA condition); wearing firefighter turnout gear and using an SCBA (FF condition); and wearing chemical protective clothing and using an SCBA (CBC condition). While exercising at low physical workloads under the LT, SCBA, FF, and CBC conditions, the study participants tolerated these work conditions for 167, 130, 26, and 73 minutes, respectively; at high physical workloads, the four protective clothing conditions were tolerated for 91, 23, 4, and 13 minutes. Heart rates and skin temperatures rose as tolerance diminished. At the high workload level, testing under the SCBA, FF, and CBC conditions had to be terminated early because the heart rates of the study participants reached critically high levels (i.e., 90% of the predicted maximal heart rate). At low physical workloads, heart rate rose progressively under the SCBA conditions (about 15 beats per minute) compared to the LT condition, then remained steady. Under high physical workloads, heart rates rose sharply and never reached a steady level until after the testing was terminated.

The authors of the NIOSH study noted that the work tolerance, heart rate, and skin temperature effects found in the study would be more severe among individuals who were not as healthy or experienced as the study participants. They attributed these effects both to the weight of the respirator and to the poor evaporative cooling properties of the personal protective clothing (i.e., the capacity to remove body heat under the humid conditions generated inside the protective clothing as a result of physical work). Based on these findings, the authors concluded that ''[the study participants] wearing protective clothing and respirators during exercise exhibited a significant degree of cardiorespiratory and thermoregulatory stress * * *''

The conclusion reached by the NIOSH study is supported by other researchers who have tested the physiological effects of personal protective clothing combined with SCBA use among healthy men performing exercise or simulated work tasks under light to moderate levels of physical exertion. (See Ex. 164, Attachment D, Smolander et al. (1984), and Smolander et al. (1985).) These researchers found that personal protective clothing substantially increased oxygen consumption and carbon dioxide production, and recommended careful evaluation of the cardiovascular health and heat tolerance of workers who must wear personal protective clothing.

In another study (Ex. 64–445), healthy young men (average age: 29 years), older men (average age: 47 years), and women (average age: 29 years) used air-purifying respirators while performing the following simulated, low physical workload, mining task: lifting a shovel weighing 3.1 lbs. (6.8 kg.) from the floor to the top of a table (a distance of 3 feet (90 cm)), releasing the shovel's grip, then lifting the shovel from the table back to the floor and releasing the grip again. The task was performed at a rate

of 10 cycles per minute for 20 minutes at temperatures of 73° F (23° C) and 104° F (40° C). The study participants wore appropriate mining clothing (i.e., pants, heavy shirt, gloves, leather apron, and safety helmet) while performing the task. The results showed that respirator use and heat combined to raise the heart rate substantially more than either variable alone, and that this effect was especially pronounced for the women.

This study, and the NIOSH study described earlier, demonstrated that information regarding such physiological stressors as physical work effort, respirator type and weight, personal protective clothing, and temperature and humidity conditions must be provided to PLHCPs who are responsible for medically evaluating employees for respirator use. The studies found that these stressors, especially respirator weight, impose physiological burdens that result in substantial impairment to functional capacity, even among healthy respirator users. OSHA believes, therefore, that information on respirator type and weight, personal protective clothing, and temperature and humidity must be provided to, and be considered by, PLHCPs to ensure that only employees who can endure these stressors without adverse medical consequences are recommended for the respiratory protection program; consequently, these items were included in paragraph (e)(5)(i) of the final standard.

The United Steelworkers (Tr. 1057) stated that ''[PLHCPs should be] mandated to have knowledge of the workplace, and possibly to have visited it at some point in time.'' OSHA agrees that familiarity with the workplace is important, and believes that many employers will make such visits a requirement. OSHA believes, however, that making such visits a requirement is unnecessary because the information required to be given to the PLHCP by the standard will be sufficient for the PLHCP to make a valid recommendation regarding the employee's ability to use the respirator.

Other revisions made to the proposed paragraph include a requirement that the weight of the respirator be provided to the PLHCP, principally to inform the PLHCP of the physical stress that a heavy respirator may impose on an employee's cardiovascular and respiratory systems. This revision was made in response to the number of commenters (Exs. 54–153, 54–165, 54–218, 54–226, 54–227, 54–263, 54–264, 54–294, 54–326, 54–327, 54–363, 54–443) who recommended that employees using SCBAs and other heavy respirators be administered medical examinations, largely because of the additional workload associated with using these respirators. A physician (Tr. 398) testified that SCBAs in particular increased an employee's workload by 20 percent. The studies just discussed also demonstrate that respirator weight plays a significant role in the increased burden that a respirator places on the user. In addition, scientific evidence obtained by Louhevaara et al. (Ex. 164, Attachment D) demonstrates that use of SCBAs by experienced firefighters performing light to moderate exercise on a treadmill substantially reduces tidal volume and increases heart rate, oxygen consumption, and ventilation rate. These physiological effects led Kilbom (Ex. 164, Attachment D) to recommend that no firefighter over the age of 50 be assigned tasks that require SCBA use.

In the NPRM, OSHA asked whether information on the duration and frequency of respirator use should be provided to the PLHCP. No comments were received on this subject. The research studies described earlier in this Summary and Explanation show that duration and frequency of respirator use interact with other respirator use conditions (e.g., respirator weight, protective clothing, temperature and humidity) in imposing pulmonary and cardiovascular stress on respirator users. OSHA believes that information about the duration and frequency of respirator use will be important to PLHCPs in making medical ability recommendations, and concludes that this information must be included in the information required to be provided to the PLHCP.

Paragraph (e)(5)(ii). As noted above, OSHA received recommendations from several commenters (Exs. 54–181, 54–234, 54–330, 54–445) to reduce the amount of information required to be submitted to the PLHCP. In responding to this recommendation, OSHA first reduced the number of items required. Second, OSHA revised the requirement so that employers only need to provide the supplemental information once to the PLHCP, unless the information differs from the information provided to the PLHCP previously or a new PLHCP is conducting the medical evaluations. Under the revised provision, therefore, the employer must ensure that: the PLHCP retains the supplemental information that is provided by the employer; the supplemental information is updated appropriately and in a timely fashion; and a new PLHCP is provided with the required supplemental information. The requirement to provide the new PLHCP with the appropriate information does not mean that the new PLHCP must medically reevaluate employees, only that the new PLHCP obtains the information required under this paragraph. The employer can meet this requirement by either providing the relevant documents to the new PLHCP or ensuring that the documents are transferred from the former PLHCP to the new PLHCP.

Paragraph (e)(5)(iii). OSHA believes that the requirement for employers to provide a copy of the final standard and a copy of the written respiratory program to the PLHCP, although not included in the proposed standard, is needed to assure that PLHCPs have a thorough understanding of their duties and responsibilities in the medical evaluation process, thereby enhancing their ability to make a sound medical recommendation on an employee's ability to use the respirator. The written program is site-specific, and will inform the PLHCP of the working conditions the employee will encounter during respirator use. This information is critical if the PLHCP is to make a thorough and accurate evaluation of the employee's ability to use the assigned respirator. The PLHCP's ability to conduct appropriate medical evaluation will also be aided by knowledge of the standard, which sets forth the requirements of the medical evaluation program, as well as other requirements that affect the employee's respirator use. Consequently, this requirement will help ensure that medical evaluations conducted by PLHCPs are thorough and accurate; recommendations regarding an employee's medical ability to use the respirator are valid; employees are informed of these recommendations; and the privacy and confidentiality of employees are maintained. OSHA believes that this requirement is necessary to ensure that the objectives and other requirements of final paragraph (e) are fulfilled.

As noted in the previous discussion of paragraph (e)(5)(ii), this information must be provided to the PLHCP only once for all employees who are involved in the employer's respiratory protection program. This information does not have to be provided again to the same PLHCP unless the standard or the employer's respiratory protection program is substantially revised. For example, the information does not have to be provided again when only minor revisions have been made to either the standard or the respiratory protection program. When the employer hires a different PLHCP to conduct medical evaluations, the employer must ensure that the new PLHCP has this information, by either providing the new PLHCP with the appropriate documents or ensuring that the

documents are transferred from the former PLHCP to the new PLHCP.

Paragraph (e)(6)—Medical Determination

Paragraph (e)(1) of the NPRM proposed that the employer be responsible for making the final determination regarding the employee's ability to use the respirator. The proposed regulatory language required the physician (now a PLHCP) to deliver a medical opinion regarding the employee's medical ability to use the respirator, including any recommended limitations on this use, to the employer. OSHA proposed, consistent with its substance-specific standards, to make the employer responsible for the final determination regarding an employee's ability to use the respirator. This determination was to be based on all of the information available to the employer, including the physician's opinion and recommendations. The final standard follows this approach, although the final rule's requirements have been revised to reflect the record.

Paragraph (e)(6)(i). This provision states that the ''employer shall obtain a written recommendation regarding the employee's ability to use the respirator from the PLHCP * * * '' Because the PLHCP's recommendation is an important element in the employer's determination as to whether it is hazardous for an employee to use a respirator, the recommendation needs to be clear and in writing.

Final paragraph (e)(6)(i) requires that the PLHCP's recommendation be restricted to the three elements listed in paragraphs (e)(6)(i)(A) through (C) (i.e., ''[t]he recommendation shall provide *only* the following information'') [emphasis added]. This requirement is similar to the proposed regulatory language for paragraph (e)(1) and paragraph (e)(1)(v) of proposed alternative 3. The purpose of this limitation is to protect employee privacy with regard to medical conditions not relevant to respirator use.

Several commenters (Exs. 54–92, 54–455) supported the need for privacy but recommended further that the basis of the PLHCP's medical recommendation not be disclosed to employers because such information could be used by an employer to remove an employee from the workforce. The AFL–CIO (Ex. 54–428) stated that ''[medical] reports to employers should contain only a statement of approval or disapproval for employees who are tested.'' The Brotherhood of Maintenance of Way Employees (BMWE) (Ex. 122) supported limiting the medical information provided to the employer to whether or not the employee can perform the required work while using the respirator, and whether or not restrictions need to be applied to the employee's respirator use. The BMWE stated further that no information should be provided on the specific medical conditions detected during the medical evaluation.

OSHA believes that protection of employee privacy and confidentiality is important to obtain accurate and candid responses from employees about their medical conditions. OSHA has retained this requirement in the final standard and believes that, as worded, it strikes the proper balance between the need to provide sufficient information to the employer to make a decision on respirator use and the need to protect employee privacy.

Paragraph (e)(6)(i)(A) in the final standard also specifies the information the PLHCP is to include in the recommendation to the employer: ''Any limitations on respirator use related to the medical condition of the employee, or relating to the workplace conditions in which the respirator will be used, including whether or not the employee is medically eligible to use the respirator.'' OSHA's experience in enforcing standards with similarly worded provisions indicates that this language is appropriate; also, OSHA believes a statement regarding the employee's medical ability to use the respirator will assist both the employer and employee in determining the final medical disposition of the employee.

Paragraph (e)(6)(i)(B) of the final standard specifies that the PLHCP must state whether there is a need for follow-up medical evaluations. This provision was added to the final standard for several reasons. First, the initial medical evaluation may indicate that there is a possibility that the employee's health may change in a way which would reduce the employee's ability to use a respirator. In these circumstances, the PLHCP is required to specify appropriate follow-up medical evaluations. Second, the final standard does not provide for periodic (such as annual) evaluations, as most other OSHA health standards do. It is therefore important that the PLHCP specify whether an employee requires follow-up medical evaluation so that the employee's ability to use a respirator can be carefully monitored by the PLHCP. This requirement will ensure that employees are using respirators that will not adversely affect their health.

Paragraph (e)(6)(i)(C) requires that the employee be provided with a copy of the PLHCP's written recommendation. No comments were received by the Agency on this proposed requirement. OSHA believes that a copy of the PLHCP's written recommendation will provide employees with information necessary to ensure that they are using respirators that will not adversely affect their health.

The employer may either transmit the PLHCP's written recommendation to the employee or arrange for the PLHCP to do so. The employer shall allow the employee, consistent with paragraph (e)(4)(ii) of the final standard, to discuss the recommendation with the PLHCP. During the discussion, the PLHCP may inform the employee of the basis of the recommendation, as well as other medical conditions that are indicated by the results of the medical evaluation but that are not directly related to the employee's medical ability to use the respirator. OSHA believes that the additional information provided to the employee by the PLHCP should be determined by the legal, professional, and ethical standards that govern the PLHCP's practice and, therefore, should not be regulated by the final standard.

Paragraph (e)(6)(ii). If the PLHCP's medical evaluation finds that use of a negative pressure respirator would place the employee at increased risk of adverse health effects, but that the employee is able to use a powered air-purifying respirator (PAPR), this paragraph requires employers to provide the employee with a PAPR. The rationale for this provision was discussed in the proposal (59 FR 58906). Negative pressure respirators can result in sufficient cardiovascular and respiratory stress to make employees medically unable to use this class of respirators. The use of PAPRs involves lower cardiovascular and respiratory stress, and PAPRs can often be tolerated by employees when negative pressure respirators cannot. Consequently, OSHA believes that this requirement is consistent with the requirements of paragraph (a)(2) of the final standard, which states that ''employers [must] provide the respirators which are applicable and suitable for the purpose intended.''

Several commenters endorsed this provision (Exs. 54–101, 54–363, 54–455). ISEA (Ex. 54–363) recommended that ''employers ensure that all alternative types [of respirators] be considered and made available'' to employees found to be medically unable to use the respirator selected initially by the employer. The proposal was consistent with this recommendation in requiring that alternative respirators be selected from among existing positive pressure respirators, including supplied-air respirators. OSHA has

determined, however, that supplied-air respirators should not be listed as alternative respirators in the final standard because, as noted earlier in this Summary and Explanation, these respirators impose many of the same pulmonary and cardiovascular burdens on employees as negative pressure respirators. The Brotherhood of Maintenance and Way Employees (BMWE) (Ex. 126) found that PAPRs would be an effective substitute for negative pressure respirators, and endorsed issuing PAPRs to employees who were found to be medically unable to use negative pressure respirators. In making this endorsement, the BMWE estimated that less than 1 percent of its membership would require such an upgrade. Consequently, OSHA removed the requirement for supplied-air respirators from the final standard, and now requires only that employers provide PAPRs to employees who are medically unable to use negative pressure respirators but who are able to use PAPRs. In addition, paragraph (e)(6)(ii) of the final standard specifies that if a subsequent medical evaluation finds that the employee is able to use a negative pressure respirator, then the employer is no longer required to provide that employee with a PAPR.

Paragraph (e)(7)—Additional Medical Evaluations

Paragraph (e)(7) of the standard requires the employer to provide additional medical evaluations whenever there is any indication that a reevaluation is appropriate. At a minimum, this would occur: if the employee reports any signs or symptoms that are related to the ability to use a respirator; if the PLHCP, program administrator or supervisor determines that a reevaluation is necessary; if information from the respiratory protection program indicates a need for reevaluation; or if a change in workplace conditions could affect the physiological burden placed on the employee. This is a significant change from the proposal, which in alternatives 2 and 3 would have required reevaluation on an annual basis of employees subject to medical evaluation. Although this would not necessarily have required a medical examination, proposed paragraph (e)(3) and alternative 3 would have required a written medical opinion. The provision in the final standard is similar to the requirement in several of OSHA's substance-specific standards that employees be medically reevaluated if they experience breathing difficulties during fit testing or under other respirator use conditions (see, e.g., the Cadmium standard at 29 CFR 1910.1027(l)(6)(iii)).

OSHA also made a specific request for comments on the appropriateness of requiring medical evaluations at the age-related intervals used by ANSI or NIOSH. ANSI and NIOSH recommend that older employees should be screened more frequently than younger employees because of the heightened risk of cardiovascular and respiratory disease associated with age. The ANSI Z88.6–1984 consensus standard recommends medical evaluations at the following age intervals: every five years below age 35, every two years for employees aged 35 to 45, and annually thereafter. NIOSH's Respirator Decision Logic (Ex. 9) calls for medical evaluations at similar intervals, except that employees over 45 years old should be evaluated every one to two years. One commenter (Ex. 54–394) stated that age-based medical evaluations are important because the American workforce is aging.

The proposed requirement that medical reevaluation be conducted annually resulted in numerous comments, most of which recommended that the requirement be revised. Eight commenters (Exs. 54–219, 54–224, 54–253, 54–264, 54–348, 54–421, 54–441, 54–455) endorsed the proposed requirement without revision. Three commenters (Exs. 54–70, 54–326, 54–357) stated that cost concerns and the administrative burden should limit annual medical evaluations to employees who use SCBAs. Other commenters (Exs. 54–70, 54–185, 54–206, 54–326, 54–357, 54–429) recommended that annual medical evaluations be administered to employees who use non-SCBA respirators only if such use is on a daily basis, for more than 50 per cent of the work week, or at least five hours per work week. A few commenters (Exs. 54–220, 54–244, 54–327, 54–424, 54–429) recommended annual medical evaluations if the evaluations consisted entirely of a medical questionnaire.

The Boeing Company (Ex. 54–445) was one of the commenters recommending that OSHA reconsider the requirement for annual medical examinations. Boeing stated:

> [Our] experience with annual review has been that approximately 1–2% of [our] employees reviewed per year are restricted from respirator use. Very rarely to never are these restrictions due to a medical condition that would make respirator use dangerous for an employee. Rather, the restrictions are related to other aspects of an employee's job or to administrative reasons, such as failure to undergo the review or employee preference.

The American Iron and Steel Institute (AISI) (Ex. 175) also provided limited evidence that regular (e.g., annual) medical examinations are ineffective. AISI cited an industry study in which 2,195 medical examinations were administered to 1,816 employees subsequent to their initial medical examination; the elapsed interval, however, was unspecified. The medical reevaluations found only two employees who had unknown (to the employees) medical conditions; one of the employees had claustrophobia, and the other employee had reduced pulmonary function and an abnormal chest x-ray. AISI recommended that the frequency of medical reevaluation be ''determined by a licensed medical provider or to verify a suspected functional disability that might affect the ability to wear a respirator.''

The statements and recommendations made by commenters who believed that the requirement should be revised or eliminated are summarized as follows:

(1) An annual interval is arbitrary or unnecessary (Exs. 54–234, 54–263, 54–267);

(2) A biannual interval should be used (Exs. 54–191, 54–278, 54–326);

(3) The intervals should be age-based, using either the ANSI or NIOSH age intervals (Exs. 54–66, 54–172, 54–215, 54–245, 54–250, 54–273, 54–318, 54–374, 54–381, 54–388, 54–426, 54–441, 54–450, 54–451, 54–452, 54–453), the age intervals recommended by the National Fire Protection Association (NFPA) under NFPA standard 1582 (Ex. 54–155), or unspecified age intervals (Exs. 54–67, 54–218, 54–240, 54–271, 54–326, 54–327, 54–342, 54–346, 54–361, 54–363, 54–429, 54–445, 54–454);

(4) Medical reevaluation should be conducted only at the request of the PLHCP (Exs. 54–70, 54–150, 54–180, 54–217, 54–224, 54–313, 54–348, 54–350, 54–361, 54–432, 54–448, 54–449, 54–450, 54–451, 54–452), employers (Ex. 54–251), employees (Ex. 54–157), or employees trained to recognize respirator-induced medical effects (Exs. 54–181, 54–219, 54–242);

(5) Medical reevaluation should be event-driven, with the events specified as a combination of age, physical condition or medical symptoms (including breathing difficulty), job conditions, respirator type, frequency of respirator use, medical history, or type of exposure (Exs. 54–79, 54–187, 54–189, 54–217, 54–218, 54–219, 54–220, 54–242, 54–253, 54–265, 54–275, 54–278, 54–318, 54–319, 54–342, 54–357, 54–381, 54–395, 54–439), or when job conditions or the type of respirator used by the employee increase the risk of

adverse effects on the employee's health (Exs. 54–151, 54–153).

Several commenters (Exs. 54–38, 54–191, 54–388) stated that medical reevaluation should not be conducted when employees experience breathing difficulties during respirator use because these effects usually occur as a result of canister or filter overloading rather than an employee's medical condition.

The commenters who endorsed the proposed requirement for an annual medical evaluation stated that annual medical evaluations would identify or prevent medical problems that may arise as a result of less frequent or event-driven medical evaluations. After carefully reviewing the entire record, OSHA decided to revise the proposed requirement and to make medical reevaluation contingent on specific events that may occur during respirator use, regardless of the duration of respirator use. OSHA also has determined that a rigid approach to medical reevaluation based on age may ignore serious medical conditions among younger employees that could be aggravated by continued respirator use. As noted by Dr. Ross H. Ronish, Site Medical Director for the Hanford Environmental Health Foundation (Ex. 54–151), ''[m]edical conditions which can affect the ability of an individual to use various types of respirator occur even in young people.''

This approach is appropriate because medical problems requiring evaluation by a PLHCP can occur after any period of respirator use and in workers of any age, and the requirement for medical reevaluation must be sufficiently flexible to accommodate this variability. In addition, the employee, supervisor, and program administrator are in a position to note conditions, such as breathing difficulty, which would trigger the need for a medical reevaluation.

The events described in paragraph (e)(7) of the final standard include significant medical, occupational, and respirator use conditions that warrant medical reevaluation because these conditions are known to impose additional physiological stress on employees, or are recognized indicators of medical problems associated with respirator use. This paragraph, therefore, will provide for flexible and prompt detection of medical problems among employees who use respirators.

The specific events OSHA has listed in paragraphs (e)(7)(i), (ii), (iii) and (iv) that trigger medical reevaluation are based on OSHA's experience with substance-specific standards and the record of this rulemaking. OSHA believes that these events cover most situations in which employees are at risk of experiencing adverse health effects because of respirator use and in which the employee's underlying medical conditions or workplace conditions have changed sufficiently to make the initial medical evaluation obsolete. As noted earlier in the discussion of this paragraph, these variables were considered by many commenters to be important in determining the frequency with which employees should be medically reevaluated.

Medical Removal Protection

The proposed rule did not include a provision for medical removal protection (MRP). Such a provision requires employers to provide employees who are unable to use respirators with alternative jobs at no loss of pay and other benefits. In the notice of proposed rulemaking (59 FR 58912), the Agency noted that MRP provisions had been included in some earlier substance-specific standards, but stated that insufficient information had been provided in response to the ANPR to include in the proposed rule an MRP provision that would be applicable to all workplaces in which respirators are used. To enable it to evaluate whether an MRP provision might be appropriate for this generic respirator standard, OSHA asked for comments and information about cases in which employees were found to be unable to use respirators in their jobs. The Agency specifically requested information about the frequency of cases in which employees were found to be unable to use respirators and the details of such cases, including how the determination of an employee's inability to use a respirator affected the worker's job responsibilities.

Numerous comments were received on this issue. Most of the commenters who addressed the issue (Exs. 54–92, 54–206, 54–220, 54–240, 54–250, 54–267, 54–273, 54–286, 54–295, 54–342, 54–381, 54–435, 54–443) suggested that a provision requiring employers to provide alternative jobs as a consequence of medical removal be excluded from the final standard, although some (Exs. 54–213, 54–387, 54–427, 54–428, 54–455) endorsed such a provision. The commenters who opposed the provision argued that: employees already receive adequate protection against medically related job displacement and unemployment through existing federal, state, and local law (e.g., the Americans with Disabilities Act and the Rehabilitation Act of 1973); the requirement exceeded OSHA's statutory authority; and OSHA failed to justify the provision adequately in the proposal. Commenters who favored MRP believed that such a provision was needed for medical evaluation to be effective. They stated that employees will refuse necessary medical evaluation if they believe their jobs might be placed in jeopardy. The Brotherhood of Maintenance of Way Employees (BMWE) (Ex. 126) endorsed MRP, claiming that in most cases such protection is feasible on both a temporary and permanent basis for the railroad industry; infeasible or inconvenient cases could be resolved, according to this commenter, under their collective bargaining agreement. The BMWE also recommended that employees who have been determined by employers to be unable to use respirators be allowed to seek a second medical opinion (i.e., to have multiple physician review) ''unencumbered by ulterior motives on the part of the employer.''

As noted above, OSHA has included MRP in some of its existing substance-specific standards for employees who are unable to use respirators. In the Cotton Dust standard, for example, OSHA provided that if a physician determines that an employee is unable to use any type of respirator, the employee must be given the opportunity to transfer to an available position in which respirator use is not required, with no loss of wages or benefits (50 FR 51154–56). OSHA specifically found, based on the evidence in the Cotton Dust rulemaking record, that some employees would be reluctant to reveal information necessary for proper health care if the employee feared that the information might result in transfer to lower paying jobs. Similar MRP provisions for employees unable to use respirators have been included in OSHA's Asbestos and Cadmium standards. However, MRP provisions for workers unable to use respirators have not been included in most of OSHA's substance-specific standards, even though all such standards require that employees who use respirators undergo medical evaluation to determine their ability to do so (e.g., the 1,3-Butadiene, Formaldehyde, Ethylene Oxide, Acrylonitrile, Benzene, and Lead standards).

OSHA believes that a number of provisions of the final standard will effectively avoid any disincentive on the part of employees to cooperate with medical evaluation. Paragraph (e)(1) requires the employer to provide medical evaluation to an employee before the employee uses a respirator in the workplace. Therefore, employees

cannot refuse to undergo medical evaluation and continue in a job that requires respirator use. All employees who use SCBAs, the type of respirator that imposes the greatest physiological burden on the user, must receive medical examinations, and the PLHCP who conducts the examination has discretion to determine the tests, consultations, and diagnostic procedures to be included in the examination. Given this discretion on the part of the PLHCP, and the PLHCP's awareness of the considerable physiological burden that SCBA use places on the user, OSHA believes that the PLHCP will be able to evaluate the employee's ability to use an SCBA even if the employee is reluctant to cooperate fully with the examination.

Moreover, paragraph (e)(7) requires the employer to medically reevaluate an employee when a PLHCP, supervisor, or program administrator observes that the employee is having a medical problem during respirator use and they inform the employer of their observation. Many of the jobs in which SCBA use is required are strenuous, and any undue physiological burden the respirator places on an employee will often be readily observable by the employer, PLHCP, supervisors, or program administrator. Paragraph (e)(7), therefore, will help ensure that an employee who is medically unable to use a respirator, whether a SCBA or another type of respirator, cannot avoid medical evaluation by refusing to cooperate.

The final standard also encourages cooperation in medical evaluation by employees who are assigned to use negative pressure respirators. Some employees will be unable to use negative pressure respirators because of breathing resistance caused by medical conditions such as asthma and bronchitis. The final standard provides these employees with a strong incentive to cooperate with medical evaluation by requiring the employer to provide them with a powered air-purifying respirator (PAPR) when the PLHCP who conducts the evaluation determines that the employees cannot use a negative pressure respirator but can use a PAPR. OSHA believes that many workers who are medically unable to use a negative pressure respirator will be able to use a PAPR, which offers considerably less breathing resistance than a negative pressure respirator. Therefore, those employees who are concerned about their medical ability to use a respirator will have a strong incentive to cooperate fully with the medical evaluation because they are likely to be provided with a less physiologically burdensome respirator that will enable them to continue in their jobs.

Paragraph (f)—Fit Testing

Introduction

The final rule requires that, before an employee is required to use any respirator with a negative or positive pressure tight-fitting facepiece, the employee must be fit tested with the same make, model, style and size of respirator that will be used. The ANSI Z88.2–1992 respiratory protection standard also recommends such testing before respirator use. Employers who allow employees to voluntarily use respirators need not provide fit testing for those employees, although OSHA encourages them to do so.

It is axiomatic that respirators must fit properly to provide protection. If a tight seal is not maintained between the facepiece and the employee's face, contaminated air will be drawn into the facepiece and be breathed by the employee. The fit testing requirement of paragraph (f) seeks to protect the employee against breathing contaminated ambient air and is one of the core provisions of the respirator program required by this standard.

In the years since OSHA adopted the previous respirator standard, a number of new fit testing protocols have been developed and tested (Exs. 2, 8, 24–2, 24–12, 24–20, 46, 49). During the same period manufacturers have developed multiple sizes and models of respirator facepieces in order to provide better fits for the variety of facial sizes and shapes found among respirator users. Incorporation of these advances into the standard is particularly important because facepiece leakage is a major source of in-mask contamination.

Studies show that lack of fit testing results in reduced protection. In a health hazard evaluation (HHE) conducted by NIOSH at a medical center (Ex. 64–56), NIOSH found that workers using disposable respirators were not getting adequate protection because the respirators had not been fit tested. Other HHEs conducted by NIOSH show that workers who used respirators where there was no fit testing suffered adverse health effects resulting from overexposure to airborne contaminants (See HETAs 81–283–1224 and 83–075–1559).

Based on the record evidence, OSHA concludes that poorly fitting facepieces expose workers to contaminants and that the use of an effective fit testing protocol is the best way of determining which respirator facepiece is most appropriate for each employee. Indeed, the need to include fit testing requirements in the standard, and to specify the proper method of accomplishing such testing, were among the major reasons OSHA proposed to revise the existing respirator standard.

Fit testing may be either qualitative or quantitative. Qualitative fit testing (QLFT) involves the introduction of a gas, vapor, or aerosol test agent into an area around the head of the respirator user. If the respirator user can detect the presence of the test agent through subjective means, such as odor, taste, or irritation, the respirator fit is inadequate. In a quantitative respirator fit test (QNFT), the adequacy of respirator fit is assessed by measuring the amount of leakage into the respirator, either by generating a test aerosol as a test atmosphere, using ambient aerosol as the test agent, or using controlled negative pressure to measure the volumetric leak rate. Appropriate instrumentation is required to quantify respirator fit in QNFT.

OSHA's prior respirator standard required training that provided opportunities for each user to have the respirator ''fitted properly'' and to wear it in a test atmosphere. However, it did not specify the test protocols to be used. The previous standard also required that employees be trained to check the fit each time the respirator is put on, although without specifying how the fit check was to be performed or the types of fit checks that were acceptable. OSHA's own compliance experience, and the experience gained from respirator research over the past 25 years, demonstrates that the existing standard's limited fit testing requirements do not provide employers with adequate guidance to perform appropriate fit testing.

The substance-specific standards that have been issued over the past 20 years show the evolution of OSHA's recognition of the need for fit testing guidance. The early standards, such as the 1978 Acrylonitrile standard (29 CFR 1910.1045) and the 1978 Lead standard (29 CFR 1910.1025), required quantitative fit tests but did not provide specific protocols. Subsequently, in 1982, the lead standard was amended to allow qualitative fit testing for half mask negative pressure respirators, provided that one of three specified protocols was followed (47 FR 51110). These specified qualitative fit testing (QLFT) protocols use isoamyl acetate, irritant smoke, or saccharin as the test agents. They have been used in all subsequent standards (e.g., Cadmium, § 1910.1027; 1–3 Butadiene, § 1910.1051; Methylene Chloride, § 1910.1052) with fit testing requirements.

One of the major changes from requirements in the previous standard made by this final standard is its requirement that fit testing be conducted according to specific protocols and at specific intervals or on the occurrence of defined triggering events. Paragraphs (f)(1) and (f)(2) of the standard require employers to ensure that each employee using a tight-fitting facepiece respirator passes an appropriate fit test before using such a respirator for the first time and whenever a different respirator facepiece is used, as well as at least annually thereafter. Paragraph (f)(3) requires the employer to provide an additional fit test whenever the employee reports, or the employer, PLHCP, supervisor, or program administrator observes, changes in the employee's physical condition that could affect respirator fit. Examples of conditions causing such changes could be the wearing of new dentures, cosmetic surgery, or major weight loss or gain. Paragraph (f)(4) specifies that if an employee who has passed a fit test subsequently notifies the employer, program administrator, supervisor, or PLHCP that the fit of the respirator is unacceptable, the employee must be given a reasonable opportunity to select a different respirator facepiece and to be retested. Paragraph (f)(5) requires that the fit test be administered according to one of the protocols included in mandatory Appendix A.

Paragraph (f)(6) limits qualitative fit testing to situations where the user of a negative pressure air-purifying respirator must achieve a minimum fit factor of 100 or less. Paragraph (f)(7) explains that a quantitative fit test has been passed when the fit factor, as determined through an OSHA accepted protocol, is at least 100 for tight-fitting half masks or 500 for tight-fitting full facepiece respirators.

Paragraph (f)(8) requires that all QLFT or QNFT fit testing of tight-fitting atmosphere-supplying respirators and tight-fitting powered air-purifying respirators be performed with respirators in the negative pressure mode, even if they are to be used in positive pressure mode in the workplace, and contains additional requirements for measuring fit testing results. It also requires that all facepieces modified to perform a fit test be restored to their NIOSH-approved configuration before being used in the workplace.

Detailed discussions of each of the paragraphs related to fit testing follow.

Fit Testing—Paragraph (f)(1)

Paragraph (f)(1) of the final standard requires that all tight-fitting respirators be fit tested in accordance with the requirements of the final standard. The ANSI Z88.2–1992 standard has a similar fit testing requirement, as did proposed paragraph (f)(3). The need to fit test ''negative pressure'' respirators was widely supported (Exs. 54–5, 54–38, 54–67, 54–153, 54–158, 54–167, 54–172, 54–173, 54–185, 54–208, 54–219, 54–263, 54–273, 54–278, 54–313, 54–330, 54–424). No comments opposing this requirement were received.

However, the record contains comments both supporting and opposing the need to require the same type and frequency of fit testing for ''positive pressure'' respirators, which are defined in the final standard as respirators ''in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.'' A number of commenters stated that positive pressure atmosphere-supplying respirator users should not be required to pass a fit test (Exs. 54–271, 54–280, 54–290, 54–297, 54–314, 54–324, 54–330, 54–339, 54–346, 54–350, 54–352, 54–361, 54–424). These commenters believed that fit testing of such respirators was not needed because the positive pressure inside the facepiece would prevent contaminated ambient air from leaking from the outside atmosphere to the area inside the facepiece.

For example, the Southern California Edison Company (Ex. 54–316) stated that there was no need to fit test tight-fitting positive pressure respirators because ''[t]he chances of these type of respirators becoming negative pressure under normal use conditions are very slim and generally occur only when there has been a restriction or failure of the air supply system.'' The Alabama Power Company (Ex. 54–217) similarly stated that there was no need to fit test tight-fitting supplied air respirators (SARs) or powered air-purifying respirators (PAPRs) because the chance was slight that a negative pressure condition would occur during normal use. The Reynolds Metals Company (Ex. 54–222) stated that, with positive pressure respirators, gross leaks were unlikely to occur if the user was trained. Beaumont & Associates (Ex. 54–246) stated that a well trained user of pressure demand or continuous flow respirators would quickly be aware of any gross leakage. Eric Jaycock, CIH, (Ex. 54–419) questioned whether requiring the fit testing of positive pressure respirators would cause employers to choose other, less protective, respirators. The County of Rockland Fire Training Center (Ex. 54–155) stated that positive pressure SCBAs may, theoretically, leak around the seal, but that, in its experience, this was unlikely to happen in normal working situations. It recommended that positive pressure SCBAs be exempted from the fit test requirement if the user passes a negative pressure fit check upon donning to ensure an effective seal.

Other evidence in the record, however, demonstrates that, even with positive pressure respirators, facepiece leakage can occur when the high inhalation rates associated with increased workloads cause the facepiece pressure to become negative in relation to the outside atmosphere. An evaluation of the performance of powered air-purifying respirators equipped with tight-fitting half masks by the Lawrence Livermore National Laboratory (Ex. 64–94) demonstrated what its authors called the ''Myth of Positive Pressure.'' The study found that, at the NIOSH-required flow rate of 4 cubic feet/minute (cfm), a half mask PAPR tested at an 80% work rate had a negative facepiece pressure during inhalation for all subjects. The authors concluded that the respirator protection that the device can provide is dependent in large part on the tightness of the seal to the face of the wearer.

Dahlback and Novak (Ex. 24–22) also found negative pressure inside the facepieces of pressure-demand respirators when workers engaged in heavy work and had inhalation peak flow rates of 300 liters a minute. Workers in this study who had not been fit tested developed negative pressure inside their masks much more frequently than those who had been fit tested.

Some commenters (Exs. 54–214, 54–217, 54–222, 54–232, 54–234, 54–245, 54–251, 54–278, 54–330, 54–424) stated that any negative pressure due to leaks on inhalation can be countered by the increased air flow of a positive pressure respirator. While increased air flow can reduce the number of negative pressure episodes (Ex. 64–94), OSHA does not believe that the realities of respirator usage allow exclusive reliance on this mechanism to substitute for fit testing. Moreover, the air pressure that positive pressure respirators provide inside the facepiece is intended to overcome the momentary leakage that may occur even with a properly fitting facepiece. This positive airflow alone is not an adequate substitute for a properly fitting facepiece, and cannot be relied upon to overcome the leakage that can occur into poorly fitting facepieces.

Requiring fit tests for positive pressure respirators is also necessary because the consequences of facepiece leakage into positive pressure respirators can be extremely serious. Positive pressure respirators are usually worn in more hazardous situations than those in which negative pressure respirators are worn. For example, only positive pressure respirators can be worn in IDLH atmospheres. By definition, there is little tolerance for facepiece leakage in such atmospheres. Positive pressure respirators also are used when the concentration of the toxic substance is many times greater than the permissible exposure limit. Even where positive pressure respirators are worn in lower risk situations, they are often selected because the hazardous gas or vapor in the atmosphere lacks adequate sensory warning properties, clearly a factor calling for the minimum amount of facepiece leakage. Employees also may believe that they can afford to use less care in using a respirator that appears to be highly protective; they may ignore seal checks and strap tensioning because they are relying on air flow to overcome any leaks. Fit testing demonstrates to employees that positive pressure respirators can leak, and offers an opportunity for the employee to see, via quantification, what actions (e.g., bending at the waist, jerking the head, talking) relating to fit will decrease protection.

Similarly, although a negative or positive pressure user seal check is important to ensure proper donning and adjustment of the respirator each time it is put on, it is not a substitute for the selection of an adequately fitting respirator through fit testing. Most respirator fit testing is preceded by a user seal check, but experience with respirator fit testing has shown that some individuals who pass this user seal check with what they think is an adequately fitting facepiece subsequently fail their fit test due to poor respirator fit. As John Hale of Respirator Support Services (Ex. 54–5) stated, ''Yes, there is some information to be obtained about gross facepiece-to-face leakage by performing these checks. But, there are no performance criteria, there is no known correlation between the result of this check and respirator fit or performance * * * .''

A number of experts and consensus organizations supported the proposal's requirement for fit testing of all tight-fitting respirators. The Washington State Department of Labor and Industries (Ex. 54–173), the Aluminum Company of America (Ex. 54–317) and the United Auto Workers (Ex. 54–387) endorsed fit testing for positive pressure respirators because these respirators do not always maintain positive pressure due to overbreathing or physical exertion. The Industrial Safety Equipment Association (ISEA)(Ex. 54–363) supported OSHA's proposal for fit testing of all tight-fitting respirators, stating that it was consistent with the ANSI Z88.2-1992 standard's requirements. Fit testing for all tight-fitting respirators is found in clause 9.1.2 of the ANSI Z88.2–1992 respirator standard (Ex. 81), which requires that positive pressure respirators with tight-fitting facepieces be qualitatively or quantitatively fit tested in the negative pressure mode. The National Fire Protection Association (NFPA) standards 1500 and 1404 also require that firefighters using SCBAs pass a fit test (Tr. 479). The American Industrial Hygiene Association (Ex. 54–208) also supported the fit testing of all tight-fitting respirators. Moreover, workplace protection factor studies conducted by respirator manufacturers, NIOSH, national laboratories and others always fit test subjects to reduce the effect of facepiece leakage that is unrelated to design and construction (See, e.g., Exs. 64–14, 64–36, 64–94).

This record has convinced OSHA that it is necessary to require the fit testing of both positive and negative pressure tight-fitting respirators. Even positive pressure respirators do not always maintain positive pressure inside the facepiece, particularly when facepiece fit is poor, strenuous work is being performed, and overbreathing of the respirator occurs (Exs. 64–94, 64-101). Leakage must be minimized so that users consistently achieve the high levels of protection they need. Most workplace use of positive pressure atmosphere-supplying respirators occurs in high hazard atmospheres (e.g., emergencies, spills, IDLH conditions, very high exposures, abrasive blasting), where a high degree of certainty is required that the respirator is maximally effective. Positive pressure respirators, like negative pressure respirators, come in a variety of sizes and models, each with its own unique fit characteristics. The only reliable way to choose an adequately fitting facepiece for an individual user from among the different sizes available is by fit testing. The problem of leakage due to poor facepiece fit can be minimized by choosing good fitting facepieces through fit testing for positive pressure respirator users. OSHA concludes that the requirement to fit test tight-fitting positive pressure respirators is appropriate to reduce leakage into facepieces, and to improve the protection that all kinds of tight-fitting respirators provide in the workplace.

Frequency of Fit Testing—Paragraph (f)(2)

Final paragraph (f)(2), like the proposal, requires that fit testing be performed prior to an employee's initial use of a respirator in the workplace; whenever a different model, size, make, or style of respirator facepiece is used; and at least annually thereafter. Only the requirement to conduct fit testing annually was disputed in the rulemaking. Commenters generally agreed that some additional fit testing beyond an initial test was necessary, but opinions varied widely on the appropriate intervals at which such tests should be performed. A few participants, including the UAW (Ex. 54–387), urged that fit testing be required every six months, since changes in weight, facial hair and scarring, dental work, and cosmetic surgery may alter respirator fit. The UAW also stated that visual observation was not a reliable way to identify the presence of these changes.

A number of commenters suggested that longer intervals, generally two to three years, would be appropriate. For example, Allied Signal (Ex. 54–175) recommended ''periodic'' or ''every two-years'' as the fit testing interval. Public Service Electric and Gas Co. (Ex. 54–196) stated that a ''two year time frame strikes a good balance between safety concerns and practicality.'' The Texas Chemical Council (Ex. 54–232) stated that, in its members' experience, ''* * * virtually no individuals fail fit tests a year after initial testing for a given chemical exposure using the same manufacturer's respirator.'' The Exxon Company (Ex. 183), in response to questions asked at the June hearings, reported that of the 230 employees at their Baton Rouge refinery given an annual QNFT in 1995, a year after their initial respirator selection in 1994, less than one percent (two employees) changed their respirator size because of failing the annual QNFT. Exxon stated that few employees change the size of their respirator from year to year, and that ''the data suggest that annual quantitative fit-testing should not be necessary and such testing may be done on a less frequent basis than once per year.'' The Peco Energy Company (Ex. 54–292) stated that its experience showed that a three year interval is sufficient to ensure a proper fit, provided that mandatory refitting is conducted if there are changes in the respirator user's physical condition. The Eastman Chemical Co. (Ex. 54–245) recommended that the time limit be not

less than two years. The International Paper Co. (Ex. 54–290) stated that ''bi-annual (sic) [every two years] fit-testing with proper training should be adequate'' and that proper training would require that employees report to the employer facial feature changes that have occurred or failure to get an adequate seal during the positive/negative pressure seal check.

Other participants believed that fit testing beyond initial fit testing should be required only when an employee switches to a different respirator, or when a significant change occurs in an employee's physical condition that may interfere with obtaining an adequate facepiece seal (Exs. 54–177, 54–187, 54–190, 54–193, 54–197, 54–214, 54–286, 54–297, 54–396, 54–397, 54–435, 54–323, 54–422, Ex. 123). The American Iron and Steel Institute (Ex. 54–307, Ex. 175) stated that annual fit testing was unnecessary, and that the steel industry experience shows that once a wearer has been fit tested and has an acceptable fit, subsequent fit tests demonstrate consistent fit factors. Mallinckrodt Chemical (Ex. 54–289) questioned the need for annual fit testing for those employees who may use a respirator infrequently, such as once or twice a year.

However, a large number of rulemaking participants supported OSHA's proposal to require the testing of respirator fit on an annual basis (Exs. 54–5, 54–6, 54–20, 54–153, 54–167, 54–172, 54–179, 54–219, 54–273, 54–289, 54–293, 54–309, 54–348, 54–363, 54–410, 54–428, 54–455, Ex. 177; Tr. 1573, 1610, 1653, 1674). The comments of these participants and other evidence in the rulemaking record convince OSHA that the annual testing requirement is appropriate to protect employee health.

Annual retesting of respirator fit detects those respirator users whose respirators no longer fit them properly. The Lord Corporation, which already performs annual fit tests, reported that of its 154 employees who wear respirators, one to three (2 percent or less) are identified each year as needing changes in model or size of mask (Ex. 54–156). Hoffman-LaRoche only performs fit tests at two-year intervals, and it reported a much higher incidence of fit test failures. Sixteen of the 233 people tested in a recent two year cycle of fit testing (6.86%) needed a change in their assigned respirators (Ex. 54–106).

The Lord experience (Ex. 54–156) indicates that annual retesting of facepiece fit detects poorly fitting facepieces, while the Hoffman-LaRoche evidence demonstrates that waiting two years for retesting can result in the discovery that quite a high percentage of workers have been relying on poorly fitting respirators. Extending the retest interval to more than one year would allow those individuals with poor fits that could have been detected by annual fit testing to wear their respirator for a second year before the poor fit is detected.

This evidence also supports OSHA's view that triggering the requirement to retest only by certain events, such as a change in the worker's condition, and not including a required retest interval, would allow poor fits to continue. Changes in a worker's physical condition, such as significant weight gain or loss, new dentures or other conditions, can cause alterations in facial structure and thus respirator fit. Physiological changes that affect facepiece fit can occur gradually over time and are easily overlooked by observers, and by the users themselves. Individuals with poorly fitting respirators were often detected only through fit testing, and not by other methods such as observation of changes in facepiece fit, failure to pass a user seal check, or an employee reporting problems with the fit of the respirator. Retesting facepiece fit solely on the basis of physical changes in individual respirator users would not be a reliable substitute for fit testing on an annual basis. These changes in an individual's physical condition do, however, indicate the need for retesting that individual's facepiece, and paragraph (f)(3) requires additional fit testing whenever any of these changes is detected.

Moreover, fit testing not only determines whether a facepiece seal is adequate; it also provides an opportunity to check that fit is acceptable, permits the employee to reduce unnecessary discomfort and irritation by selecting a more comfortable respirator, and reinforces respirator training by providing users with a hands-on review of the proper methods of donning and wearing the respirator. Therefore, as well as providing the opportunity to detect poorly fitting respirator facepieces, the annual fit testing requirement complements OSHA's requirement for, and may partially fulfill, annual training under final paragraphs (k)(1), (k)(3) and (k)(5). For the reasons presented above, and based on a thorough review of the record, OSHA has included an annual fit test requirement in the final rule.

Refitting Due to Facial Changes—Paragraph (f)(3)

Paragraph (f)(7) in the proposal addressed the need to refit respirators when changes in the employee's physical condition occur. The proposal identified facial scarring, cosmetic surgery, or an obvious change in body weight as conditions requiring refitting. Some commenters (Exs. 54–280, 54–428, 54–455) suggested that dental work affecting facial shape should also trigger refitting. The International Chemical Workers Union (ICWU) suggested that a change of five percent in body weight or twenty pounds should be regarded as an obvious change in body weight that requires refitting (Ex. 54–427). One commenter opposed requiring the employer to determine whether an employee's physical change should trigger refitting, stating that the responsibility for reporting physical changes should rest with the employee (Ex. 54–357).

The language of the proposed paragraph has been revised in the final rule to provide greater clarity and to account for these comments. Because weight loss or gain affects the facial configuration of different individuals differently, OSHA does not believe it possible to stipulate a given weight change ''trigger'' for requiring a new fit test. The final standard thus retains the proposed language regarding an obvious change in body weight. In response to the comments that dental work can affect facial shape and respirator fit, the language in final paragraph (f)(3) has been revised to add dental changes as another item that can trigger a new fit test requirement. The provision has been modified to trigger retests based on employee reports of facial changes, in addition to changes observed by the employer, supervisor, program administrator, or PLHCP that may affect facepiece fit. Employer observations of potential problems with fit, along with self-reported problems with facepiece fit or changes in facial configuration, would trigger a respirator fit retest under final paragraph (f)(3).

Paragraph (f)(3) requires employers to conduct an additional fit test whenever an employee reports changes, or there are observations of changes, in the employee's physical condition that could affect respirator fit. This provision addresses the rare situation in which an employee's facial features change to the extent that a respirator that once fit properly may no longer fit. The conditions listed in the standard that may cause such changes in facial features—facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight—will generally be observable by the employer. If the employee reports facial changes that are not readily observable, the employer may require verification of

the changes before offering an additional fit test.

Retesting for Unacceptability—Paragraph (f)(4)

Paragraph (f)(4) of the final standard requires retesting whenever the respirator becomes ''unacceptable'' to the employee. An employee who notifies the employer, the program administrator, supervisor, or the PLHCP that the fit of the respirator is unacceptable must be given a reasonable opportunity to be retested and to select a different respirator facepiece. This requirement was derived from paragraph (f)(8) in the proposal, which required refitting within the first two weeks of respirator use for masks that become ''unacceptably uncomfortable.''

Although some commenters wanted to delete this provision on the grounds that a properly fitted and trained worker should have no reason to exchange the respirator (Exs. 54–6, 54–20, 54–156, 54–209, 54–215), others urged that the employee be allowed to request a refit at any time a respirator becomes unacceptable. These commenters saw no reason to limit this period to two weeks (Exs. 54–154, 54–165). The utility of the two week period was specifically questioned for situations where respirators are not routinely used for long periods of time (Ex. 54–66), or are used only occasionally (Ex. 54–220). Exxon (Ex. 54–266) stated that the two week provision was too restrictive, and that employees should be allowed to select another respirator or facepiece as necessary . Dow (Ex. 54–278) also suggested dropping the two week limitation. The American Petroleum Institute (Ex. 54–330) recommended revised performance language for this provision. The Occidental Chemical Company (Ex. 54–346) saw no reason to specify a two week period, and stated that employees should be permitted to select a new respirator facepiece at any time because of unacceptable discomfort.

In the final rule, OSHA has deleted the two week limitation on the time in which an employee may have a respirator retested. In addition, the term ''unacceptable'' has been substituted for the term ''uncomfortable,'' which was used in the proposal and was objected to by several commenters (Exs. 54–154, 54–266, 54–278, 54–330). A respirator may be unacceptable if it causes irritation or pain to an employee or if, because of discomfort, the employee is unable to wear the respirator for the time required.

Fit Testing Protocols—Paragraph (f)(5)

Paragraph (f)(5) in the final standard, which is substantively the same as proposed paragraph (f)(3), requires that the employer use an OSHA-accepted QLFT or QNFT protocol for fit testing. These protocols are described in mandatory Appendix A. Appendix A also describes the methods OSHA will use to determine whether to approve additional fit test methods. The provisions in proposed paragraphs (f)(3), (f)(4), and (f)(5) that referenced alternative fit test procedures therefore have been removed from the final rule.

For qualitative fit testing (QLFT), Part I of Appendix A contains the OSHA-accepted qualitative fit testing protocols for the isoamyl acetate QLFT protocol; the saccharin QLFT protocol; and the irritant smoke QLFT protocol, which were first adopted in the Lead standard (29 CFR 1910.1025). In addition, Appendix A contains an OSHA-accepted protocol for the Bitrex™ (Denatonium benzoate) QLFT method, which was submitted to the rulemaking record and commented on during this rulemaking.

Appendix A also lists three protocols for the QNFT methods that are OSHA-accepted. The first is the traditional generated aerosol QNFT method in which a test atmosphere (corn oil, DEHS, or salt) is generated inside a test enclosure and the concentration inside and outside the mask is measured. The second method is the ambient aerosol QNFT method, commonly called the Portacount™ method, which uses a condensation nuclei counter to measure the ambient aerosol concentrations inside and outside the mask. The third method that has been added is the controlled negative pressure (CNP) QNFT method (Dynatech Nevada FitTester 3000™), which was the subject of comments during this rulemaking. These OSHA-accepted QLFT and QNFT methods are described further in the discussion of Appendix A that follows.

The only fit test method that generated any controversy during the rulemaking proceeding was the irritant smoke QLFT protocol. OSHA is continuing to accept the irritant smoke QLFT protocol for use under this standard because the method is valuable when used properly and is often used by small employers because it is relatively inexpensive. Moreover, it is also the only QLFT method where facepiece leakage elicits an involuntary response, which can eliminate the possibility that a wearer could pretend to pass the fit test in order to be eligible for a job requiring respirator use.

Nevertheless, OSHA is aware that high levels of irritant smoke can be produced during a fit test and that these concentrations can be dangerous. Employees exposed to excessive concentrations of irritant smoke have suffered severe reactions (Ex. 54–437; Tr. 390). For this reason, it is particularly important that employers using the irritant smoke protocol ensure that test operators are well trained in this method and comply with all the steps in the OSHA protocol. To ensure that any leakage will be as minimal as possible, the test must not be performed until the employee has passed a user seal check. In performing the sensitivity check necessary to determine that the particular user is sensitive to irritant smoke, it is extremely important to assure that the employee is exposed to the least amount of irritant smoke necessary to trigger a response. Appendix A is a mandatory appendix, and failure to comply completely with its protocols will constitute a violation of this standard.

QLFT Limits—Paragraph (f)(6)

Paragraph (f)(6) of the final standard limits qualitative fit testing to situations where the user of a negative pressure air-purifying respirators must achieve a minimum fit factor of 100 or less. A similar limitation was contained in the proposal (paragraph (f)(6)(i)(A)). This limitation is based on the fact that the existing evidence only validates the use of qualitative fit testing to identify users who pass the QLFT with a respirator that achieves a minimum fit factor of 100. Dividing the fit factor of 100 by a standard safety factor of 10 means that a negative pressure air-purifying respirator fit tested by QLFT cannot be relied upon to reduce exposures by more than a protection factor of 10. The safety factor of 10 is used because protection factors in the workplace tend to be much lower than the fit factors achieved during fit testing; the use of a safety factor is a standard practice supported by most experts to offset this limitation. For example, the ANSI Z88.2–1992 standard states, in clause 9.1.1, ''If a quantitative fit test is used, a fit factor that is at least 10 times greater than the assigned protection factor (table 1) of a negative-pressure respirator shall be obtained before that respirator is assigned to an individual. If a qualitative test is used, only validated protocols are acceptable. The test shall be designed to assess fit factors 10 times greater than the assigned protection factor.''

The only objection to this limitation was expressed by a few commenters (Exs. 54–153, 54–178) who noted that in

the future, new QLFT protocols may be developed allowing the measurement of higher fit factors. If new methods are developed that permit QLFT use for higher fit factors, OSHA will, as part of the acceptance process for these new methods, adjust this requirement appropriately.

QNFT Minimum Fit Factors—Paragraph (f)(7)

Paragraph (f)(7) of the final standard lists the minimum fit factors required to be achieved during quantitative fit testing. These minimum fit factors were listed in paragraphs (f)(6)(i)(B) and (f)(6)(ii)(B) of the proposal. Half masks are required to achieve a minimum fit factor of 100 during QNFT, and full facepiece respirators must achieve a minimum fit factor of 500. Paragraph (f)(7) in the final standard consolidates the minimum QNFT fit factors for half mask and full facepiece respirators into one provision. The safety factor of ten used for full facepiece respirators is the same as that for half masks.

The minimum fit factors in the final standard for QNFT are the same as those that were proposed, and are identical to the minimum fit factors required in OSHA substance-specific standards that require QNFT (See e.g., Asbestos, 29 CFR 1910.1001; Cadmium, 29 CFR 1910.1027; Benzene, 29 CFR 1910.1028; Formaldehyde, 29 CFR 1910.1048; 1,3-Butadiene, 29 CFR 1910.1051).

Most participants who commented on the issue agreed with these minimum fit factors. A few participants argued for higher minimum fit factors (Exs. 67, 54–405). For example, Robert da Roza, citing his study on the reproducibility of QNFT (Ex. 24–9), stated in his testimony at the OSHA hearings on minimum fit factors that ''What I feel confident in is that you do need something higher than a ten. It may be as high as 800. I'm suggesting that some statistician look at this a little more rigorously and come up with some better number.'' (Tr. 102)

TSI, Inc. (Ex. 54–405), in discussing the pass/fail levels for QNFT, recommended the following:

> The proposed requirement that a successful QNFT achieve a fit factor of at least 100 for a half mask and 500 for a full-face mask should be raised. The proposed values allow employers to accept what in reality is a very poor fit compared to what can be achieved with proper employee training * * * We feel that a fit factor of at least 1000 for half masks and at least 2000 for full face respirators is justifiable and readily achievable with minimal extra effort by the employer.

However, empirical data or statistical analyses that supported the need to increase the minimum fit factors proposed were not presented. Although fit factors substantially higher than the minimum values are frequently achieved, OSHA's experience enforcing the substance-specific standards that have similar requirements to the minimum fit factors contained in the final respiratory protection standard shows that these factors are adequate to distinguish well fitting respirators from those that fit poorly, which is the purpose of fit testing. Accordingly, OSHA is retaining the proposed fit factors in the final standard.

Testing Positive Pressure Respirators—Paragraph (f)(8)

Paragraph (f)(6)(iii)(B) in the proposal required that fit testing of positive pressure respirators be conducted without any of the air-supplying equipment or attachments that produce a positive pressure inside the facepiece during respirator use. Thus, the proposal required positive pressure respirators to be tested under negative pressure. Final paragraph (f)(8) similarly requires that positive pressure tight-fitting respirators be fit tested in the negative pressure mode. Fit testing seeks to measure the tightness of the facepiece seal. If the air pressure inside the facepiece is higher than that outside, the pressure differential reduces the amount of ambient air leaking into the facepiece, and the measurements obtained during the fit test do not represent the tightness of the seal between the face and the facepiece. Many tight-fitting respirator facepieces are available in both air-purifying models and atmosphere-supplying units. For these, fit testing can be performed using an identical negative pressure air-purifying respirator facepiece, with the same sealing surfaces, as a surrogate for the atmosphere-supplying facepiece the employee will actually be using. Where an identical negative pressure facepiece is unavailable, the employer may convert the facepiece of the employee's unit to allow for qualitative or quantitative fit testing. Many SCBA manufacturers (e.g., MSA, Interspiro and Survivair) sell fit testing adaptors for this purpose that allow for fit testing of their SCBA facepieces.

Final paragraphs (f)(8)(i) and (f)(8)(ii) describe the specific ways in which these alternatives apply for performing QLFT and QNFT measurements, respectively. If the respirator facepiece has been modified for fit testing, final paragraph (f)(8)(iii) requires that the modifications must be completely removed and the respirator restored to its NIOSH-approved configuration before it is used in the workplace. These requirements replace the similar provisions in proposed paragraph (f)(6), and should clearly inform employers of the requirements for fit testing tight-fitting atmosphere-supplying or powered air-purifying respirators. These provisions are designed so that the testing reflects the conditions of respirator use as accurately as possible. There were no significant objections to this provision in the record.

Proposed Paragraph (f)(9)—Interim Use of QLFT

The final standard deletes proposed paragraph (f)(9), which would have allowed an employer initially to perform a qualitative fit test to fit the respirator user where an assigned protection factor greater than 10 is required if the employer had an outside party conduct quantitative fit testing within 30 days. OSHA proposed this provision to address those few instances when contractors were not available to test employees who had been hired after the annual fit testing for a given establishment had been conducted. There was considerable opposition to this provision. John Hale of Respirator Support Services (Ex. 54–5) recommended that this provision be eliminated because the provision could be abused. The Exxon Company (Ex. 54–266) also recommended that the provision be deleted, suggesting that full facepiece respirators fit tested using a QLFT be limited to use in atmospheres containing 10 times the exposure limit of a hazardous substance until an adequate QNFT is performed. Other commenters stated that retaining the provision could result in overexposure of the employee to workplace contaminants (Exs. 54–280, 54–303, 54–408). The Los Alamos National Laboratory (Ex. 54–420) criticized the provision on the basis that it is the employer's responsibility to provide appropriate fit testing prior to assigning employees to work where respirators are required. The U.S. Army (Ex. 54–443D) stated that if employers have a functioning respirator program and know of the requirement for annual testing, then they should be able to schedule fit testing appropriately, with no need for an extra 30 days.

Some participants who supported the proposed requirement stated that QNFT has not been shown to be a better predictor of workplace protection than QLFT, and recommended that QNFT be an optional, rather than a required method, when fit factors greater than 10 are needed. Moldex Metric Inc. (Ex. 54–153) recommended that the provision be broadened to allow the employer some

latitude in selecting which fit testing methods must be used. Bayer Corporation (Ex. 54–210) recommended the period be extended to 90 days, and that the provision be broadened to include repair and/or calibration of fit testing instruments; other participants also recommended a 60 or 90 day period (Exs. 54–222, 54–278, 54–330, 54–361, 54–424, Ex. 54–430).

OSHA has concluded that the rulemaking record demonstrates that proposed paragraph (f)(9) is unnecessary. Contractors who perform QNFT services are located throughout the country, and an employer can arrange a schedule to ensure that fit testing will be available when required. QNFT instruments are also available for rent and can be used by employers themselves after appropriate training if no contractor is available. Several different types of reasonably priced QNFT instruments are manufactured, and OSHA believes many employers can readily purchase one to perform their own QNFT. The instruments are highly portable and can be readily shipped to where they are needed. As the Army points out (Ex. 54–433D), an employer with a respirator program that requires annual fit testing can readily schedule fit testing appropriately.

In addition, the comments OSHA received urging that the provision be expanded increase OSHA's concern that leaving the option in the standard could expose employees unnecessarily to excessive concentrations of hazardous substances. The QNFT exemption as proposed was intended to be narrow in scope and to apply only when contractors were not readily available to test new employees who were hired after the annual fit testing session. The reasons advanced for extending this QNFT exemption were not convincing. OSHA believes that there are other ways to address the concerns raised by commenters in support of this QNFT exemption. For example, employers can schedule QNFT instrument calibration during times when fit testing is not scheduled and can obtain a substitute QNFT instrument when their own unit needs repair. OSHA concludes that this provision is not appropriately included in the final standard.

Appendix A—Mandatory Fit Test Protocols

Appendix A contains the fit test protocols that employers must follow in performing qualitative and quantitative fit testing for tight-fitting respirators. The Appendix also contains procedures OSHA will use to evaluate ''new'' fit testing methods. Proposed Appendix A addressed the same subjects. Employers who have in the past performed fit tests pursuant to a substance-specific standard must now follow the protocols for OSHA-accepted fit tests that are set out in Appendix A. OSHA has removed the fit testing protocols in the substance-specific standards to eliminate duplication and consolidate all fit testing protocols in Appendix A.

Appendix A has been reorganized from its proposed format to improve clarity and usefulness. The provisions dealing with administering OSHA-accepted fit testing protocols have been moved to part I.

Section A of part I contains general provisions and test exercises that apply to both QLFT and QNFT.

Section B contains the OSHA-accepted QLFT protocols for isoamyl acetate, saccharin, Bitrex, and irritant smoke fit tests.

Section C contains the OSHA-accepted QNFT protocols for generated aerosol, ambient aerosol (CNC), and controlled negative pressure (CNP) fit tests.

Part II addresses the methodology OSHA will use to evaluate new fit test methods and technology.

Appendix A provides general instructions for performing fit testing which have been simplified and clarified by combining the common elements for both QLFT and QNFT and presenting them in Section A of Part I. This includes directions for such procedures as selecting a respirator for fit testing and performing the required test exercises. By combining common elements and eliminating the duplication of fit test protocols in the substance-specific standards, OSHA has reduced the number of pages in its regulations dedicated to fit testing. The purpose of the OSHA fit testing protocols is to tell fit test operators how to perform fit testing to ensure that an adequately fitting facepiece is selected. The protocols reflect the fit test elements (i.e., equipment and basic procedures) that were performed during the validation testing that initially led to their acceptance by OSHA. The protocols do not contain specific instructions on operating any particular fit test instrument because each instrument has specific manufacturer's operating instructions that must be followed to obtain valid results.

The fit testing procedures and specific requirements in the QLFT and QNFT protocols in Sections B and C of part I reflect both the experience that has been gained in performing fit testing and the validation testing that was done initially in order for each method to be accepted by OSHA. The OSHA-accepted methods were evaluated by comparing their performance with that of another accepted fit test to demonstrate that each new method would reliably identify adequately fitting facepieces. The OSHA-accepted protocols reflect the specific procedures and equipment that were used in validation testing, and they must be followed to ensure minimum reproducibility. These elements in the OSHA protocols are not written in performance-oriented language, since any significant variation from the required protocols would invalidate the reliability testing that was performed initially to gain OSHA acceptance and would add uncertainty to the validity of fit test results.

Fit Testing Procedures—General Requirements

The general requirements for fit testing contained in Appendix A, part I.A apply to all OSHA-accepted fit test methods, both QLFT and QNFT. These provisions contain general requirements and instructions for both the person being fit tested, and the person conducting the fit testing. The provisions have been modified slightly from the proposal.

Provision A.1 requires that the test subject be afforded a selection of respirators of various sizes and models from which to pick the most acceptable. The revised language of this provision reflects the substitution of the term ''acceptable'' for ''comfortable'' in paragraph (d)(1)(iv). Provision A.2 is identical to that proposed. The test operator shows the person being fit tested how to don the respirator properly. This instruction may complement the training required by paragraph (k) of this standard. Provisions A.3 to A.7 contain instructions for selecting the most acceptable respirator for fit testing.

Provision A.8 requires the subject to perform a ''user seal check'' before the fit test is performed. The language in this provision has been modified to reflect the use of the new definition for ''user seal check.'' Provision A.9 restates that fit testing shall not be conducted if there is any hair growth between the skin and sealing surface of the respirator. If the test subject exhibits breathing difficulty during fit testing, provision A.10 requires that he or she be referred to a PLHCP. Minor revisions to this provision reflect changes made to paragraph (e) of the standard on medical evaluation. Provision A.11 requires retesting whenever the employee finds the fit unacceptable. Provision A.12 of Appendix A, Part II of the proposal regarding fit testing records has been moved to paragraph (m) of the final

standard to consolidate all recordkeeping provisions.

Provisions A.12 through A.14 of this final standard describe the specific exercises to be performed under all qualitative and quantitative fit tests protocols. The exercises are mostly the same; however, the grimace exercise is not performed for QLFT protocols. In addition, a separate test regimen is prescribed in Section C for the CNP quantitative fit test. Except for minor modifications, the exercises are identical to those in the proposal and to those in OSHA's substance-specific health standards. Participant comments focussed on a few issues: the number and duration of fit test exercises (Exs. 54–158, 54–187, 54–206, 54–218, 54–219, 54–261, 54–271, 54–273, 54–350, 54–325, 155), and the need for the grimace, bending over/jogging-in-place, and talking exercises (54–153, 54–173, 54–175, 54–179, 54–208, 54–218, 54–219, 54–261, 54–273, 54–317, 54–363, 54–408, 54–420, 54–424). These comments are addressed below.

Provision A.14 requires the employee being fit-tested to perform eight exercises. Seven of the exercises must be performed for one minute, while the grimace exercise lasts for only 15 seconds. The test exercises and exercise sequence are: normal breathing; deep breathing; turning the head side to side; moving the head up and down; talking; grimacing; bending over (or jogging in place if the test unit is not large enough for the test subject to bend at the waist); and normal breathing.

Some participants complained that the number and length of the exercises required to be performed were excessive. For example, the 3M Company stated that OSHA has made numerous changes to accepted protocols without verifying the effect of the changes on test performance (Ex. 54–218). According to 3M, OSHA arbitrarily altered the fit tests by requiring the test exercises to be performed for one minute, rather than 30 seconds, and by including the grimace and the bending over/jogging-in-place exercises, and that this alteration violates the original validation of the fit test protocols. In fact, the protocols in this standard are virtually identical to those in other OSHA health standards that have been promulgated over the past fifteen years. The isoamyl acetate (IAA) QLFT test that was evaluated and adopted in the lead standard in 1982 has six exercises. Five of the exercises must be performed for one minute, and the talking exercise is performed for ''several'' minutes. Thus, the total test time for the six exercises is seven to eight minutes, compared to the seven minutes and 15 seconds that completion of the exercises in this standard will take. Since the length of the two test protocols is similar, OSHA concludes that the IAA concentration at the end of the fit test under this standard would be the same as if the fit test was performed under the IAA QLFT protocol contained in the lead standard.

The grimace exercise drew a number of comments. The test is intended to simulate the type of normal facial movements that could break a respirator seal. It was developed in the asbestos standard in 1986 and has been incorporated into subsequent OSHA standards. Participants questioned the need for the grimace exercise, particularly with QLFT, where a break in the facepiece seal could cause sensory fatigue (Exs. 54–153, 54–208, 54–218, 54–219, 54–263, 54–273, 54–363, 54–408, 54–424). Several commenters (Exs. 54–173, 54–179, 54–261, 54–317) stated that the grimace exercise cannot be described so that its effects are standardized and reproducible. DuPont (Ex. 54–350) recommended that the standard incorporate only six exercises, deleting both the grimace and bending/jogging exercises. DuPont stated that if the grimace remained in the fit test protocol, it should be performed last, with the results excluded from the calculations. Allied Signal (Ex. 54–175) also recommended that the grimace exercise be deleted; however, if retained, it should be performed at the completion of the other test exercises. In contrast, the Los Alamos National Laboratory (Ex. 54–420), which originated fit testing protocols, stated that their researchers included the grimace exercise as part of the test exercises for full facepieces in the early 1970s. Los Alamos stated that an exercise that simulates a worker's normal facial movements should not be excluded from the test exercises, and recommended that it be retained.

These comments have persuaded OSHA to delete the grimace exercise as one of the required fit testing exercises for QLFT, but to retain it for QNFT. A break in the facepiece seal during a QLFT could cause sensory fatigue that would invalidate the results of the grimace test and any remaining fit test exercises. Performing the exercise as the final element of the qualitative fit test would not address this concern because one purpose of the test is to determine whether the respirator reseals after the seal has been broken, and performing the grimace test after all the others have been completed will not allow a determination of whether the respirator has resealed effectively after the test.

The concern about sensory fatigue does not exist with quantitative fit tests, however, and OSHA believes the grimace exercise is a valuable aspect of these tests. Because the exercise stresses the facepiece seal, it allows the test to determine whether the facepiece reseats itself during subsequent exercises. The results from the grimace exercise are not to be used in calculating the fit factor for QNFT (provision C(2)(h)(1)), since breaking of the seal would necessarily produce a low fit factor for the grimace exercise. However, if the respirator facepiece fails to reseat itself, the fit factors measured for the subsequent exercises would reflect this failure, causing the employee to fail the fit test. Therefore the grimace exercise has been retained as one of the required QNFT fit testing exercises.

The Air Conditioning Contractors of America (Ex. 54–248) questioned the need to require employees to read from a text, such as the Rainbow Passage. Members of the association stated that their technicians had their own methods of determining fit. As stated above, however, OSHA believes that standardized fit testing protocols provide important safety benefits to employees. To the extent that employers develop other valid fit test methods, Part II of Appendix A provides a procedure through which they can seek OSHA approval of those fit test protocols. The talking exercise requirement is also not onerous. To perform this exercise, the employee must either read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song. These alternatives provide employers and employees with some flexibility when performing this exercise.

Qualitative Fit Test (QLFT) Protocols—Appendix A, Paragraph B

B.1. General. Provision B.1.(a) of Part I of Appendix A on qualitative fit test protocols contains two general provisions relating to QLFT. The provisions are substantively the same as in the proposal. The term ''assure'' has been replaced by ''ensure,'' reflecting a change that has been made throughout the regulatory text.

Provision B.1.(a) requires the employer to ensure that the person administering QLFT be able to perform tests correctly, to recognize invalid tests, and to ensure that the test equipment is in proper working order. This applies regardless of whether the tester works directly for the employer or for an outside contractor. When QLFT is performed by the employer's own personnel, the testers must be properly

trained in the performance of the particular QLFT protocol that will be used. If outside contractors are used to provide fit testing support, the employer must ensure that the test operators performing the fit testing protocols are trained, and can competently administer the QLFT according to the OSHA protocols. This provision is performance oriented, since it lists the abilities the test operator needs, but does not describe a specific training program. The type of QLFT operator training needed is specific to the QLFT method selected, and new methods may be developed in the future that require additional training.

The second provision, B.1.(b), requires that the QLFT equipment be kept clean and well maintained so it operates within its designed parameters. For example, the nebulizers used for the saccharin and Bitrex QLFT protocols can clog when not properly cleaned and maintained, resulting in invalid tests. The test operator must maintain the equipment used for fit testing to ensure proper performance. The requirement is again performance oriented, since the QLFT equipment used will vary with the type of QLFT selected.

There are four qualitative fit test protocols approved in this Appendix. The isoamyl acetate (IAA) test determines whether a respirator is protecting a user by questioning whether the user can smell the distinctive odor of IAA. Both the saccharin and Bitrex tests involve substances with distinctive tastes, which should not be detected through an effective respirator. The irritant smoke test involves a substance that elicits an involuntary irritation response in those exposed to it.

B.2—Isoamyl acetate protocol. The IAA test protocol included in the final standard evolved out of the IAA protocol OSHA originally adopted for the lead standard (29 CFR 1910.1025). It requires that an employee first be tested to determine if the employee can detect the odor of IAA, often called banana oil because it gives off a distinctive banana-like smell. The fit test is only to be conducted on employees who can detect this odor. An employee passes the fit test with a particular respirator if he/she cannot detect the IAA odor while wearing the respirator. The primary drawback of the test is the strong ability of IAA to induce ''odor fatigue,'' so that an individual quickly loses the ability to detect the odor if exposed to it for any period of time. Odor sensitivity is the key to the IAA fit test, and any decrease in the employee's odor sensitivity due to background levels of IAA could invalidate IAA fit testing. For this reason several provisions of the protocol are intended to minimize the possibility of background exposure to IAA that could impair the test subject's ability to detect the odor in the fit test.

IAA vapor easily penetrates a particulate filter, and the IAA protocol therefore cannot be used to fit test particulate respirators unless the respirator is equipped with an organic vapor filter. The protocol requires that separate rooms be used for the odor screening and fit tests, and that the rooms be ventilated sufficiently to ensure that there is no detectable odor of IAA prior to a test being conducted. In prior standards, OSHA has required that separate ventilation systems, in addition to separate rooms, be used for these functions (e.g., Lead [47 FR 51114]). OSHA proposed to do the same in this standard. However, OSHA has been convinced by the comment of Mobil Oil Corporation (Ex. 54–234) that this elaborate precaution against odor fatigue and general background contamination is burdensome and unnecessary. OSHA agrees with Mobil that the ventilation simply needs to be adequate to prevent IAA odor from becoming evident in the rooms where odor sensitivity testing and respirator selection and donning take place, and that the need to have separate ventilation systems for IAA fit testing will make it unnecessarily difficult to find an acceptable building in which to perform fit testing. OSHA is therefore removing the requirements that the odor threshold screening test and fit test rooms not be connected to the same ventilation system. Instead, the ventilation requirement is stated in performance language in the final standard: the testing rooms must be sufficiently ventilated to prevent the odor of IAA from becoming evident to the employee to be tested. OSHA believes that this performance-based language will be sufficient to alert employers to the requirement to prevent olfactory fatigue among workers being fit tested by preventing a buildup of IAA in the general room air.

The proposed IAA protocol required that the test atmosphere be generated by wetting a paper towel or other absorbent material with 0.75 cc of pure IAA and suspending the towel from a hook at the tip center of the test chamber. Two commenters stated that the standard should also allow the test atmosphere to be generated by the use of commercially prepared test swabs or IAA ampules as long as these methods generate the required airborne concentrations of IAA (Mobil Oil (Ex. 54–234); Bath Iron Works (Ex. 54–340)).

OSHA agrees that alternative methods of generating the IAA test atmosphere should be permitted as long as those methods have been shown to reproducibly generate the minimum concentration of IAA needed for a successful fit test. The National Bureau of Standards (Ex. 64–182), in its report on fit testing of half mask respirators using the IAA protocol in the OSHA lead standard, found that the minimum IAA concentration inside the test chamber was 100 ppm during fit testing. Accordingly, the IAA protocol in Appendix A of the final standard has been modified to permit the use of test swabs or ampules as long as these have been shown to generate a test atmosphere concentration comparable to that generated by the towel-saturation method in the proposed standard. An employer who wishes to use test swabs or ampules would need to demonstrate that the swabs or ampules generate an acceptable test atmosphere. For this purpose, the employer may rely on data obtained from the manufacturer of the swabs or ampules as long as the employer uses the products in a way that reproduces the concentrations obtained by the manufacturer under the manufacturer's test conditions.

OSHA has also added a provision recommended by the American Industrial Hygiene Association (Ex. 54–208) to reduce the possibility of test area contamination from used paper towels. AIHA recommended that B.2.(b)(10) be revised to ensure that the used towels are stored in self-sealing bags to prevent test area contamination. OSHA adopted the language changes the AIHA proposed; the final standard requires that used IAA towels be removed from the test chamber to avoid test area contamination.

AIHA (Ex. 54–208) also recommended that OSHA remove the language in B.2.(b)(2) of the IAA fit test protocol requiring that organic vapor cartridges be changed at least weekly. AIHA stated that a fit test operator who is competent to implement an adequate QLFT program will be able to determine an adequate cartridge change schedule. OSHA agrees, and has removed the language requiring weekly filter changes, because weekly changes may overstate or understate appropriate frequencies. However, the program administrator or the fit test operator must replace the cartridges as appropriate to ensure their proper function.

After the close of the NPRM comment period and the hearings, during the post-hearing comment period, the ISEA (Ex. 54–363B) submitted a report on fit testing for full facepiece respirators

using an IAA QLFT protocol for which the test concentration of IAA was raised to 10 times the concentration used in the OSHA-accepted IAA protocol. ISEA reported that the pass/fail cutoff for the modified IAA QLFT was a required fit factor of 1000, and that this increased IAA concentration fit test could therefore be used to test full facepiece respirators for use where ambient exposures were 100 times the PEL. ISEA stated that the validation data that it submitted for this new IAA fit test meet the validation requirements of the September 17, 1989 ANSI Z88.10 draft standard entitled ''Respirator Fit Test Methods.'' OSHA notes, however, that all draft provisions of the draft ANSI fit testing standard are still subject to change until published as part of the final ANSI Z88.10 standard. Further, ISEA did not indicate that the test met the validation criteria proposed by OSHA. In addition, no comments were received from the regulated community on this modified IAA protocol. Since the proposed, ISEA-modified, IAA qualitative fit test was submitted as a post-hearing comment, an opportunity did not exist for the regulated community to comment on it as part of this rulemaking record. The revised IAA fit test, therefore, has not received the review and public comment to which the other new fit tests (i.e., Portacount, CNP, Bitrex) were subjected during this rulemaking. Accordingly, OSHA is not adding the modified IAA fit test for full facepieces to the final standard's fit test protocols. This Appendix establishes procedures for OSHA acceptance of new fit test protocols, and a proponent of the modified IAA fit test may submit it for review under those procedures.

B.3 and B.4—Saccharin Solution and Bitrex™ (Denatonium benzoate) Solution Aerosol Protocols. The protocols for the saccharin and Bitrex solution aerosol fit test methods are similar. Both involve test agents that a test subject will taste if his or her respirator is not functioning effectively. Saccharin is a sugar substitute with a sweet taste, and Bitrex is a bitter taste-aversion agent. In both cases, the subjects are first tested to ascertain that they are in fact able to taste the test agent being used, and then are tested with a respirator. During the fit test the subjects are instructed to breathe with their mouths slightly open and their tongues extended. If they can taste the test agent during the fit test, the test has failed.

The proposal included the saccharin protocol but not the Bitrex protocol, which was not validated until after the proposal was issued. The saccharin protocol was identical to that contained in the Lead standard (29 CFR 1910.1025, Appendix D II; 29 CFR 1910.1027 (Cadmium); 29 CFR 1910.1028 (Benzene); 29 CFR 1910.1048 (Formaldehyde); 29 CFR 1910.1050 (Methylenedianaline); 29 CFR 1910.1051 (1–3 Butadiene)). Several commenters (Exs. 54–208, 54–218, 54–219, 54–363) recommended minor revisions to the language of the protocol to correct specific problems, and to clarify the procedures. In response to these comments, the formula for preparing the threshold check solution has been revised to remove an error in dilution contained in the lead standard protocol. OSHA has also changed the requirement that employees being tested open their mouths wide to a requirement that they open their mouths slightly, since opening the mouth wide could distort normal facepiece fit and invalidate the test results. Opening the mouth slightly is sufficient to allow the employee to detect leakage of the test agent into the respirator when testing for facepiece seal leakage.

The final standard also does not restrict employers to using a DeVilbiss Model 40 nebulizer but also allows them to use an equivalent test nebulizer. Allowing the use of alternative nebulizers that can produce an acceptable test atmosphere is a change from the lead standard protocol, which allowed only the use of the DeVilbiss nebulizer. Finally, the protocol now states clearly that, to elicit a taste response, a minimum of ten nebulizer squeezes is required during the threshold screening. This matches the minimum number of squeezes of the fit test nebulizer required by the protocol.

NIOSH (Ex. 54–437) was the only participant to object to the saccharin aerosol protocol. NIOSH is concerned that saccharin is a potential carcinogen, and it believes that Bitrex is an acceptable alternative test agent. Although saccharin is suspected of being a carcinogen when ingested in large quantities over long periods of time, it is not a substance that OSHA has regulated, and even NIOSH does not have a Recommended Exposure Limit for it. A test subject would be exposed to saccharin only for a brief time during the pre-test sensitivity check, and again either upon failing the test or during the post-test sensitivity check. Either exposure would likely occur only once a year. These exposures would be very low, at or near the threshold of detectability, and it is extremely unlikely that they pose a significant risk to the health of employees or that they would exceed any realistic exposure limit that may be established.

Moreover, although the Bitrex fit test protocol is an acceptable alternative for situations in which the saccharin protocol is used, Bitrex is not as widely available as saccharin, and the test is not as widely accepted. The Bitrex QLFT protocol was developed by 3M (Ex. 54–218). The test protocol is essentially the same as that for the saccharin QLFT, with changes made in preparing the threshold check solution and the fit test solution to account for the non-linear taste sensitivity of Bitrex. A recent paper by Mullins, Danisch, and Johnston (Ex. 178) in the November 1995 AIHA journal describes the development of the Bitrex QLFT method. Validation testing consisted of 150 paired qualitative and quantitative fit tests, with test volunteers using half mask respirators. The Bitrex fit test was evaluated against the saccharin fit test and found to have a test sensitivity of 0.98 and a predictive value for passing of 0.98 at a fit factor of 100. The overall test results were identical for the Bitrex and saccharin fit test methods.

Only one rulemaking participant objected to the possibility that OSHA would approve the Bitrex test. Robert daRoza of the Lawrence Livermore Laboratory (personal communication with John Steelnack, OSHA, 6/4/97) stated that this method has not been adequately tested by multiple facilities, and that the ratio of the concentrations specified does not follow the same logic used in the saccharin method. Until the method is validated by multiple facilities and the logic of the specified concentrations determined, Mr. daRoza believes that the test should not be incorporated into the final standard.

In contrast, NIOSH has recommended Bitrex as an acceptable alternative test agent for saccharin (Ex. 54–437). OSHA has reviewed the validation studies (Ex. 178) in depth, and believes that they establish the Bitrex protocol as an appropriate fit test method. Therefore, OSHA is approving this protocol.

Irritant Smoke (Stannic Chloride) Protocol

The irritant smoke protocol (also called irritant fume) uses stannic chloride smoke tubes to produce a smoke containing hydrochloric acid. Exposure to this test agent causes irritation resulting in coughing. Because the response to irritant smoke is involuntary, the irritant smoke fit test is the only QLFT method that does not rely on the subjective response of the employee being tested (Exs. 54–325, 54–424). The protocol contains a number of provisions intended to minimize employee exposure to the irritant

smoke, which can be harmful to some individuals at high exposure levels.

Irritant smoke is the oldest method of fit testing still in use. It was developed at the Los Alamos National Laboratory more than fifty years ago (Ex. 25–4). OSHA has approved the protocol in all of its health standards that allow QLFT (See 29 CFR 1910.1025 (Lead); 29 CFR 1910.1027 (Cadmium); 29 CFR 1910.1028 (Benzene); 29 CFR 1910.1048 (Formaldehyde)).

The irritant smoke protocol also has the drawback, however, that excessive exposure to irritant smoke can cause severe irritation and, in some cases, permanent harm. For this reason, NIOSH (Ex. 54–437) recommended against the continued use of irritant smoke for qualitative fit testing. NIOSH has conducted the only study known to OSHA that assessed the concentrations of hydrogen chloride produced from irritant smoke tubes. When smoke tubes were attached to an aspirator bulb, NIOSH measured concentrations of hydrochloric acid that ranged from 100 ppm (measured at a distance of six inches from the end of the smoke tube) to 11,900 ppm (measured at a distance of two inches). The use of a low-flow pump produced hydrogen chloride concentrations ranging from 1500 ppm to more than 2000 ppm within 10 seconds of turning on the pump. NIOSH did not measure the amount of irritant smoke inside any respirator facepieces (Tr. 411). The OSHA PEL for hydrogen chloride is a ceiling limit of 5 ppm, which may not be exceeded at any time (29 CFR 1910.1000(a)). NIOSH has established an IDLH value of 50 ppm and notes that a concentration of 309 ppm has been reported as the level of hydrogen chloride causing a severe toxic endpoint in laboratory animals. NIOSH also cited a recommendation by a National Academy of Sciences committee to limit emergency exposure to 20 ppm (Ex. 54–437R at p. 6).

NIOSH performed these measurements after evaluating irritant smoke testing at the request of the Anchorage Alaska Fire Department (Ex. 54–437R) because four firefighters had reported experiencing either skin or eye irritation during irritant smoke fit testing inside a test enclosure. NIOSH additionally described a telephone report it had received of vocal chord damage caused by exposure to hydrochloric acid during an irritant smoke fit test. OSHA notes, however, that this fit test was performed inside a test enclosure and that the test subject failed four consecutive fit tests using this challenge agent (Tr. 411).

TSI, Inc. (Ex. 54–303), the manufacturer of the Portacount QNFT system, also recommended that the irritant smoke QLFT protocol be deleted from the final standard. Like NIOSH, TSI was concerned that employees being fit tested may be exposed to hydrochloric acid in excess of the PEL and, sometimes, in excess of the IDLH level. TSI also stated that the proposed protocol did not contain a threshold test to measure the employee's sensitivity to irritant smoke, and does not provide a means for generating a stable test-agent concentration. The 3M Company (Ex. 137), citing the NIOSH recommendation that irritant smoke not be used for fit testing, also recommended against its use. In addition, 3M stated that ''the irritant smoke test has not yet been completely validated. Neither the level of smoke necessary to evoke a response nor the challenge concentration during the fit test have been measured and shown to be reproducible.''

In contrast, OSHA received comments urging that it continue to approve the irritant smoke protocol. The Organization Resources Counselors, Inc. (ORC) (Ex. 54–424) noted that the irritant smoke protocol is generally considered to be one of the easiest, cheapest, quickest, and most effective QLFT methods available, although ORC recognized that precautions must be taken to minimize exposures. For example, ORC pointed out that irritant smoke fit testing should not be performed in a small chamber, such as an inverted plastic bag or hood, since this could allow the accumulation of high concentrations of hydrogen chloride. SEIU (Ex. 54–455) supported the use of irritant smoke QLFT because of the benefits of its involuntary response. The SEIU stated:

> SEIU objects to the use of non-irritant challenge agents (isoamly acetate and saccharine). We have found that many of our members are pressured to complete fit tests quickly and get back to work, and hence will not acknowledge when a respirator has leaked during a fit test. The reaction to an irritant fume is very difficult to disguise.

Willson Safety Products (Ex. 54–86) also supported the use of the irritant smaoke fit test, citing ''the thousands of businesses who now use the irritant smoke fit test procedure with a 50 ml squeeze bulb. They find the irritant fume protocol the least complicated and most easily performed of the QLFT protocols.''

All of the comments urging OSHA not to approve the irritant smoke protocol were based on the possibility that the test could expose employees to high levels of hydrogen chloride. The irritant smoke protocol in Appendix A has been carefully designed to minimize such exposures. The initial and post fit-test sensitivity checks must be performed with ''a small amount'' of ''a weak concentration'' of irritant smoke, with care being taken to use ''only the minimum amount of smoke necessary to elicit a response.'' (See provisions I.B.5(a)(4); and 5(b)(3)). Test subjects are to be instructed to close their eyes to prevent eye irritation during the test. The test must be performed in a well-ventilated area to prevent any build-up of irritant smoke in the general atmosphere (provision I.B.5(a)(5)). Unlike other QLFT methods, the irritant smoke test may not be performed inside a test enclosure or hood (provision I.B.5(a)(3)).

Persons being fit tested must pass a user seal check before the fit testing begins (See provision I.A.8). The irritant smoke fit test starts with a small amount of the irritant smoke being produced from a smoke tube, and the person being tested wafting a small portion of the smoke toward his or her breathing zone to determine if any gross facepiece leakage occurs. Only after determining that the initial fit is adequate does the operator direct smoke at the facepiece seal area, starting at least 12 inches away from the head and working around the seal area and gradually approaching the test subject's face. Because the test is performed in an open area, the person being tested can step back into clean air any time irritant smoke is detected within the mask. This limits the maximum exposure to as little as one breath of irritant smoke.

Following this protocol would have avoided both of the adverse reaction incidents NIOSH described. In the Anchorage case, positive pressure SCBAs were fit tested by placing the users inside a test enclosure and pumping it full of irritant smoke. The users were apparently not warned to close their eyes during the fit test. The use of a test enclosure is expressly prohibited in the OSHA protocol, as is exposing test subjects to more than the minimum amount of smoke necessary to elicit a response. And test subjects must be instructed to close their eyes during testing. The test subject in the second incident who suffered damage to her vocal cords was also tested inside a test enclosure; in addition, she failed four consecutive fit tests involving this agent. Repeated testing of a subject who fails the test not once, but four consecutive times, inside a test enclosure filled with irritant smoke is prohibited by the OSHA protocol. Following the OSHA-accepted protocol would have reduced to substantially lower levels the exposures received by these employees.

In approving this fit test protocol, OSHA is not discounting the evidence that irritant smoke can cause adverse reactions in test subjects. All of the cases OSHA is aware of, however, involve tests that were not done in a way that OSHA considers acceptable, and consequently exposed the test subjects to excessive concentrations of irritant smoke. OSHA emphasizes the critical importance of following its approved protocol, including all of the safeguards against excessive exposure, when this test is used. Indeed, paragraph (f)(5) requires that employers follow these protocols and failure to do so constitutes a violation of the standard.

Participants also made a number of suggestions about specific aspects of the protocol. The proposed irritant smoke protocol, which was derived from protocols promulgated in other standards (29 CFR 1910.1025 and subsequent health standards), required the use of a low-flow air pump set to deliver 200 milliliters of irritant smoke per minute. Several participants commented that an aspirator bulb should be acceptable for generating an irritant smoke test agent, and that further justification was needed for requiring a low-flow air pump (Exs. 54–38, 54–86, 54–135, 54–309, 54–316, 54–324, 54–363, 54–424). The Coastal Corporation (Ex. 54–272) said that requiring only the low-flow air pump would impose an unnecessary financial burden, and recommended that OSHA allow for alternative methods, such as an orifice adapter on a compressed air system, for delivering a uniform stream of irritant smoke. The ISEA (Ex. 54–363) stated that its members were not aware of a commercially available low-flow air pump, and also recommended that an aspirator bulb, which it said was now used by many fit test operators, be allowed instead.

In response to these comments, the requirement that only a low-flow pump may be used to generate the irritant smoke has been changed in the final standard. In addition to the low-flow pump, an aspirator squeeze bulb may be used to generate the irritant smoke for fit testing. However, care must be taken by the fit test operator to ensure that the aspirator bulb produces irritant smoke at the required flow rate of 200 ml/minute. Since aspirator bulbs vary in size, the person performing the fit test must know the volume of the aspirator bulb being used to push air through the smoke tube. The number of bulb squeezes per minute will vary depending on bulb volume. For example, a large 50 ml bulb would need four squeezes per minute to produce the required volume of irritant smoke, while a smaller 25 ml bulb would need eight squeezes per minute. The squeezes should be uniform, and evenly spaced out through each minute to maintain a relatively constant flow of irritant smoke. The use of an aspirator bulb to deliver the test agent at a stable, constant rate requires some skill on the part of the test operator, since each squeeze can be different, and care must be taken by the fit test operator to produce a steady stream of irritant smoke. An aspirator bulb can produce a large amount of irritant smoke during a single squeeze. However, the squeeze bulb method when properly performed can be an effective fit test for determining facepiece fit. Willson Safety Products (Exs. 54–86) submitted a March 4, 1991 letter of interpretation it had received from Thomas Shepich of the OSHA Directorate of Technical Support regarding the use of a squeeze bulb for performing the irritant smoke QLFT under the asbestos, lead, benzene and formaldehyde standards. Mr. Shepich stated:

> In your letter you indicated that a majority of your customers use a 50 ml rubber squeeze bulb that is capable of delivering a flow of 200 ml of air per minute if used correctly. You also express concern over the need to spend $500.00 or more to use a mechanical pump since the rubber squeeze bulb can adequately meet the intent of the OSHA standard.
>
> The QLFT method is a pass/fail test. Since a rubber squeeze bulb generated challenge agent can be as effective as a mechanically aspirated one, the intent of the standards has been met. The training of individuals administering QLFT by the rubber squeeze bulb method must include techniques on the proper number of compressions per minute necessary to generate an appropriate air flow.

A few other modifications to the protocol have also been made. As the ISEA (Ex. 54–363) recommended, the term ''irritating properties'' has been substituted for ''characteristic odor'' in the irritant smoke protocol in Appendix A, since the term better describes what the employee experiences. Based on ORC recommendations (Ex. 54–424), the reference to the MSA smoke tube has been removed, and language has been added requiring that the end of the smoke tube be covered with a short length of tubing to prevent injury from any jagged glass where the tube has been opened. As the AIHA (Ex. 54–298) recommended, the description ''involuntary cough'' has been added to the description of the response to irritant smoke. A clear statement that no form of test enclosure or hood is to be used with irritant smoke has been added, as supported by ORC (Ex. 54–424), and in response to the problems described by NIOSH and TSI (Exs. 54–303; 54–437R).

Quantitative Fit Test (QNFT)

Appendix A includes three quantitative fit test protocols, the generated aerosol protocol, the Portacount ™ protocol that uses ambient aerosol as the test agent and a condensation nuclei counter (CNC) as the test instrumentation, and the controlled negative pressure (CNP) protocol (i.e., the Dynatech FitTester 3000 ™). Only the generated aerosol protocol was included in the proposal. Each QNFT method is described in a separate section of Appendix A.

Part I of section C contains general requirements for QNFT. The employer is to ensure that the individuals who perform the QNFT, whether employees or contractors, are able to calibrate equipment and perform tests properly, recognize invalid tests, calculate fit factors properly and ensure that test equipment is in proper working order. The employer is also responsible for ensuring that the QNFT equipment is cleaned, maintained, and calibrated according to the manufacturer's instructions so that it will operate as designed.

Respirators used for QNFT must be in proper working condition. Respirators are to be rejected if leakage is detected from exhalation valves that fail to reseat adequately, near the probe or hose connections, or if the respirator is missing gaskets. The requirement in paragraphs (h)(1)(iv) and (h)(3)(i)(A) that all respirators used in non-emergency situations be inspected for defects before each use and cleaned after each use also apply to fit testing. The test operator must inspect the test respirator for: cracking, holes, or tears in the rubber body of the facepiece; cracks or tears in valve material and in the inhalation and exhalation valve assemblies; foreign material between the valve and valve seats; proper installation of the valve body in the facepiece; and warped or wrinkled valves. Respirators with any of these defects cannot be used for fit testing.

A user seal check must be conducted prior to starting QNFT to ensure that the respirator facepiece is properly adjusted. The use of an abbreviated, or screening, QLFT before QNFT fit testing to identify poorly fitting respirators is optional.

Paragraph 2—Generated Aerosol QNFT

The procedures for conducting the generated aerosol quantitative fit test are widely recognized and accepted by the industrial hygiene community. The test is performed inside a test unit such as

a hood, portable booth, or chamber. An aerosol of a test agent is generated inside the enclosure. A stable ambient test agent concentration must be achieved prior to beginning the test exercise regimen. The test unit must be large enough to permit the employee being tested to freely perform the QNFT exercise regimen without disturbing the test agent concentration, and the unit must effectively contain the test agent in a uniform concentration.

During the test, the respirators are fitted with filters, such as high efficiency HEPA, or P100 filters, that offer 99.97% efficiency against 0.3 micron aerosols as defined by NIOSH in 30 CFR part 11 or 42 CFR part 84. Therefore, virtually any measurable leakage should be the result of leaks between the respirator sealing surface and the respirator user's face. If test agents other than particulates are used, the sorbent/filters must offer a similar degree of collection efficiency against the test agent. The concentration of the test agent is measured both inside and outside the respirator. Commonly used detection methods include forward light-scattering photometry or flame photometry.

Three methods were proposed for using the results of these measurements to calculate fit factors: the average peak penetration method; the maximum peak penetration method; and the use of an integrator to calculate the area under the individual peak for each exercise (59 FR 58919). OSHA proposed that the fit factor derived from QNFT using test agents be calculated by dividing the average test agent concentration inside the chamber (i.e., the ambient concentration) by the average test agent concentration inside the respirator for each test exercise (excluding the grimace exercise). The average ambient concentration is derived from the measurement of the test agent concentration in the test chamber (i.e., outside the respirator) at the beginning and end of the test. TSI, Inc. (Ex. 54–8) stated that while the language proposed for determining the average test chamber concentration was correct, better accuracy could be obtained by averaging the chamber concentration before and after each exercise, and by allowing for continuous chamber concentration measurements. OSHA agrees that the standard should allow for these other methods of measuring average test chamber concentration, and has adopted the revised language submitted by TSI.

In the proposal, the average test agent concentration inside the respirator was to be determined from the aerosol penetration during each test exercise using one of three approved methods for calculating the overall fit factor. TSI, Inc. (Ex. 54–8) noted that the intuitive, but algebraically incorrect, method of computing the arithmetic average of the fit factors for all exercises (i.e., for instruments that report their exercise results as fit factors instead of peak penetrations) would result in an overestimation of the overall fit factor. This commenter suggested that OSHA adopt the equation from the draft ANSI Z88.10 fit testing standard that correctly states how to perform the fit factor calculation for instruments that report results as exercise fit factors instead of peak penetration values. OSHA agrees and has added this equation to Appendix A in the final standard.

The test aerosol penetration measured for the grimace exercise is not to be used in calculating the average test agent concentration inside the respirator (See provision I.C.2(b)(8)(i)). The purpose of the grimace exercise is to determine whether the respirator being fit tested will reseat itself on the face after the respirator seal is stressed during the exercise. With a properly fitting respirator, the test instrumentation should record a rise in test agent concentration inside the mask during the grimace exercise, and a drop in test agent concentration when the respirator reseats itself. If the respirator fails to reseat itself following the grimace exercise, the subsequent normal breathing exercise will show excessive leakage into the mask and result in a failed fit test. Since even a properly fitting respirator may show increased test agent penetration during part of the grimace exercise, the penetration value measured during the grimace exercise is not to be used in calculating the overall fit factor.

A clear association is required between an event taking place during testing and the record of the event. This requirement is critical for the proper calculation of aerosol penetration for specific test exercises. Short duration leaks (displayed as peaks on the recording instrument) can occur during, and as a result of, each fit test exercise, and these leaks indicate poor respirator fit. These penetration peaks are used to determine the fit factor. An inability to measure these penetration peaks could result in the fit factor being overestimated, since averaging all the test exercise penetration peaks may obscure the high penetration levels that occur during a test exercise. An inability to clearly associate the exercise event with the recording makes correct calculation of the fit factor impossible.

Several factors can affect the time interval between an exercise event occurring during QNFT and the recording of the event, such as the diameter of the sampling line, sampling rate, and the length of the sampling line. Response time will increase with an increase in the length and/or diameter of the sampling line. Therefore, the length and inside diameter of the sampling line should be as small as possible. The line used for sampling the test chamber test agent concentration, and the line used for testing the test agent concentration inside the respirator, must have the same length and inside diameter so that aerosol loss caused by aerosol deposition in each sample line is equivalent for the two lines.

To minimize both contamination of the general room atmosphere and test operator exposure to the test agent, the generated aerosol protocol requires that air exhausted from the test unit must pass through a high-efficiency filter (or sorbent).

Since the relative humidity in the test chamber may affect the particle size of sodium chloride aerosols, the protocol further requires that the relative humidity of the test unit be kept below 50 percent. This requirement is consistent with manufacturer's instructions for sodium chloride units.

Prior to beginning the generated aerosol QNFT, a stable test agent concentration must be achieved inside the test unit. The concentration inside small test booths or waist-length hoods may be diluted significantly when the employee enters the booth. Normally, the test agent concentration will stabilize within two to five minutes.

Adjustments to the respirator must not be made during the QNFT. Any facepiece fit adjustments must be made by the employee before starting the exercise regimen. This requirement will prevent manipulation of the respirator during fit testing to achieve higher fit factors. The fit test is to be terminated whenever any single peak penetration exceeds two percent for half masks and quarter facepiece respirators, and one percent for full facepiece respirators. Such leaks correspond to fit factors below 100 for half masks and 500 for full facepiece respirators, and indicate an unacceptable respirator fit. In such cases, the respirator may be refitted or adjusted, and the employee retested. If a subsequent QNFT test performed after the respirator has been refitted or adjusted is terminated because of excessive penetration, then the respirator fit for that individual must be considered unacceptable, and a different respirator must be selected and tested.

OSHA had proposed that an employee successfully complete three separate fit

tests with the same respirator using a QNFT protocol. The proposed requirement was derived from the fit testing protocols in OSHA's substance-specific standards, e.g., the Benzene standard (29 CFR 1910.1028). This proposed provision received more than 150 comments. Many commenters stated that only a single QNFT was needed, and that the additional tests would only increase the cost of fit testing without a corresponding improvement in attaining a successful fit (Exs. 54–11, 54–26, 54–35, 54–37, 54–41, 54–44, 54–63, 54–83, 54–114, 54–124, 54–139, 54–208, 54–289, 54–316, 54–359, 54–363). Some said that requiring three tests for QNFT would discourage employers from adopting QNFT (Ex. 54–164), or would force employers to use the less protective QLFT, which requires only one fit test (Exs. 54–316, 54–359, 54–363, 54–434). One commenter stated that three fit tests for QNFT would only be needed if OSHA allows higher APFs based on the results (Ex. 54–84). (OSHA notes that the concept of increasing the APF based on repeated fit testing, originally contained in the ANSI Z88.2–1980 respirator standard, was subsequently removed from the Z88.2–1992 revision of that standard (Ex. 54–443)). The Bath Iron Works (Ex. 54–340) stated that the variation between separate fit tests is significant, and recommended that this problem could be resolved by increasing the safety factor beyond 10. Other commenters suggested that increasing the fit factor required for passing a single QNFT was an alternative to requiring three fit tests (Exs. 54–139, 54–154, 54–173, 54–340).

The final standard does not include the requirement to perform three successful QNFTs because performing three tests has not been shown in this record to better detect poor respirator fit. Increasing the safety factor of 10, thereby raising the minimum fit factor required to pass a QNFT, also has not been adopted by OSHA because experience indicates a safety factor of ten is sufficient. While many employers have, on their own, decided to require higher fit factors during fit testing, data in the record do not support the suggestion that increasing the safety factor beyond 10 is appropriate. Using a safety factor of 10 is current practice in fit testing, and is used to account for the variability in fit testing procedures, as well as other variables (e.g., differences in respirator fit between the workplace and during fit testing).

The results of the fit test must be at or above the minimum fit factor required for that class of tight-fitting air-purifying respirator. The required fit factors are established by applying a safety factor of 10 to the APFs for that class of respirator. For example, quarter and half mask air-purifying respirators with an APF of 10 must achieve at least a fit factor of 100, and full facepiece air-purifying respirators with an APF of 50 require a minimum fit factor of 500.

Paragraph 3—Condensation Nuclei Counter (CNC) QNFT

A protocol for the ambient aerosol condensation nuclei counter (CNC) quantitative fit testing protocol (i.e., TSI, Inc. Portacount ™) has been added to the final standard as an accepted QNFT method. Many commenters pointed to the need for a CNC QNFT protocol. Commenters, (Exs. 54–216, 54–326, 54–359) noted that the Portacount is the most commonly used method, and that sufficient data have been developed over the past several years to validate its effectiveness. The use of the Portacount has been allowed by OSHA under a compliance interpretation published in 1988. Commenters urged that the ambient aerosol CNC method be included in the list of accepted QNFT methods in the final standard (Exs. 54–216, 54–326, 54–359). OSHA agrees with these comments. The written instructions for performing the fit test in Appendix A are essentially the same as the instructions provided by the manufacturer.

Paragraph 4—Controlled Negative Pressure (CNP) QNFT

The protocol for the controlled negative pressure (CNP) quantitative fit test method (Dynatech Nevada FitTester 3000 ™) has also been added to the list of accepted QNFT methods. This fit test method involves the use of a fit test instrument to generate a controlled negative pressure inside the facepiece of the respirator to measure the resulting leak rate.

This fit test protocol is the same protocol allowed by OSHA under a compliance interpretation letter issued in 1994 and based on various studies on the performance of the CNP method conducted by its developer, Dr. Cliff Crutchfield (Exs. 71, 54–436). These studies reported results that were validated by comparing them to results from the existing aerosol fit test systems. The data showed that the fit factors measured with CNP are always lower than the fit factors measured with an aerosol QNFT. OSHA had reviewed these studies before issuing its compliance letter. OSHA believes that the CNP method, based on Dr. Crutchfield's validation data, constitutes adequate support for the method's reliability in rejecting bad fits. Although no body of data is available that describes employer experience using the CNP method in the workplace, OSHA is confident that the extensive validation data showing consistently conservative results using CNP means that this method will identify bad fits at least at the same rate as other accepted fit test protocols.

Several commenters urged OSHA to provide a protocol for the CNP method and to list it as approved (See, e.g., Exs. 54–167, 54–216). In addition, NIOSH in its comments and testimony stated that ''NIOSH recommends that OSHA recognize * * * the following fit test procedures as acceptable * * * Quantitative fit tests using controlled negative pressure and appropriate instrumentation to measure the volumetric leak rate of a facepiece to quantify the respirator fit'' (Tr. 359, Ex. 54–437). NIOSH further stated in its comment (Ex. 54–437) that ''[o]nly the controlled negative pressure fit test system, which has been excluded in the OSHA proposal, has been subjected to limited validation'' (Decker and Crutchfield, 1993). The State of Washington Department of Labor and Industries (Ex. 54–173) requested that OSHA provide performance criteria so that methods such as ''Dynatech test equipment'' described as ''proven'' and ''accepted'' may more easily be used.

Penelec/Genco reported favorable experience using the CNP method (Ex. 54–167). As stated in its comment:

> Penelec/Genco recently quantitatively fit tested approximately 1500 employees on both half and full face respirator facepieces using the Dynatech/Nevada FitTester 3000. For the past 10 years we have performed fit tests using particle counting equipment. We are most pleased with the results provided by the FitTester 3000 * * * We believe that the science is sound, the equipment is reliable, and the results are valid. When used as part of a complete respiratory protection program, we believe controlled negative pressure fit testing is an effective way of matching each person with the best-fitting, most comfortable facepiece respirator.
>
> All the peer-reviewed studies consistently show that controlled negative pressure equipment and protocols always produce more conservative fit test results than particle counting equipment and protocols. Our experience totally supports this.
>
> We find the Dynatech/Nevada FitTester 3000 to be durable, reliable and easy to use. Results are always reproducible, with minimum variation. Employee acceptance is excellent, especially because they get a direct perception of fit (leaks or lack of) which corresponds well to the machine's fit results.
>
> Using the FitTester 3000 we are able to select more comfortable, better fitting respirators for our employees. We believe that certain respirator brands are far superior to others in terms of fit and comfort. As a result, we have switched brands. Our

employees are far more satisfied with the fit and comfort of their new respirators * * * (Ex. 54–167)

TSI, Inc. (Exs. 54–229, 54–302) stated that OSHA should reject the CNP method as a valid QNFT, since employees who are tested using this method must hold their breath and remain motionless during the measurement, i.e., they cannot perform the required exercises simultaneously with the measurement. According to TSI (Ex. 171), dynamic exercises are necessary to simulate the face seal stresses imposed by workplace conditions. Dr. Crutchfield, in his post-hearing submission (Ex. 134), responded to statements made by Jeff Weed of TSI at the hearing and in TSI's submissions to the record regarding the CNP fit test method. He discussed the ability of aerosol-based fit test methods to measure transient leaks, stated that leakage occurs with inhalation, and that the CNP method measured more respirator leakage than aerosol-based systems, and further, that CNP fit factors ''tend to align more closely with workplace protection factors than do aerosol-based fit factors.'' Dr. Crutchfield stressed the importance of being able to effectively measure fundamental leakage into the respirator, stating that ''most dynamic exercises do not seem to have a statistically significant effect on measured fit factors.''

OSHA recognizes the need to perform fit testing exercises to stress the facepiece seal, and has included a full range of exercises in the CNP protocol in Appendix A. They differ from the exercises for the CNC method, since test results are not taken while the test exercise is being performed, but are taken after the exercise is completed. However, since the CNP method cannot distinguish changes in facepiece volume that are related to movement during an exercise from leakage into the facepiece caused by poor respirator fit, the CNP protocol requires that the employee remain motionless during the short sampling period that is required after each exercise. OSHA believes that any changes in fundamental fit caused by the test exercises should, consequently, be measured by the CNP method during the 10-second sampling period following each exercise, and that this does not affect the test's ability to detect poor fits when the seal is stressed.

In addition to the OSHA-accepted CNP fit test protocol, Dr. Crutchfield (Tr. 254) testified about a new fit test protocol for the CNP method. This new protocol is substantially different from the OSHA-accepted protocol, which requires the performance of test exercises followed by CNP measurements. The new protocol was also described in detail in a letter from Senator John McCain of Arizona on behalf of Dr. Crutchfield (Ex. 54–460). The new protocol submitted after the close of the post-hearing comment period is described as consisting of three exercises and two redonnings. The first exercise measured ''fundamental respirator fit'' with the head facing forward. The second exercise was a bending exercise, with the respirator parallel to the floor. The third exercise consisted of vigorously shaking the head from side-to-side for three seconds, followed by a ''fundamental fit'' measurement. The respirator user then is required to remove and redon the respirator twice, with ''fundamental fit'' measured after each redonning. This protocol results in five CNP measurements, from which a harmonic mean fit factor is calculated and used to make a pass-fail determination for the fit test.

The information on the new protocol was not submitted to the rulemaking docket in time to allow an opportunity for public comment. OSHA, therefore, cannot include it in this final standard. Appendix A, Part II establishes procedures by which OSHA will approve new fit testing protocols after allowing opportunity for public comment. A proponent of the revised CNP fit test protocol may submit it for approval in accordance with Appendix A, Part II.

Proposed part (II)(A)(12) of Appendix A required that the employer maintain a record of the qualitative or quantitative fit test administered to an employee. This requirement has been moved to paragraph (m)(2) in the final standard to consolidate the standard's recordkeeping requirements. The fit test record must include the date and type of fit test performed, employee information, and type of respirator. When a QNFT is administered, a record of the test (e.g., strip charts, computer integration) must be retained. The fit test records are to be maintained until the next fit test is administered. A record is necessary for OSHA to determine compliance by verifying that: the employee has been fit tested, both prior to starting respirator use and at least annually thereafter; the tested employee passed the qualitative fit test or achieved a sufficiently high fit factor to pass the quantitative fit test for the required assigned protection factor; the quantitative fit test was correctly performed, and the fit factor calculated properly; and the model and size of the respirator used during fit testing are the same as the model and size of the respirator used by the employee in the workplace.

New Fit Test Protocols

Paragraph (f)(3) of the proposed rule stated that OSHA would evaluate new fit test protocols under criteria specified in Section I of Appendix A and would initiate rulemaking under section 6(b)(7) of the OSH Act if the proponent of a new fit test method submitted the method and validation testing data to OSHA for evaluation. The section listed detailed criteria OSHA would apply in determining whether to approve the new protocol.

Some commenters recommended alternative approaches for approving new fit test protocols. Mobil Oil (54–234) and the American Petroleum Institute (Ex. 54–330) suggested that NIOSH should be the reviewer of alternative fit test methods. Exxon (Ex. 54–266) questioned the role OSHA would have in the approval of new fit test protocols, stating that NIOSH or other agencies or laboratories could better review new fit test methods. The American Association of Occupational Health Nurses (Ex. 54–213) supported the use of other new fit test methods, provided that they have been demonstrated to be statistically equivalent to the existing OSHA-accepted methods, but stated that the administrative rulemaking procedure OSHA had proposed would result in delays and paperwork that would discourage the development of new methods. The Composites Fabricators Association (Ex. 54–295) also stated that subjecting new fit test methods to rulemaking would discourage an employer from developing or adopting any fit test method not already approved by OSHA. The Society of the Plastics Industry (Ex. 54–310) stated that rulemaking on new methods was unnecessary, and that OSHA should publish criteria for fit tests and allow employers to adopt new methods without cumbersome rulemaking. The National Association of Manufacturers (Ex. 54–313) proposed that publication of a new fit test method in a peer-reviewed journal should be *prima facie* evidence that the method had been validated.

OSHA cannot accept the suggestion by some commenters that it should accept new fit test protocols without following the OSH Act's rulemaking procedures. Appendix A was adopted under the OSH Act's rulemaking procedures and, under section 6(b) of the Act, can only be modified through the same rulemaking procedures. Modifications to Appendix A to add new fit test protocols would therefore

have to undergo the same type of rulemaking scrutiny, including the opportunity for public comment, that the approved protocols have received.

In response to comments received, OSHA has modified Appendix A from the version contained in the proposal. These changes streamline the process of approving new fit test protocols by assuring that any new method proposed is supported by data of high quality. As modified, Appendix A also takes a more performance-oriented approach to the approval process than did the proposal. Rather than listing the detailed criteria a new fit test protocol must satisfy, final Appendix A requires that a proposed new protocol be supported either by test results obtained by an independent government research laboratory or by publication in a peer-reviewed industrial hygiene journal.

Both of these options will assure that any new fit test protocol proposed will have a sound scientific basis before being submitted to OSHA. Government research laboratories such as Los Alamos National Laboratory and Lawrence Livermore National Laboratory have considerable expertise in reviewing new fit test protocols to determine whether they are safe, accurate, and statistically valid. A favorable recommendation by such a laboratory, along with the supporting data gathered by the laboratory, will provide a solid basis on which OSHA can base its evaluation. Moreover, because the laboratory's report and recommendation will be in the public record when the OSHA rulemaking proceeding begins, the public will have the opportunity to examine the data supporting the proposed new method and to provide any additional data either in support of or in opposition to the proposed method.

An application for a new test protocol that has been published in a peer-reviewed industrial hygiene journal will similarly provide a sound basis for rulemaking on the new method. Like review by a national research laboratory, the peer-review process assures that the data supporting the method has been scrutinized and found acceptable by a neutral party with expertise in evaluating fit test methods. The published article would be available to the public when the rulemaking commences, and interested members of the public would therefore be apprised of all relevant aspects of the proposed method and would be well-positioned to comment on the method.

OSHA believes that the final rule's approach will streamline the process of accepting new fit test protocols and avoid discouraging the development of new methods. A rulemaking on a new protocol would thus only begin after the protocol's proponent has established a solid basis for seeking the Agency's approval. At the time the rulemaking begins, interested members of the public would know the scientific basis on which approval is sought and would be able to afford OSHA the benefit of their views. The rulemaking process should therefore be able to proceed more quickly than if OSHA were to evaluate data that had not previously been scrutinized by an expert body and were to base the approval process on the detailed criteria contained in Appendix A of the proposed rule. And because the rulemaking process can be expected to proceed expeditiously once a qualifying application has been submitted, parties interested in developing new protocols should not be discouraged from doing so.

New fit test methods are to undergo notice and comment rulemaking. This decision reflects OSHA's long experience in evaluating fit test methods, which includes, in this rulemaking, such fit test methods as the ''condensation nuclei counter'' (CNC) method and the ''controlled negative pressure'' (CNP) method and, in past rulemakings, the ''saccharin QLFT'' method and the ''isoamyl acetate QLFT'' method. In the past 20 years there have only been a few new methods, but each has required the evaluation of supporting data, and each new method has generated wide public interest and comment. New fit test methods, particularly those that involve new scientific principles and new techniques for evaluating respirator performance, require full consideration and public discussion of the issues by the regulated community, competitive interests, respirator experts, and labor groups. The notice and comment rulemaking process will ensure that OSHA receives the necessary public input, as well as data required for open evaluation, and that all interested parties have a chance to comment publicly on any new method. Publishing a new fit test method in the **Federal Register** should: elicit public comment and debate over the merits of the method; notify the regulated community of the possible availability of a new method; and solicit any additional information that would be relevant for consideration before OSHA makes its final decision. OSHA does not intend the rulemaking process to be cumbersome or involved, but such a process will ensure that all information and comments are available to the public, and that any known problems with the new method are addressed before final acceptance.

Adopting an approach that allows for the acceptance of new fit test methods is a fundamental change to this standard. Fit test methods directly impact a worker's health, since fit tests are designed to identify poorly fitting respirators. Without the careful evaluation that a new fit test method will receive during the rulemaking process, OSHA cannot be sure that a flawed fit test method would not be developed and marketed to respirator users. If used to select respirators, a flawed method would lead to unnecessary worker exposure to hazardous substances, since poorly fitting respirators would not be detected by the method. Determining the reliability of new fit test methods requires more evaluation, for example, than do new respirator cleaning methods or new user seal check methods, which can be developed by the respirator manufacturer (See Appendix B). New cleaning methods and user seal checks need not undergo rulemaking to become accepted methods. The more rigorous evaluation through notice and comment is required only for new fit testing methods, where OSHA experience has shown the need for a public review of performance.

Moldex (Ex. 54–153) Mobil Oil (Ex. 54–234), Exxon (Ex. 54–266), and the American Petroleum Institute (Ex. 54–330), recommended that OSHA allow interested parties other than employers to submit new fit test methods for OSHA acceptance. In the past, OSHA has allowed other interested parties, such as the developers of new fit test equipment, to submit new test protocols and methods for OSHA approval, and will continue to do so. To make this explicit, the final rule states that a proposed new protocol may be submitted by any person.

Paragraph (g)—Use of Respirators

The final rule requires employers to establish and implement procedures for the proper use of respirators. Paragraph (g)(1) contains specific requirements for ensuring an adequate facepiece seal each time a respirator is used. Paragraph (g)(2) requires employers to reevaluate respirator effectiveness when there are changes in environmental or user conditions, as well as requiring that employees leave the respirator use area if they detect any signs that respirator effectiveness has been compromised or to perform any adjustments. Paragraphs (g)(3) and (g)(4) address procedures for the use of respirators in IDLH atmospheres and in interior structural fire fighting, respectively.

Paragraph (g) of the proposal addressed the same issues in the context of requiring employers to develop and implement written standard operating procedures. As suggested by a number of commenters, OSHA has deleted the requirement for written procedures in light of the fact that paragraph (c) already requires a written respiratory protection program (Exs. 54–38, 54–163, 54–226, 54–428). In addition, OSHA has moved to paragraph (d), governing respirator selection, the proposed paragraph (g) requirement that employers ensure that SCBAs are certified for a minimum service life of 30 minutes if they are to be used in IDLH atmospheres, for emergency entry, or for fire fighting. Final paragraph (g) thus contains only those requirements necessary for the appropriate use of respirators in non-IDLH, IDLH, and interior structural fire fighting atmospheres.

Paragraph (g)(1)—Facepiece Seal Protection

Paragraphs (g)(1)(i) and (g)(1)(ii) are intended to ensure that facial hair, other conditions potentially interfering with the facepiece seal or valve function, and eyewear or other personal protective equipment does not interfere with the effective functioning of the respirator. Paragraph (g)(1)(iii) requires employees to perform a user seal check each time they put on a respirator for use in the workplace.

Paragraph (g)(1)(i)(A) prohibits an employer from allowing respirators with tight-fitting facepieces to be worn by employees who have ''facial hair that comes between the sealing surface of the facepiece and the face or that interferes with valve function.'' Paragraph (g)(1)(i)(B) prohibits tight-fitting facepieces to be worn by employees who have any condition that interferes with the face-to-facepiece seal or with valve function. The prior standard prohibited the wearing of respirators ''when conditions prevent a good face seal. Such conditions may be a growth of beard [or] sideburns * * *.'' The proposed requirement would similarly have prohibited employers from allowing tight-fitting respirator facepieces to be worn by employees ''with conditions that prevent such fits.'' ''Facial hair that interferes with the facepiece seal'' was listed as one example of such a condition. The final rule thus clarifies the language of the NPRM.

OSHA's final standard affords employers more flexibility than the ANSI Z88.2–1992 standard, Section 7.5.1, which prohibits the use of any respirator equipped with a facepiece, whether tight or loose-fitting, if the user has facial hair that comes between the sealing surface of the facepiece and the face. Although some commenters recommended that OSHA adopt the language of the ANSI standard (Exs. 54–218, 54–219), OSHA has determined that it is only necessary to apply the facial hair prohibition to tight-fitting respirators.

The rulemaking record (Exs. 15–11, 15–26, 15–28, 15–27A, 15–30, 15–33, 15–35, 15–36, 15–41, 15–52, 15–58, 15–62, 15–73, 15–77) also contains strong evidence that facial hair can interfere with tight-fitting facepiece seals. According to the study by Hyatt and Pritchard, discussed further below, facial hair includes stubble (Ex. 23–5). A number of studies and comments that were submitted to the record (Exs. 23–5, 36–49, 36–31, 36–45, 36–47, 54–443D, 54–408) addressed the effect of facial hair on respirator performance. McGee and Oestenstad (Ex. 23–2) tested eight volunteers on a closed-circuit, pressure-demand, self-contained breathing apparatus. The volunteers were clean-shaven at the beginning of the study. They underwent quantitative fit tests at two-week intervals over an eight-week beard growth period. Beard growth had a profound, negative effect on the observed fit factors. Most of the volunteers started with fit factors of 20,000 when first fit tested; after eight weeks, these same workers achieved fit factors ranging only from 14 to 1067.

In another study, E.C. Hyatt, J.A. Pritchard and others (Ex. 23–5) investigated the effect of facial hair on the performance of half-mask and full-facepiece respirators. Quantitative fit tests were performed on test volunteers with varying amounts of facial hair, including stubble, sideburns, and beards. The results showed that facial hair can have a range of effects on respirator performance, depending on factors such as the degree to which the hair interferes with the sealing surface of the respirator, the physical characteristics of the hair, the type of respirator, and facial characteristics. In general, the presence of beards and wide sideburns had a detrimental effect on the performance of the respirators. The authors concluded that:

- Individuals with excessive facial hair, including stubble and wide sideburns, that interfere with the seal cannot expect to obtain as high a degree of respirator performance as clean shaven individuals.
- The degree of interference depends on many factors (e.g., the length, texture, and density of facial hair) and the extent to which those factors interfere with the respirator's sealing surface.
- Short of testing a bearded worker for fit daily, the only prudent approaches are to require that facial hair not interfere with the respirator seal surface (e.g., shave where the seal touches the face) or to prohibit the employee from working in areas requiring respiratory protection.

Other fit testing studies also show that non-bearded workers have significantly higher fit factors than bearded workers. Skretvedt and Loschiavo (Ex. 23–3) tested both half-mask and full facepiece respirators on 370 male employees who were fit tested both qualitatively and quantitatively; 67 of the employees had full beards. The bearded workers consistently failed qualitative fit testing. Bearded employees using half-masks had a median fit factor of 12, while clean-shaven employees had a median fit factor of 2950. For full facepiece respirators, bearded workers had a median fit factor of 30 and clean-shaven employees had a fit factor of greater than 10,000.

Only one study found no significant difference in respirator performance for employees with or without beards. Fergin (Ex. 23–1) studied workplace protection factors, but not fit factors, for three different types of disposable respirators used by carbon setters during carbon setting and ore bucket filling operations. The study, which involved a total of 75 samples collected from 38 non-bearded and 22 bearded workers, compared ambient concentrations with ''in-mask'' concentrations. Beard types were classified as light, medium, heavy, fine, soft, coarse, and curly. Results showed no clear relationship between type of beard and respirator protection factor. The authors recommended that, ''* * * where acceptable protection factors can be demonstrated for subjects with facial hair, the no-beard rule should be waived.''

OSHA does not find this study a persuasive basis for changing its position on facial hair. The fact that an acceptable protection factor can be obtained for a bearded respirator wearer in a workplace protection factor study does not mean that the worker can achieve the same protection level each time the respirator is used. First, protection factor studies are designed to minimize program defects and are often conducted under very tight supervision, which is generally not typical of conditions in real workplaces. Second, beards grow and change daily, resulting in variability of protection from one day to the next.

Fergin based his conclusion that respirator performance is similar for

bearded and non-bearded workers on a statistical comparison of geometric means, calculated separately for each type of respirator for bearded and non-bearded workers. OSHA is more concerned about the wide range of values than the geometric mean values. The protection factors observed by Fergin varied greatly and ranged from 1–1041 (no beards) and 4–332 (beards) for a 3M–9910 respirator; 12–36 (no beards) and 7–30 (beards) for a 3M–8706 respirator; and 5–1006 (no beards) and 42–391 (beards) for a 3M–9906 respirator. OSHA notes that the protection factors of 5 and lower that Fergin achieved for both bearded and clean-shaven workers are below the NIOSH recommended protection factors for disposable respirators of the types tested by Fergin (NIOSH Respirator Decision Logic, 1987, Ex. 9).

There are several other weaknesses in this study that undermine its use as a counterweight to so much other evidence and expert opinion. The study did not account for particle size or the differences between protection factors obtained when the respirators were used in high as compared to low ambient concentrations. Moreover, two of the three respirators involved lacked adjustable face straps, which makes any sort of tightening impossible. Finally, the author himself cautioned that facial hair can significantly impair respirator seal effectiveness in atmospheres that are highly toxic or IDLH.

In fact, most rulemaking participants (Exs. 3, 13, 15–50, 23–2, 23–3, 23–5) agreed that facial hair can be a problem for respirator users, although they suggested different approaches to address this issue. A few commenters recommended that OSHA simply prohibit the use of respirators by bearded workers, based on the ANSI rationale that beards interfere with the functioning of all respirators (Exs. 54–443, 54–408). In general, these commenters were opposed to any requirement in the standard that would have required employers to provide bearded workers with loose-fitting respirators to accommodate their beards. Other commenters stated that OSHA should require employers to provide loose-fitting respirators (e.g., supplied-air hoods, helmets, or suits) for use by employees with beards (Exs. 15–14, 15–31, 15–34, 15–46, 15–47, 15–48, 15–54, 15–55, 15–79, 15–81, 54–427, 54–387, 54–363). For example, NIOSH recommended that, when the situation permits, employers should be allowed to accommodate bearded workers by providing respirators that will not be affected by facial hair (Ex. 54–437). Daniel Shipp of the Industrial Safety Equipment Association (ISEA) also stated that, in situations where employers do not intend to enforce policies against facial hair, the ISEA would recommend that employers provide respirators that do not rely on a tight facepiece fit (Ex. 54–363).

Richard Uhlar and Michael Sprinker of the International Chemical Workers Union (ICWU) stated that there should be some provision in the standard to notify employees that respirators other than tight-fitting respirators can be used by bearded workers (Ex. 54–427). This comment is in basic agreement with NIOSH's recommendation that there should be some provision in the standard to notify employees that other respirators that can be worn with beards exist (Ex. 54–437).

In contrast, other commenters (Exs. 54–408, 54–443) recommended that OSHA prohibit the wearing of beards by employees who use respirators on the grounds that employers should not have to supply loose-fitting respirators because an employee is unwilling to shave off his beard. More specifically, George Thomas of Duquesne Light Company (Ex. 54–408) stated that his company does not support a requirement that employers should provide workers with loose-fitting respirators when employees have facial hair. According to Mike Rush of the Association of American Railroads, requiring employers to provide respirators other than tight-fitting air-purifying respirators would be cost-prohibitive, because PAPRs cost 50 times as much as half masks (Ex. 54–286). A. Gayle Jordan of Norfolk Southern Corporation quoted the cost of a PAPR as $700 (Ex. 54–267).

This standard does not interfere directly with employer policies regarding facial hair. Instead, it requires employers to take the presence or absence of facial hair into consideration in developing policies for a given workplace; different policies may affect the range of choices available. However, OSHA notes that several respiratory protection alternatives, such as loose-fitting hoods or helmets, are available to accommodate facial hair.

Some commenters focused on the specific language in the proposal. One commenter said that the term ''any hair growth'' should be substituted for ''facial hair'' (Ex. 54–69). Another urged OSHA to specify what acceptable facial hair growth was (Ex. 54–138). OSHA believes that the term ''facial hair'' is appropriate because the record shows that any facial hair, including beard stubble, can interfere with facepiece seal (Exs. 23–5, 54–69). By prohibiting hair that ''comes between the sealing surface of the facepiece and the face,'' as well as hair that ''interferes with valve function,'' OSHA believes it is being as precise as possible. OSHA believes that the second phrase is necessary because employees with large beards may shave the skin area where the facepiece of the respirator seals to the face but the fullness or length of the beard could still block the valve or cause the valve to malfunction.

In a standard that will apply as broadly as this one will, it is not possible for OSHA to specify every condition under which respirator use may be affected by an employee's facial hair. Workplace situations are variable, as is hair growth. OSHA has instead written the standard in performance-oriented terms, stressing the importance of the face-to-facepiece seal and conditions that might interfere with that seal. The thrust of the entire standard is on making sure that the fit and the performance of the respirator are not compromised. Employers, therefore, must ensure that respirators fit and perform properly.

Paragraph (g)(1)(i)(B) prohibits an employer from allowing respirators with tight-fitting facepieces to be worn by employees who have any condition that interferes with the face-to-facepiece seal or valve function. Examples of these conditions include, but are not limited to, missing dentures, the presence of facial scars, the wearing of jewelry, or the use of headgear that projects under the facepiece seal. As with the facial hair requirements, the intent of this provision is to prevent an employee from wearing a respirator if there is any factor that could prevent an adequate facepiece-to-face seal. Therefore, conditions such as missing dentures or facial scars will not prevent an employee from using a respirator where it can be demonstrated that those conditions do not prevent an adequate seal.

Paragraph (g)(1)(ii) requires employers to ensure that corrective glasses or goggles or other personal protective equipment is worn in a manner that does not interfere with the seal of the facepiece to the face of the user. The proposal contained a similar provision that addressed only eyewear. The prior standard contained a similar provision, but also prohibited the use of contact lenses with respirators. Final paragraph (g)(1)(ii) is consistent with the 1992 ANSI standard, which allows the use of corrective lenses, spectacles, and face protection devices, providing that these items do not interfere with the seal of the respirator; ANSI also allows the use of contact lenses where the wearer has successfully worn such lenses before

and practices wearing them with the respirator.

Most comments supported the proposed provision (Exs. 54–68, 54–266, 54–286, 54–150, 54–155, 54–177, 54–189, 54–196, 54–209, 54–214, 54–219, 54–222, 54–346, 54–402, 54–408, 54–267, 54–286, 54–361, 54–232, 54–234, 54–244, 54–245, 54–263, 54–265). Some commenters, however, addressed specific pieces of corrective eyewear. For example, Barbara Price of the Phillips Petroleum Company recommended, based on the company's experience with successful quantitative fit testing of employees while wearing sports goggles, that prescription sports goggles be permitted with full facepiece respirators (Ex. 54–165). Darrell Mattheis of the Organization Resources Counselors (ORC) also supported the use of prescription sports goggles, such as the mask-adaptable goggles (MAG–1) by Criss Optical, with a full facepiece respirator, based on ORC companies' successful quantitative fit testing experience (Ex. 54–424).

Again, the standard is written in performance terms so that any particular piece of equipment may be used as long as it does not interfere with the facepiece seal. This has consistently been OSHA's position under the prior standard as well. For example, in a compliance interpretation letter dated April 7, 1987, OSHA addressed the use of eyeglass inserts or spectacle kits inside full facepiece respirators. OSHA stated that eyeglass inserts or spectacle kits are acceptable if the devices: (1) Do not interfere with the facepiece seal; (2) do not cause any distortion of vision; and (3) do not cause any physical harm to the wearer during use (Ex. 64–519).

OSHA again addressed the appropriateness of using the MAG–1 goggles with full facepiece respirators and SCBAs in a September 20, 1995, letter to the Excelsior Fire Department. By 1995, OSHA had the benefit of four quantitative fit testing studies of MAG–1 goggles, two funded by the goggle manufacturer and the other two funded by OSHA itself. The letter to Excelsior stated that since the MAG–1 straps project under the facepiece, use of the MAG–1 could in some cases violate paragraph (e)(5)(i) of the previous standard. The letter concluded that obtaining a fit with these goggles is quite complex because the respirator user may be able in some cases to control the factors determining whether a seal can be obtained. (For a full discussion, see letter, 9/20/95, Ex. 64–520, Docket H–049a.) In a post hearing comment submitted by the Exxon Company, Steve Killiany commented about Criss Optical Mag Spectacles with thin rubber straps (Ex. 183). Mr. Killiany stated that the spectacles can safely be worn with full facepiece respirators as long as users are fit tested with the spectacles in place during fit tests. In its program, Exxon prohibits eyeglasses with temple pieces for users of full facepiece respirators. Exxon also prohibits hard contact lenses, but users are allowed to wear soft contact lenses.

The NPRM contained a lengthy explanation of OSHA's proposal not to include a prohibition against the use of contact lenses with respirators in the final rule (59 FR 58921, 11/15/94). Although a few participants requested that OSHA retain the prohibition, or at least prohibit contact lenses in certain situations (Exs. 54–334, 54–387, 54–437), most of the commenters agreed with OSHA's conclusion that contact lenses can be used safely with respirators (Exs. 54–68, 54–266, 54–286, 54–150, 54–155, 54–177, 54–189, 54–196, 54–209, 54–214, 54–219, 54–222, 54–232, 54–234, 54–244, 54–245, 54–263, 54–265, 54–346, 54–402, 54–408, 54–267, 54–286, 54–361). For example, NIOSH specifically recommended that OSHA allow respirator users to wear contact lenses (Ex. 54–437). Larry DeCook, President of the American Optometric Association, stated that the Association was not aware of any reports of injury because of the use of contact lenses with respirators (Ex. 54–235). Similarly, a study by the Lawrence Livermore National Laboratory showed that far fewer firefighters who wore contact lenses with their SCBAs had problems that necessitated the removal of their facepieces than did firefighters wearing glasses (Ex. 38–9). Finally, OSHA's review of the record identified no evidence that the use of contact lenses with respirators increases safety hazards.

OSHA notes that employers of employees who wear corrective eyewear must be sure that the respirator selected does not interfere with the eyewear, make it uncomfortable, or force the employee to remove the eyewear altogether. Employers should use the respirator selection process to make accommodations to ensure that their respirator-wearing employees can see properly when wearing these devices.

In this final rule, OSHA has also expanded the requirements of paragraph (g)(1)(ii) to cover personal protective equipment other than goggles and glasses. Other forms of personal protective equipment are required by OSHA under specific circumstances (See, e.g., Subpart I—Personal Protective Equipment, and Section 1910.133—Eye and face protection). Like eyewear, this equipment may interfere with the fit of respiratory protection equipment. The generic phrase ''other personal protective equipment'' applies to faceshields, protective clothing, and helmets, as well as to any other form of personal protective equipment that an employee may wear that could interfere with safe respirator use.

Paragraph (g)(1)(iii) requires employers to ensure that their employees perform user seal checks each time they put on a tight-fitting respirator, using the ''user seal check'' procedures in Appendix B–1 or equally effective procedures recommended by the respirator manufacturer. The proposal would also have given employers the option of using either the Appendix B–1 procedures or those recommended by the manufacturer, which is also the approach recommended by the ANSI standard. Although the prior standard also required a fit check each time the worker used a respirator, it mandated that the manufacturer's instructions be followed when performing the check.

OSHA's prior respirator standard referred to respirators being ''fit * * * checked.'' The NPRM used the phrase ''facepiece seal check,'' and this has been changed in the final standard to ''user seal check.'' The three phrases are synonymous, and all three were used interchangeably by rulemaking participants (e.g., Exs. 54–218, 54–219, who recommended that the term ''fit check'' be used to be consistent with the ANSI Z88.2–1992 definition). Other commenters (Exs. 54–5, 54–408) used the term ''seal check'' or ''facepiece seal check.'' The final standard uses the term ''user seal check'' because OSHA believes that this phrase best describes the actual procedure to be performed by the respirator wearer. Also, commenters stated that the similarity between the terms ''fit check'' and ''fit test'' might lead to confusion, causing employers erroneously to conclude either that complete fit testing must be done each time an employee puts on a respirator or that the fit check can be substituted for a fit test.

In general, commenters (Exs. 54–221, 54–185, 54–321, 54–427, 54–414, 64–521) agreed with OSHA that user seal checks are necessary. Although these checks are not as objective a measure of facepiece leakage as a fit test, they do provide a quick and easy means of determining that a respirator is seated properly. If a user seal check cannot be performed on a tight-fitting respirator, the final rule prohibits that respirator from being used. Appendix B–1, which derives from the 1992 ANSI standard, contains procedures for user seal checking of negative pressure and

positive pressure devices. It states that a check is to be performed every time the respirator is donned or adjusted to ensure proper seating of the respirator to the face.

Participants expressed diverse views on whether the negative/positive fit check procedures in Appendix B–1 should be the exclusive means of compliance with this requirement or whether procedures recommended by respirator manufacturers should also be allowed. John Hale of Respirator Support Services stated that the only way to perform a fit check is to use the negative/positive fit check methods in Appendix B–1 (Ex. 54–5). George Notarianni of Logan Associates also recommended that reference to manufacturers' procedures for fit checking be deleted, because he was unaware of any effective fit check methods other than those described in Appendix B (Ex. 54–152). Richard Miller of the E.D. Bullard Company, however, stated that the manner in which fit checks are conducted should be left up to the manufacturer (Ex. 54–221).

The positive/negative user seal checks described in Appendix B–1 cannot be performed on all tight-fitting respirators. William Lambert of the Mine Safety Appliances Company (MSA) (Ex. 54–414) stated that respirators for which negative or positive pressure tests cannot be performed should not be used. He also recommended that OSHA work cooperatively with NIOSH to develop a testing protocol that would preclude approval of respirators that cannot be easily checked using a positive/negative fit check.

The rulemaking record, however, contains evidence that effective user seal checks can be performed in several ways. OSHA reviewed a study by Myers (1995) in which the authors described several ANSI fit check methods, an AIHA/ACGIH negative/positive pressure check, and manufacturer-recommended check methods (See Myers et al., ''Effectiveness of Fit Check Methods on Half Mask Respirators,'' in Applied Occupational Environmental Hygiene, Vol. 10(11), November 1995) (Ex. 64–521). In addition, the authors briefly explained that manufacturers of disposable, filtering facepieces recommended covering the mask with both hands, exhaling, and checking for air flow between the face and the sealing surface of the respirator. Since it was not the intent of the authors to evaluate different fit check methods, they did not present any comparison data; however, they did conclude that employing the manufacturer's recommended fit check procedure will help detect and prevent poor respirator donning practices. OSHA is also aware that some manufacturers make a fit check cup that can be used to perform a user seal check even with valveless respirators. The final rule thus allows for the use of the methods in Appendix B–1 as well as manufacturers' recommended procedures for user seal checks where these are equivalently effective. This means that respirator manufacturers' recommended procedures may be used for user seal checking if the employer demonstrates that the manufacturer's procedures are as effective as those in Appendix B–1. The intent of the ''equally effective'' phrase is to ensure that the procedures used have been demonstrated to be effective in identifying respirators that fit poorly when donned or adjusted. OSHA believes that the use of performance language will provide incentives to respirator manufacturers to develop new user seal check methods and to develop respirators for which user seal checks can be performed.

There are also respirators for which no user seal checks can be conducted. A number of rulemaking participants argued that the inability to seal check a respirator should disqualify these respirators from use (See, e.g., Exs. 54–152, 54–408, 54–427, 54–321). For example, William Lambert of MSA (Ex. 54–414) pointed out that, since respirators are not put on and taken off the same way each time, the seal check is essential to verify that the user has correctly donned the respirator.

OSHA agrees with those commenters who stated that OSHA should not allow the use of respirators that cannot be fit checked. Without the ability to perform user seal checks, employees may be overexposed to respiratory hazards as a result of the respirator leakage caused by multiple redonnings and adjustments. OSHA believes that user seal checks are important in assuring that respirators are functioning properly. If no method exists to check how well a respirator performs during multiple redonnings under actual workplace conditions, OSHA does not consider the respirator acceptable for use.

Richard Olson of the Dow Chemical Company raised another issue about paragraph (g)(1)(iii). He stated that use of the word ''ensure'' was inappropriate in this instance, because employers cannot ''ensure'' that user seal checks are performed:

> This is impossible for the employer to do in all cases because the employer is not there. Supervision is not at the work site at all times, sometimes the employee is the only person in the facility. The employee can be trained to do this however the employer can not personally be there to observe and ensure every time the employee wears a respirator (Ex. 54–278).

OSHA has stated consistently, in connection with the use of the word ''ensure'' in other standards, that it is not OSHA's intent that each employee be continually monitored. Further, OSHA case law has held that employers are required by the use of the word ''ensure'' to take actions that will result in appropriate employee behavior. These actions consist of: rules with sanctions, training employees in behaviors required, and exercising diligence in monitoring the safety behavior of their employees. The past enforcement history of the use of the word ''ensure'' in other OSHA standards, including the respirator provisions in substance specific standards, shows that employers who demonstrate this level of responsibility are in compliance with provisions that use the term ''ensure.''

Paragraph (g)(2)—Continuing Respirator Effectiveness

Paragraph (g)(2) contains three sub-paragraphs. Paragraph (g)(2)(i) requires employers to be aware of conditions in work areas where employees are using respirators. Paragraph (g)(2)(ii) requires employers to ensure that their employees leave the respirator use area to perform any activity that involves removing or adjusting a respirator facepiece or if there is any indication that a respirator may not be fully effective. Paragraph (g)(2)(iii) requires employers to replace, repair, or discard respirators if there is any indication that they are not functioning properly.

The prior standard did not contain any of these provisions; however, OSHA proposed them after including similar requirements in a number of OSHA substance-specific health standards. OSHA believes that these provisions are important because the effectiveness of even the best respirator program is diminished if employers do not have procedures in place to ensure that respirators continue to provide appropriate protection.

Final paragraph (g)(2)(i), which states, ''Appropriate surveillance shall be maintained of work area conditions, and degree of employee exposure or stress,'' reiterates paragraph (b)(8) of the prior standard. This means that employers are required to evaluate workplace conditions routinely so that they can provide additional respiratory protection or different respiratory protection, when necessary. By observing respirator use under actual workplace conditions, employers can

note problems such as changes in the fit of a respirator due to protective equipment or conditions leading to skin irritation. The employer can then make adjustments to ensure that employees continue to receive appropriate respiratory protection.

Paragraph (g)(2)(ii) requires employers to ensure that employees are allowed to leave the respirator use area in several circumstances. The intent of this requirement is to ensure that employees leave the area when necessary. The final standard stipulates that, in these cases, employees are to leave the ''respirator use'' area, not the work area or workplace. This language is intended to give employers the flexibility to establish safe areas in their workplaces that will minimize interruptions in work flow and production while ensuring that the area where respirators are removed is free of respiratory hazards or contamination.

Paragraph (g)(2)(ii)(A) requires employers to ensure that their employees leave the respirator use area to wash their faces and respirator facepieces as necessary to prevent eye or skin irritation; such irritation occurs frequently with the wearing of tight-fitting respirators. Many of OSHA's substance specific-standards, such as the cadmium (29 CFR 1910.1027) and arsenic (29 CFR 1910.1018) standards, as well as the ANSI Z88.2–1992 standard, contain provisions allowing employees to leave the respirator use area to wash their faces and respirator facepieces to prevent the skin irritation that is often associated with the use of respirators. Paragraph (g)(2)(ii) is thus consistent with these requirements of the Agency's substance-specific standards, as well as with the ANSI Z88.2–1992 standard.

A number of participants (Exs. 54–6, 36–47, 54–362) questioned the need for this provision, however. For example, Christopher Seniuk of Lovell Safety Management Company stated that allowing employees to leave the area to wash their faces is counterproductive because allowing frequent breaks increases the chance of contamination while putting on and removing the respirator (Ex. 54–6). Richard Boggs of ORC (Ex. 36–47) also recommended that this requirement be dropped, on the grounds that the frequency with which employees leave their work areas is a ''labor relations'' issue. Kevin Hayes of ABB Ceno Fuel Operations (Ex. 54–362) expressed a similar concern; he suggested that employees be allowed to leave the work area periodically, rather than on an ''as necessary'' basis, and asked that OSHA quantify the extent of skin irritation that needed to be present for employees to leave the area for washing and cleaning. Mr. Hayes was concerned that disgruntled employees could use this requirement to ''establish a revolving door from the work area.''

Dr. Franklin Mirer, director of safety and health for the United Auto Workers, supported this provision, however; he stated that allowing employees to leave the area to wash would lead to fewer hygiene problems (Ex. 54–387). OSHA agrees with Dr. Mirer: if employees are allowed to wash their faces and respirators, the amount of contamination will be reduced, employees' hands and respirators will be cleaner, and employees will be donning cleaner respirators. OSHA believes that, to protect employee health, employees must be able to wash their faces and facepieces as often as necessary. The skin irritation caused by dirty respirators can interfere with effective respirator use (Ex. 64–65). Clearly, any skin irritation that causes the wearer to move the respirator in a way that breaks the facepiece-to-face seal is sufficient to warrant an employee leaving the respirator use area to wash. Whenever eye or skin problems interfere with respirator performance, the wearer should be able to leave the use area.

Paragraphs (g)(2)(ii)(B) and (C) require the employer to ensure that employees leave the respirator use area if they detect vapor or gas breakthrough, changes in breathing resistance, or leakage of the facepiece, and to replace the respirator or the filter, cartridge, or canister elements when these have been exhausted. These requirements are consistent with the NIOSH Respirator Decision Logic (Ex. 9, page 8), which states that workers who suspect respirator failure should be instructed to leave the contaminated area immediately to assess and correct the problem. In addition, employees may need to leave the respirator use area to change the cartridge or canister when the end-of-service-life indicator (ESLI) or change schedule demands a change in canister or cartridge. (See the Summary and Explanation for paragraphs (c) and (d).) The requirements in paragraph (g)(2)(ii)(B) are essential to ensure the continuing effectiveness of the protection provided to the wearer by the respirator. If, for example, the wearer can detect the odor or taste of a vapor or gas, the cartridge or canister is clearly no longer providing protection. Similarly, if a filter element is so loaded with particulates that it increases the work-of-breathing, it clearly must be changed to continue to be effective. The leakage of air through the facepiece also requires immediate attention, because it is a sign that the facepiece-to-face seal has been broken and that the wearer is breathing contaminated air.

Paragraph (g)(2)(ii)(C) requires employers to ensure that respirator wearers leave the use area when the filter element, cartridge, or canister must be changed in order for it to continue to provide the necessary protection. In the proposal, the term ''filter elements'' was used instead of the more specific language ''cartridge'' and ''canister,'' and the proposed language generated several comments requesting the Agency to clarify this terminology (See, e.g., Ex. 54–173). A representative from Monsanto Company suggested that OSHA should change the language from ''filter'' to ''cartridge'' or ''canister'' (Ex. 54–219) because filters apply only to particulates, not vapors and gases. Larry Zobel, Medical Director of 3M, made a similar comment (Ex. 54–218). OSHA has amended the language in final paragraph (g)(2)(ii)(C) to make it more precise, and the final rule uses the terms ''cartridge,'' ''canister,'' and ''filter'' as these specifically apply.

Paragraph (g)(2)(iii) requires the employer to replace, repair, or discard a respirator that is not functioning properly. This requirement applies in addition to the provisions in paragraphs (d) and (h) of this section that address the routine replacement of respirators and respirator parts. The language of this paragraph has been changed from the proposal to emphasize that a malfunctioning or otherwise defective respirator must be replaced or repaired before the user returns to the work area.

Rulemaking participants agreed that respirators should not be used if they are defective in any way (See, e.g., Ex. 54–362, Kevin Hayes of ABB Combustion Engineering Nuclear Operations). However, one commenter, Peter Hernandez of the American Iron and Steel Institute, objected to the proposal's requirement that defective respirators be repaired ''immediately.'' Mr. Hernandez stated that it is necessary immediately to replace, but not immediately to repair or discard, a defective respirator (Ex. 54–307). OSHA agrees that employers can delay repairing or discarding respirators so long as the affected employees have been issued proper replacement respirators. This was the intent of paragraph (g)(8) in the NPRM, and this point has been clarified in the final regulation by placing the word ''replace'' first and deleting the word ''immediately.'' The intent of final paragraph (g)(2)(iii) is to ensure that employees receive the necessary protection whenever they are in a respirator use area. This paragraph

means that employers must ensure that employees in the respirator use area are wearing respirators that are in good working order.

The proposed rule would have required disposables to be discarded at the end of the task or workshift, whichever came first (See paragraph (g)(9) of the NPRM). A number of commenters (See, e.g., Exs. 54–309, 54–307, 54–442) discussed the use of, and the criteria for discarding, disposable respirators. OSHA has deleted specific references to the term ''disposable'' in the final rule and has instead required, in paragraph (g)(2)(iii), that employers replace, repair, or discard respirators if employees detect vapor or gas breakthrough, a change in breathing resistance, or leakage of the facepiece, or identify any other respirator defect, before allowing the employee to return to the work area. This requirement thus focuses on the need for respirators to function properly to provide protection to employees rather than on a time schedule for discarding particular respirators.

Some commenters stated that disposable respirators should be allowed to be used until the physical integrity of the respirator is compromised, which may take longer than one work shift (Exs. 54–190, 54–193, 54–197, 54–205, 54–214, 54–222, 54–241, 54–253, 54–268, 54–271, 54–307, 54–357, 54–171). For example, Peter Hernandez, representing the American Iron and Steel Institute, stated that employees may perform 20 different tasks in a work day (Ex. 54–307). The implication of Mr. Hernandez' comment is that workers who perform short duration tasks would have been required by the proposed requirement to use many disposable respirators in the course of such a day, which would be unnecessarily expensive. Suey Howe, representing the Associated Builders and Contractors, recommended that employees be allowed to keep their disposable respirators in clean containers on days when the same task may be performed intermittently (Ex. 54–309). Homer Cole of Reynolds Metals Company stated that some workplace situations exist where the environment is clean enough for disposable respirators to be reused (Ex. 54–222). Randy Sheppard, Battalion Chief of Palm Beach County Fire-Rescue (Ex. 54–442), stated that disposing of HEPA disposable respirators after each use would be extremely costly for large fire departments that respond to many emergency calls. He noted that these respirators should be discarded, however, when they are no longer in their original working condition, whether this condition results from contamination, structural defects, or wear. In a post hearing comment submitted by the North American Insulation Manufacturers Association (NAIMA), Kenneth Mentzer, Executive Vice President, and others stated that OSHA should make it clear that NIOSH-approved disposable respirators may be used when they provide adequate protection factors for the exposures encountered. The authors of this submission also stated that NIOSH-approved disposable respirators provide protection and have some advantages over reusable respirators (Ex. 176).

Richard Niemeier of NIOSH (Ex. 54–437) recommended that dust-mist and dust-mist-fume disposable respirators not be reused, on the grounds that many of these models degrade in oil mist and humid environments. He also recommended that only filters approved under 42 CFR Part 84 be considered for use beyond one shift.

OSHA has considered all of these comments in revising the language in final paragraph (g)(2)(iii) to reflect a more performance-oriented approach to the replacement, repair, or discarding of respirators. Nonetheless, employers still have the responsibility, in paragraph (a)(2), to ensure that respirators are suitable for each use to which they are put. [See also discussion in NPRM, 59 FR 58922.]

Paragraphs (g)(3) and (g)(4)—Procedures for IDLH Atmospheres and Interior Structural Fire Fighting

Paragraphs (g)(3) and (g)(4) of the final rule contain requirements for respirator use in IDLH atmospheres. Paragraph (g)(3) addresses all IDLH atmospheres, and paragraph (g)(4) contains three additional requirements applicable only to the extra-hazardous environments encountered during interior structural fire fighting. These two paragraphs, which deal with requirements for standby personnel outside the IDLH atmosphere and communication between those standby personnel and the respirator users inside the atmosphere, are intended to ensure that adequate rescue capability exists in case of respirator failure or some other emergency inside the IDLH environment.

Paragraphs (g)(3) (i), (ii), and (iii) require that at least one employee who is trained and equipped to provide effective emergency rescue be located outside the IDLH respirator use area, and that this employee maintain communication with the respirator user(s) inside the area. Paragraphs (g)(3)(iv) and (v) require, respectively, that the employer or authorized designee be notified before the standby personnel undertake rescue activity and that the employer or designee then provide appropriate assistance for the particular situation. Paragraph (g)(3)(vi) addresses emergency equipment needed by the standby personnel so that they can perform their duties effectively.

The prior standard, § 1910.134(e), did not distinguish between types of IDLH atmospheres. Instead, it distinguished between IDLH and potentially IDLH atmospheres. It stated that only one standby person was necessary when a respirator failure ''could'' cause its wearer to be overcome, but that standby ''men'' (plural) with suitable rescue equipment were required when employees must enter known IDLH atmospheres wearing SCBA. Under this provision, at least two standby personnel were required for known IDLH atmospheres (See, e.g., May 1, 1995 memo from James Stanley, Deputy Assistant Secretary, to Regional Administrators and state-plan designees). In IDLH atmospheres where airline respirators are used, the prior standard required that users be equipped with safety harnesses and safety lines to lift or remove them from the hazardous atmosphere and that ''a standby man or men,'' equipped with suitable SCBA, be available for emergency rescue.

The proposal would have required that, for all IDLH atmospheres, at least one standby person, able to provide emergency assistance, be located outside any IDLH atmosphere, and that this person must maintain communication with the employee(s) in the IDLH atmosphere.

The need for standby personnel when workers use respirators in IDLH atmospheres is clear. The margin for error in IDLH atmospheres is slight or nonexistent because an equipment malfunction or employee mistake can, without warning, expose the employee to an atmosphere incapable of supporting human life. Such exposure may disable the employee from exiting the atmosphere without help and require an immediate rescue if the employee's life is to be saved. Accordingly, the standard requires that, whenever employees work in an IDLH atmosphere, at least one standby person must remain outside the atmosphere in communication with the employee(s) inside the atmosphere. It also requires that the standby personnel be trained and equipped to provide effective emergency assistance.

A number of reports from OSHA's investigative files demonstrate the types of failures that can give rise to the need for immediate rescues of workers in

IDLH atmospheres. These cases illustrate that the absence of properly equipped standby personnel greatly increases the risk to the employees who enter the IDLH atmosphere. For example, a fire in a cold-rolling mill triggered a carbon dioxide fire extinguishing system and created an oxygen deficient atmosphere in the mill's basement. Two security guards descended a stairway into the basement to reset the system. Although the employees had been provided SCBAs, they left those respiratory devices in their vehicle and took only a single self-rescuer with them. The workers collapsed upon reaching the bottom of the stairway. No standby personnel were present and, as a result, the workers were not discovered until 30 minutes had elapsed. Attempts to revive them failed. This case illustrates that the suddenness with which workers can be disabled in an IDLH atmosphere can prevent the workers from leaving the atmosphere under their own power and underlines the need for employers to provide standby personnel whenever workers enter such atmospheres. If a properly trained and equipped standby person had been present, that person could have notified the employer that help was needed when the two workers collapsed and could have initiated rescue efforts immediately.

In another case, two mechanics entered a corn starch reactor to perform routine maintenance and repair. Employee No. 1 detected the odor of propylene oxide and then observed the chemical running out of an open vent. Employee No. 1 managed to escape, but employee No. 2 was overcome and died. A standby person equipped with proper rescue equipment would have been able to provide immediate, effective assistance once employee No. 2 was overcome and might have saved that employee's life.

Some cases from OSHA's investigative files involve fatalities that occurred when standby personnel were present but were unable to prevent the fatalities from occurring. These cases illustrate both the types of failures that can give rise to the need for immediate rescue efforts in IDLH atmospheres and the importance of standby personnel being trained and equipped to provide effective rescue capability.

In one case, an employee (No. 1) was working in a confined space while wearing an SCBA. A standby person (No. 2) advised employee No. 1 that the respirator's air supply was low and that he should leave the confined space. However, employee No. 1 collapsed and died before he could exit. Employee No. 2 had no equipment with which to extricate employee No. 1 from the confined space. This example illustrates, first, that even an employee who is properly equipped when entering an IDLH atmosphere may need to be rescued as a result of human error and/or equipment failure. It also illustrates the need for the standby person to be equipped to be able to provide effective emergency rescue.

In yet another case, an employee (No. 1) was sandblasting inside a rail car wearing an airline respirator with an abrasive blasting hood. A standby person (No. 2) was stationed outside the car. During the operation, employee No. 1 swallowed a dental appliance and lost consciousness. Employee No. 2 had not maintained constant communication with employee No. 1 and only discovered that employee No. 1 had been overcome too late to save his life. This case shows that the demanding work often required by a worker constrained by respiratory equipment in an IDLH atmosphere may lead to accidents that can disable the worker and require immediate rescue efforts. It also illustrates that the need for emergency assistance can arise at any time and without warning, and that standby personnel must therefore maintain constant communication with the worker(s) inside the IDLH atmosphere.

Standby personnel must also be adequately trained and equipped to protect themselves against the IDLH atmosphere if an emergency arises. In a recent case, two employees (Nos. 1 and 2) were installing a blind flange in a pipeline used to transfer hydrogen sulfide. As the flange was opened, the hydrogen sulfide alarm sounded. Employee No. 1 tried to remove his full-facepiece respirator, was overcome, and died. Employee No. 2 had previously loosened the straps on his respirator to test for the smell of hydrogen sulfide and was also overcome. A standby person (No. 3) equipped with an SCBA was on the ground outside the area and attempted an immediate rescue. Unfortunately, his respirator caught on an obstruction and tore as he attempted to enter the atmosphere and he, along with employee No. 2, was overcome and required hospitalization. The case is another example of the type of human and equipment failures that can endanger employees who must work in IDLH atmospheres. Although the rescue effort in this case faltered, the presence of a standby person equipped with an SCBA increased the chance that the employees in the IDLH atmosphere could have been rescued before they were killed or seriously injured, and the availability of appropriate respiratory equipment reduced the risk to the standby person who attempted the rescue. It illustrates the benefit of having standby personnel who can undertake immediate rescue efforts and the need for such personnel to be trained and equipped properly for their own protection as well as the protection of the workers in the IDLH atmosphere.

The proposed provision would have required only a single standby person in most IDLH situations. However, firefighter representatives urged OSHA (Ex. 75, Tr. 468–469) to retain the prior standard's requirement for two standby personnel and to expand the provision to cover all IDLH atmospheres. OSHA has determined, however, that outside of the fire fighting and emergency response situations, which are discussed in connection with paragraph (g)(4), environments containing IDLH atmospheres are frequently well-enough characterized and controlled that a single standby person is adequate. In most fixed workplaces, the atmosphere is known, i.e., has been well characterized either through analysis of monitoring results or through a process hazard analysis. For example, employers in chemical plants have conducted comprehensive process hazard analyses as required by OSHA's Process Safety Management standard, 29 CFR 1910.119, to determine which of their process units pose potential IDLH hazards. In such situations, effective communication systems and rescue capabilities have been established. In addition, in many industrial IDLH situations, only one respirator user is exposed to the IDLH atmosphere at a time, which means that a single standby person can easily monitor that employee's status. Even in situations where more than one respirator user is inside an IDLH atmosphere, a single standby person can often provide adequate communication and support. For example, in a small pump room or shed, even though two or three employees may be inside an IDLH atmosphere performing routine maintenance activities such as changing pump seals, one standby person can observe and communicate with all of them. In this type of situation, one standby person is adequate and appropriate.

In other cases, however, more than one standby person may be needed; paragraph (g)(3)(i) of the final standard therefore states the requirement for standby personnel in performance language: ''one employee or, when needed, more than one employee * * * [shall be] located outside the IDLH atmosphere.'' For example, to clean and paint the inside of a multi-level, multi-

portal water tower, a process that often generates a deadly atmosphere as a result of cleaning solution and paint solvent vapors, employees often enter the tower through different portals to work on different levels. In such a situation, there will be a need for good communications at each entry portal, and more than one standby person would be needed to maintain adequate communication and accessibility.

Several commenters (Exs. 54–6, 54–38, and 54–266) requested clarification of the proposed requirements that employers ensure that communication is maintained between the employee(s) in the IDLH atmosphere and the standby personnel located outside the IDLH environment. For example, Exxon (Ex. 54–266) requested that OSHA make clear that, in addition to voice communication, visual contact and hand signals may be used. In response, paragraph (g)(3)(ii) of the final rule clarifies that visual, voice, or signal line communication must be maintained between the employee(s) in the IDLH atmosphere and the employee(s) located outside the IDLH atmosphere.

Under final paragraph (g)(3)(iv), employers must ensure that before entering an IDLH environment to provide emergency rescue, standby personnel notify the employer, or a designee authorized by the employer to provide necessary assistance, that they are about to enter the IDLH area. The employer will have determined, in advance, as part of the written respirator program's worksite-specific procedures, the procedures standby personnel will follow and whom they must notify in rescue situations. The employer's emergency response team may provide the necessary support, or other arrangements may have been made with local firefighting and emergency rescue personnel. The language used requires that the employer be notified, which provides the employer great flexibility in determining who will respond to such emergency rescue situations.

Paragraph (g)(3)(iv) responds to concerns expressed by several participants (Exs. 54–6, 54–266, 54–307, 54–330) about the obligation of standby personnel to provide effective emergency rescue. A number of comments emphasized that standby personnel should not attempt any rescue activities without making sure that their own whereabouts are known and monitored. According to Exxon (Ex. 54 266), ''the ''stand-by'' person should be able to summon effective emergency assistance and only *then provide* the assistance.'' Christopher Seniuk of Lovell Safety Management Company also stated that a standby employee should have a telephone or radio to summon help and should not be expected to enter an IDLH environment for rescue until additional help arrives (Ex. 54–6). The American Iron and Steel Institute (Ex. 54–307) agreed, stating that the standby person should be in communication with the employee(s) in the IDLH atmosphere and be ''able to assist in providing or obtaining effective emergency assistance.'' The American Petroleum Institute (Ex. 54–330) also stated that when the employee wears a respirator in an IDLH atmosphere, the employer must ensure that adequate provisions have been made for rescue.

OSHA agrees that standby personnel should contact the employer or employer's designee before undertaking any rescue activities in an IDLH atmosphere. Accordingly, final paragraph (g)(3)(iv) includes an employer or designee notification requirement. Although this requirement was not contained in the NPRM, a similar requirement has been included in other OSHA standards, e.g., the Permit Required Confined Spaces standard, 29 CFR 1910.146, and the Hazardous Waste Operations and Emergency Response standard, 29 CFR 1910.120. By including this requirement, OSHA is pointing to the need for the employer or authorized designee to take responsibility for ensuring that rescue operations are carried out appropriately, that rescuers are provided with proper respiratory equipment, and that employees are adequately prepared to facilitate rescue attempts.

On the other hand, the notification provision is not intended to suggest that standby employees should wait indefinitely for their employer or designee to respond to notification before entering the IDLH atmosphere when employees inside are in danger of succumbing and standby personnel are appropriately trained and equipped to provide assistance. OSHA is aware that this practice is followed in fire fighting situations (See paragraph 6–4.4, NFPA 1500 standard, 1997.) In the majority of cases, however, rescuers should not enter the IDLH environment until receiving some response to the notification that rescue is necessary, i.e., the employer or designee should know that the rescuers are entering, and emergency response units should be on their way to the incident. OSHA believes that these requirements are consistent with current industry practice (Exs. 54–266, 54–307, 54–6) and with other OSHA standards (e.g., the permit-required confined spaces standard).

This practice is consistent with OSHA's interpretations of other standards. (See letter of interpretation of the Hazardous Waste and Emergency Response Standard 29 CFR 1910.120 regarding the number of standby personnel present when there is a potential emergency); ''* * * process operators who have (1) informed the incident command * * * of the emergency * * * (2) [have] adequate PPE (3) [have] adequate training * * * and (4) employed the buddy system, may take limited action * * * once the emergency response team arrives, these employees would be restricted to the action that their training level allows * * * this has been OSHA's long standing policy for operators responding to emergencies * * *'' McCully to Olson; July 11, 1996.

Failure to follow such practices can result in employee death. For example, recently, one employee (No. 1) was working inside a reactor vessel, attempting to obtain a sample of catalyst. He was wearing a supplied air respirator with an escape bottle. The standby ''attendant'' informed the employee inside that it was time to exit to change the air supply cylinder; witnesses said the inside employee (No. 1) did not appear to hear this instruction. When the air supply became critical, other workers outside ''yelled'' to the inside employee to hurry outside; by then, the inside employee was moving slowly and then fell. The attendant tried to check the air pressure while another employee, a bystander welder (No. 2), entered the vessel without a breathing apparatus and tried to help the inside employee (No. 1). The welder also fell down. Other bystanders were partially overcome by the nitrogen coming out of the vessel. The air hose on the respirator on the inside employee (No. 1) was disconnected. Neither the first employee inside (No. 1) nor the welder (No. 2) was wearing a harness or lifeline. The inside employee later died. [OSHA citation text abstracts for unscheduled investigations of accidents involving fatalities (one or more) and catastrophic injuries during calendar years 1994 and 1995].

Once the employer or designee has been notified, paragraph (g)(3)(v) requires the employer or designee to provide the necessary assistance appropriate to the situation. Such assistance does not always require that additional standby personnel enter the hazardous atmosphere; in some cases, the appropriate assistance could be, for example, the provision of emergency medical treatment. If standby employees do need to enter the hazardous environment to perform rescue

operations, however, the employer must ensure that those rescuers are fully protected.

Final paragraphs (g)(3)(vi) (A), (B), and (C) require that standby personnel have appropriate equipment to minimize the danger to these personnel during rescue efforts. They stipulate that standby employees be equipped with pressure demand or other positive pressure SCBA, or a pressure demand or other positive pressure supplied-air respirator with auxiliary SCBA, according to final paragraph (g)(3)(vi)(A). This requirement was contained in paragraph (g)(2)(i) of the proposal, and was not objected to by any participants. It is also consistent with requirements in clause 7.3.2 of ANSI Z88.2—1992.

The requirements that address appropriate retrieval equipment and means of rescue in paragraphs (g)(3)(vi)(B)–(C) are written in performance-based language. Established rescue procedures are well known, and retrieval equipment is readily available. OSHA therefore believes that it is necessary merely to state that this equipment must be used unless its use would increase the overall risk associated with entry into or rescue from the IDLH environment. OSHA acknowledged in the Permit-Required Confined Space standard, 58 FR 4530, that situations exist in which retrieval lines (harnesses, wristlets, anklets) may pose an entanglement problem, especially in areas in which air lines or electrical cords are present in the work areas in which the IDLH atmosphere occurs. Most of the time, however, rescue with retrieval equipment is effective, and much safer for the rescuers (Ex. 54–428).

Paragraph (g)(4) applies only to respirator use in the ultra-hazardous context of interior structural fire fighting; the requirements in this paragraph apply in addition to those in paragraph (g)(3). OSHA has included this provision in its standard in response to the record evidence about the extreme hazards of this activity. Paragraph (g)(4)(i) requires that workers engaged in interior structural fire fighting work in a buddy system: at least two workers must enter the building together, so that they can monitor each other's whereabouts as well as the work environment. In addition, for interior structural firefighting, paragraph (g)(4)(ii) retains the requirement that there be at least two standby personnel outside the IDLH respirator use area, i.e., outside the fire area. Paragraph (g)(4)(iii) requires that all personnel engaged in interior structural fire fighting use SCBA respirators. Finally, the notes to paragraph (g)(4) clarify that these requirements are not intended to interfere with necessary rescue operations, and the extent to which the standby personnel can perform other functions.

Paragraph (g)(4) of this Federal standard applies to private sector workers engaged in firefighting through industrial fire brigades, private incorporated fire companies, Federal employees through Section 19 of the OSH Act, and other firefighters. It should be noted that Federal OSHA's jurisdiction does not extend to employees of state and local governments; therefore, public sector firefighters are covered only in the 25 states which operate their own OSHA-approved occupational safety and health state programs and are required to extend the provisions of their state standards to these workers. These states and territories are: Alaska, Arizona, California, Connecticut, Hawaii, Indiana, Iowa, Kentucky, Maryland, Michigan, Minnesota, Nevada, New Mexico, New York, North Carolina, Oregon, Puerto Rico, South Carolina, Tennessee, Utah, Vermont, Virginia, Virgin Islands, Washington, and Wyoming . Eighteen (18) of these states under certain circumstances also consider ''volunteers'' to be employees and thus may provide protection to private or public sector volunteer firefighters, subject to specific interpretation of state law. State and local government employees, including firefighters, in States which do not operate OSHA-approved state plans, are not covered by these requirements, unless voluntarily adopted for local applicability.

Although the proposed rule did not distinguish between interior structural fire fighting and other IDLH situations, OSHA decided to include separate requirements for the former activity in the final standard in response to evidence in the record that safeguards that may be adequate for well-controlled and well-characterized IDLH situations are not adequate in the uncontrolled and unpredictable situation presented by a burning building. The firefighting community already recognizes that one person alone cannot be sent safely into a structure to fight a fire that is beyond the incipient stage. The final rule's staffing requirements for fire fighting are consistent with OSHA's current enforcement practice for employers subject to federal OSHA enforcement, and assure that firefighters will not be subject to any diminution in protection as a result of the more flexible requirements for IDLH respirator use included in other paragraphs of the final rule.

OSHA has previously recognized that emergency situations analogous to interior structural fire fighting require additional safeguards for employees involved in emergency response activities. For example, the Hazardous Waste Operations and Emergency Response (HAZWOPER) standard, at 29 CFR 1910.120(q), requires the use of a ''buddy system'' in responding to IDLH atmospheres. This means that employees involved in such operations are to be organized into workgroups in such a manner that each employee of the work group is designated to be observed continuously by at least one other employee in the work group. Paragraph (q)(3)(v) of § 1910.120 requires operations in hazardous areas to be performed using the buddy system in groups of two or more; paragraph (q)(3)(vi) of that standard specifies that back-up personnel shall stand by with equipment ready to provide assistance or rescue. OSHA has made clear that these provisions require more than one standby person to be present.

The final standard is also consistent with relevant National Fire Protection Association (NFPA) standards. The NFPA is recognized internationally as a clearinghouse for information on fire prevention, fire fighting procedures, and fire protection. A number of NFPA standards require firefighters using SCBA to operate in a buddy system. NFPA 1404, ''Fire Department Self-Contained Breathing Apparatus Program,'' states, in paragraph 3–1.6, that members using SCBA are to operate in teams of two or more, must be able to communicate with each other through visual, audible, physical, safety guide rope, electronic, or other means to coordinate their activities, and are to remain in close proximity to each other to provide emergency assistance.

The NFPA 600 standard addressing industrial fire brigades requires in paragraph 5.3.5 that firefighters using SCBA ''operate in teams of two or more who are in communication with each other * * * and are in close proximity to each other to provide assistance in case of an emergency.'' Although this standard, which applies only to industrial fire brigades where firefighters are working in fixed locations that are well characterized and have established communications and rescue systems, requires only one standby person outside the fire area, another standard, NFPA 1500, ''Standard on Fire Department Occupational Safety and Health Programs,'' which addresses fire department safety and health programs

in the general sense, requires at least two standby personnel. This provision first appeared in 1992, as a Tentative Interim Amendment to NFPA 1500 requiring, in paragraph 6–4.1.1, that ''[a]t least four members shall be assembled before initiating interior fire fighting operations at a working structural fire.'' In 1997, NFPA finalized the Amendment. Paragraph 6–4 of the current NFPA 1500 standard, ''Members Operating at Emergency Incidents,'' addresses the number of persons required to be present, and requires at least four individuals, consisting of two persons in the hazard area and two individuals outside the hazard area, for assistance or rescue (paragraph 6–4.4). One standby member is permitted to perform other duties, but those other duties are not allowed to interfere with the member's ability to provide assistance or rescue to the firefighters working at the incident (paragraph 6–4.2).

In addition, a 1994 CDC/NIOSH Alert, titled ''Request for Assistance in Preventing Injuries and Death of Firefighters,'' also recommends the use of a buddy system whenever firefighters wear SCBAs. The recommendation states:

> Two firefighters should work together and remain in contact with each other at all times. Two additional firefighters should form a rescue team that is stationed outside the hazardous area. The rescue team should be trained and equipped to begin a rescue immediately if any of the firefighters in the hazardous area require assistance.

Similarly, in testimony on H.R. 1783 before the Subcommittee on Economic and Educational Opportunities, House of Representatives, 104th Congress (July 11, 1995, Chairman: Cass Ballenger), Harold A. Schaitberger, Executive Assistant to the General President of the International Association of Fire Fighters (IAFF), stated that ''* * * our organization understood from the outset that the regulation [29 CFR 1910.134(e)] required firefighters wearing self-contained breathing apparatus and involved in interior structural fire operations to operate in a 'buddy system,' with two firefighters entering a burning building and two firefighters stationed outside the endangered area for assistance or rescue, and for accountability purposes * * * The two-in/two-out rule has been the industry standard in the fire service for over 25 years.''

The record in this rulemaking provides strong support for including this requirement in the final standard. Richard Duffy, Director of Occupational Health and Safety for the International Association of Fire Fighters (IAFF), argued strongly for provisions similar to those in the HAZWOPER standard for SCBA users working in IDLH situations. In his written testimony (Ex. 75), Mr. Duffy stated that the proposed requirements in paragraph (g)(2)(ii), which would not have required the buddy system or that two standby personnel be available outside the IDLH atmosphere, would place workers using respiratory protection in IDLH situations at considerable risk.

The IAFF recommended that a minimum of 4 individuals be present any time employees are using SCBA in an IDLH atmosphere: two individuals to work as a team inside the IDLH atmosphere and two identically trained and equipped employees to remain outside to account for, and be available to assist or rescue, the team members working inside the IDLH atmosphere (Tr. 468–469). The inside employees would use a buddy system and maintain direct voice or visual contact or be tethered with a signal line (Tr. 468–469).

According to Mr. Duffy, these changes were necessary:

> to save workers'—specifically firefighters'—lives. Since 1970 * * * 1,416 members of [IAFF] have died in the line of duty. Prohibiting employers from allowing employees to work alone while working in IDLH, potentially IDLH or unknown atmospheres * * * would have saved many of these firefighters' lives * * * [I]f there was a team in place that accounted for employees while they were working in IDLH * * * many more firefighters would have been saved and [be] alive today (Ex. 75).

Mr. Duffy described several incidents in which firefighters had been injured or killed because of inadequate safety practices, and particularly the failure to have specific individuals assigned to keep track of employees in IDLH atmospheres. For example, he referred to a recent occurrence (Tr. 470) in which three firefighters died inside an IDLH atmosphere. In this incident, although many firefighters were on the scene, no one could account for the three firefighters who had been overcome by the IDLH atmosphere. Their bodies were later discovered inside the burned building. It appears that more stringent precautions, such as a buddy system and standby personnel specifically assigned to keep track of the firefighters' condition, could have prevented these deaths.

In addition, the Oklahoma Department of Labor submitted comments stating that it supports a two-in/two-out rule, especially for firefighters. Specifically, it stated that ''Although we are not a state plan state, we operate a fully functional OSHA safety and health program in the public sector * * * it would be unfortunate if the new respiratory protection standard's interpretation of the 'buddy system' * * * confused this issue (two-out for firefighters) [Ex. 187].'' However, some firefighter services and organizations urged OSHA to abandon its existing requirement for at least two standby personnel. For example, Truckee Meadows Fire Protection District in Nevada (Ex. 384) stated that:

> there are circumstances where a three person * * * company can safely and efficiently respond and aggressively attack a fire. Similarly, there are occasions where additional personnel and resources may be required before initiating an attack * * * the emphasis must be practically placed upon assessment of the risk at the time of arrival and throughout the incident to determine the resources and precautions needed. The overriding concern should be * * * safe egress or recovery of personnel should conditions change, regardless of the standby crew assembled.

A similar opinion was expressed by the fire chief of Sparks, Nevada (Ex. 54–129).

Even a comment from the County of Rockland Fire Training Center, Pomona, New York (Ex. 54–155) recommending removing the requirement for standby personnel from the final rule, noted that ''in operations during a fire or emergency, it is a standard practice to utilize the team approach.'' The comment went on to state, however, that ''removing the restriction of having persons outside the IDLH * * * and allowing the incident commander the flexibility of moving personnel around as he or she sees fit at any given situation * * * would actually enhance the safety of our forces operating at the scene of a fire or emergency.'' As discussed below, OSHA believes that the requirements in the final standard allow enough flexibility to maximize safety.

OSHA concludes that, for interior structural fire fighting, a buddy system for workers inside the IDLH atmosphere and at least two standby personnel outside that atmosphere are necessary. In fact, as noted above, OSHA has previously explained that under the prior standard and the OSH Act's general duty clause, there must be more than one person present outside and at least two firefighters inside when conducting an interior attack on an interior structural fire. Accordingly, special provisions have been included in this revised respiratory protection standard to clarify that firefighters may not enter an IDLH atmosphere alone during interior structural firefighting, and that two standby personnel are

required for all interior structural fire fighting.

As discussed above, however, OSHA does not believe that similar practices are necessary in better controlled and characterized IDLH situations, such as those potentially arising in industrial environments. In those cases, where standby personnel can more easily track the precise movements of the respirator users and communication mechanisms are in place, OSHA believes that one standby person will often be sufficient, although paragraph (g)(3)(i) clearly recognizes that some nonfirefighting IDLH situations will require multiple standby personnel.

These additional requirements are necessary because fire fighting ranks among the most hazardous of all occupations, and interior structural fire fighting is one of the most dangerous fire fighting jobs (See, e.g., Jankovic et al. 1991). As the International Association of Fire Chiefs (Ex. 54–328) pointed out, ''[t]he fire fighter is usually operating in a hostile environment where normal systems, facilities, processes and equipment to ensure safety have already failed.'' A very basic difference between firefighters—particularly those involved in fighting interior structural fires—and employees in other occupations is that the work site is always new and unknown. Firefighters do not report to a fixed location or work in a familiar environment. Heat stress also affects firefighters differently than other workers. Petrochemical workers and those in other high heat-stress occupations, such as highway workers, can deal with issues such as heat stress through other options, including acclimatization periods for new employees, scheduling high exertion work at night, and allowing frequent breaks (Smith 1996). Firefighters do not have these options.

Fire fighting is also extremely stressful mentally because of the sense of personal danger and urgency inherent in search and rescue operations. A firefighter regularly steps into situations that others are fleeing, accepting a level of personal risk that would be unacceptable to workers in most other occupations. Psychological stress is caused by the firefighter's need to focus on the protection of lives and property, as well as the need to maximize his or her own personal safety and that of his/her coworkers. Tenants and others in the process of being rescued have also been known to panic and attack firefighters to obtain air from the firefighter's respirator in an attempt to save their own lives (1994 NIOSH Alert).

Fire fighting is a high-risk occupation with a very narrow window of survivability for those who lose their orientation or become disabled on the job. The terrible toll among firefighters is recorded in many different national data bases. For example, for the period 1980–1989, the NIOSH National Traumatic Occupational Fatalities (NTOF) Surveillance System reported 278 deaths among firefighters caused just by work-related traumatic injuries; NIOSH recognizes that this number is an underestimate because of the collection and reporting methods used by NTOF, which limit the kinds of events recorded. Data collected by the IAFF for the period 1970–1994 report 1,369 firefighter deaths, and data collected by the NFPA for the period 1990–1992 indicate that 280 firefighters died in this 2-year period alone (1994 NIOSH Alert). OSHA believes that the requirements of this respirator standard may prevent a significant number of these deaths and injuries. For example, in a recent incident, a team of two firefighters was operating inside a structural fire. Rapidly deteriorating conditions occurred in which there was dense smoke. Confusion ensued and the team lost contact, resulting in one firefighter death. (Incident number 2; OSHA Investigations of Firefighter Fatalities; 10/1/91–3/17/97; IMIS) In this situation, the need for additional accountability and monitoring of firefighters during interior structural fire fighting is clear. Multiple standby personnel and two-person teams inside an IDLH atmosphere are therefore necessary to check for signs of heat stress, other illnesses, disorientation, malfunctioning of respiratory and other protective equipment, and to assist in exit or rescue when needed (Smith, 1996).

OSHA emphasizes that the requirement for standby personnel does not preclude the incident commander from relying on his/her professional judgment to make assignments during a fire emergency. Although the standard requires at least two standby persons during the attack on an interior fire, there are obviously situations where more than two persons will be required both inside and outside the interior structure, a decision ultimately to be made by the incident commander. In addition, as is the case under the previous respiratory protection standard, one of the standby personnel may have other duties and may even serve as the incident commander. According to OSHA's letter to Chief Ewell, IFC, Oakland, CA, (J. Dear; 2/27/96), ''* * * one of the two individuals outside the hazard area may be assigned more than one role, such as incident commander in charge of the emergency or the safety officer. However, the assignment of standby personnel of other roles such as the incident commander, safety officer, or operator of fire apparatus will not be permitted if by abandoning their critical task(s) to assist in, or if necessary, perform a rescue clearly jeopardizes the safety and health of any firefighter working at the incident.'' OSHA has included specific guidance regarding other duties of standby personnel under paragraph (g)(4). These duties are consistent with OSHA's past enforcement policy and NFPA recommendations (NFPA 1500, 1977 Edition; Section 6–4.4.2).

It is important to have at least two standby people available so that in the event of an emergency in which both members of the interior team need rescue or other assistance, adequate personnel are available for rescue. As Harold A. Schaitberger testified, ''* * * The two-in/two-out rule has been the industry standard in the fire service for over 25 years. It is also based on common sense. If there are two firefighters inside a burning building when a roof caves in, at least two firefighters are required to assist and/or rescue them (Testimony on H.R. 1783 before the Subcommittee on Economic and Educational Opportunities, House of Representatives, 104th Congress (July 11, 1995, Chairman: Cass Ballenger).'' Whenever possible, the use of the buddy system should also be maintained during rescue operations.

Moreover, the ''two-in/two-out'' requirement does not take effect until firefighters begin to perform interior structural fire fighting. While the fire is in the incipient stage, the incident commander or other person in charge may conduct an investigation or ''size up'' the situation to determine whether the fire has progressed beyond the incipient stage. During this investigative phase, the standard does not require two-member teams inside and outside the structure. Similarly, nothing in this rule is meant to preclude firefighters from performing rescue activities before an entire team has assembled. If there are fewer than four team members available, and an individual inside the burning structure must be rescued immediately, this rule does not prevent the rescue from occurring, as the Note to the regulatory text makes clear. However, once firefighters begin the interior attack on an interior structural fire, the atmosphere is assumed to be IDLH and paragraph (g)(4) applies.

OSHA's requirement in no way is intended to establish staffing

requirements with regard to, for example, the number of persons on a fire truck or the size of a fire company. Rather, the 2 in / 2 out provision specifies only the number of firefighters who must be present before the interior attack on an interior structural fire is initiated. Firefighters may be assembled from multiple companies, or arrive at the scene at various times. All that is intended is that an interior attack should not be undertaken until sufficient staff are assembled to allow for both buddy and standby teams.

These requirements are consistent with OSHA's past enforcement policy. OSHA has relied on the NFPA recommendations as a basis for determining an appropriate standard of care in fire fighting situations under the General Duty Clause of the OSH Act, 29 U.S.C. 654(a)(1). In its interpretative memoranda addressing requirements that are applicable to firefighters, OSHA noted that occupational exposure to fire is a well-recognized hazard, and that firefighters using SCBA in hazardous atmospheres should be operating in a buddy system of two or more personnel. The Agency explained that even under OSHA's previous respiratory protection standard, a minimum of four personnel should be used, with two members inside the hazardous area and two members outside the hazardous area who are available to enter the area to provide emergency assistance or rescue if needed. One memorandum also pointed out that there was no prohibition against the outside standby personnel having other duties, such as functioning as incident commander or safety officer, as long as it would not jeopardize the safety and health of any firefighter working at the incident if the standby personnel left those duties to perform emergency assistance and rescue operations.

OSHA notes that the requirements of paragraph (g)(4) apply in addition to the requirements of OSHA's specific fire protection standards, subpart L of 29 CFR 1910. OSHA intends to begin negotiated rulemaking on those fire protection standards in the near future.

Paragraph (h)—Maintenance and Care of Respirators

This final standard for respiratory protection, in paragraph (h), addresses the elements of respirator maintenance and care that OSHA believes are essential to the proper functioning of respirators for the continuing protection of employees. As OSHA stated in the preamble to the NPRM (59 FR 58923), ''a lax attitude toward this part of the respiratory protection program will negate successful selection and fit because the devices will not deliver the assumed protection unless they are kept in good working order.'' The maintenance and care provisions, which are divided into cleaning and disinfecting, storage, inspection, and repair, are essentially unchanged (with the exception of the cleaning and disinfecting provisions) from paragraph (f) of OSHA's prior respiratory protection standard. Some rearrangement and consolidation of the regulatory text and minor language changes have been made to this paragraph to simplify and clarify the requirements as a result of comments and concerns that were raised in response to the proposed rule.

Paragraph (h)(1) of the final standard requires that employers provide each respirator wearer with a respirator that is clean, sanitary, and in good working order. It further requires that employers use the procedures for cleaning and disinfecting respirators described in mandatory Appendix B–2 or, alternatively, procedures recommended by the respirator manufacturer, provided such procedures are as effective as those in Appendix B–2. The prior respiratory protection standard required that employers clean and disinfect respirators in accordance with the maintenance and care provision of paragraph (f), but offered no specific guidance on how to perform these procedures. Mandatory Appendix B–2 presents a method employers may use to comply with the cleaning and disinfecting requirements of final paragraph (h)(1). The procedures listed in Appendix B–2 were compiled from several sources, including publications of the American Industrial Hygiene Association, ANSI Z88.2–1992 (clause A.4, Annex A), and NIOSH. Other methods may be used, including those recommended by the respirator manufacturer, as long as they are equivalent in effectiveness to the method in Appendix B–2. Equivalent effectiveness simply means that the procedures used must accomplish the objectives set forth in Appendix B–2, i.e., must ensure that the respirator is properly cleaned and disinfected in a manner that prevents damage to the respirator and does not cause harm to the user.

Several commenters (Exs. 54–267, 54–300, 54–307) supported the cleaning and disinfecting provisions in general and the inclusion of manufacturers' instructions in particular. The American Iron and Steel Institute (AISI), for example, suggested the following language: ''Respirators must be cleaned and maintained in a sanitary condition. The cleaning procedures recommended by the respirator manufacturer or in Appendix B, or a recognized standard-setting organization should be followed'' (Ex. 54–307).

The need for appropriate cleaning and disinfecting procedures was also supported during the hearings. For example, James Johnson of Lawrence Livermore National Laboratories testified:

> [P]rocedures and schedules for cleaning, disinfecting, storing, inspecting, repairing, or otherwise maintaining respirators * * * are elements of the respiratory protection program which are important and are addressed in the rule * * *. I did some personal evaluation on the disinfecting procedures recommended by several U.S. respirator manufacturers. I found that they vary significantly. If you look in Appendix B of the proposed rule, the hypochlorite or bleach recommendation and the other disinfectants outlined there are certainly what is typically recommended and used (Tr. 184).

The Appendix B–2 procedures can be used both with manual and semi-automated cleaning methods, such as those using specially adapted domestic dishwashers and washing machines. As with most effective cleaning procedures, Appendix B–2 divides the cleaning process into disassembly of components, cleaning and disinfecting, rinsing, drying, reassembly and testing. Recommended temperatures for washing and rinsing are given in Appendix B–2, as are instructions for preparing effective disinfectants.

OSHA has made minor changes to the contents of Appendix B–2 in the final standard. For example, the cleaning procedures listed in the final rule are more consistent with the procedures suggested in Clause A.4, Annex A of the ANSI Z88.2–1992 standard than those proposed, particularly with regard to the temperatures recommended to prevent damage to the respirator. Additionally, automated cleaning, which is now being used by many larger companies, is allowed as long as effective cleaning and disinfecting solutions are used and recommended temperatures, which are designed to prevent damage to respirator components, are not exceeded.

Commenters (Exs. 54–91, 54–187, 54–330, 54–389, 54–309, Tr. 695) generally supported the need for a respirator maintenance program but took differing approaches to the provisions proposed in paragraph (h)(1) (i)–(iii) dealing with the frequency of cleaning and disinfecting respirators. One commenter (Ex. 54–187) agreed with the provisions as proposed. Others (Exs. 54–208, 54–67, 54–91, 54–408) recommended a more performance-oriented approach.

For example, Darell Bevis of Bevis Associates International objected to the proposed requirement that respirators that are issued for the exclusive use of an employee be cleaned and disinfected daily by stating:

[D]iffering workplace conditions will require that cleaning and disinfection may be required more frequently or even less frequently than daily. A requirement for daily cleaning when unnecessary results in considerable additional respirator program costs with no benefit. A more realistic and still enforceable requirement would be routinely used respirators issued for the exclusive use of an employee shall be cleaned and disinfected as frequently as necessary to ensure that the user has a clean, sanitary, properly functioning respirator at all times (Tr. 695).

Other commenters (Exs. 54–67, 54–91, 54–234, 54–271, 54–278, 54–286, 54–289, 54–293, 54–334, 54–350, 54–374, 54–424, 54–435, Ex. 163) also objected to cleaning and disinfecting respirators at the end of each day's use if the respirator is issued for the exclusive use of a single employee. These comments were in general agreement with the American Industrial Hygiene Association's statement:

The performance-oriented language of the existing standard is more reasonable [than the proposed language]. Cleaning and disinfecting of individually assigned respirators should be done ''as needed'' to assure proper respirator performance and to preclude skin irritation or toxicity hazards from accumulation of materials. Disinfecting an individually issued respirator is probably not necessary at all unless the ''contaminant'' is biological in nature (Ex. 54–208).

Several other commenters (See, e.g., Exs. 54–330, 54–389, 309) were in favor of cleaning individually assigned respirators at the end of each day's use, but recommended disinfecting or sanitizing only after longer periods or when necessary. Michael Laford, Manager of Industrial Hygiene and Safety at Cambrex, commented as follows:

It is important to clean all personal protective equipment, preferably after each use as needed, and not just once a day. However, is the additional requirement for daily disinfection * * * where respirators are individually assigned, supported with valid studies or data? In the absence of data that supports a real benefit of this requirement, the language should revert to ''periodic'' disinfecting of respirators (Ex. 54–389).

The need for flexibility with respect to maintaining clean and sanitary respirators was also discussed during the hearings. For example, in response to a question asked by a member of the OSHA panel regarding how often a respirator mask should be cleaned, James Centner, Safety and Health Specialist with the United Steel Workers of America (USWA), replied that it depended on the length of time the respirator is worn and the workplace conditions. He stated, ''If you're working in a smelter where it's hot and dirty and dusty, workers probably need to take that respirator off about every 30 minutes and do a good, thorough job of washing the grit and dirt off their face and . . . do a quick maintenance clean-up job on the sealing surface of the respirator so it maintains an adequate fit'' (Tr. 1068). Darell Bevis of Bevis Associates International (Tr. 747–748) responded similarly when asked this question; he contrasted dusty workplaces, such as fossil fuel power generation plants where respirators become filthy with hazardous particulates, to workplaces involving exposure only to gases and vapors where respirators may remain clean for long periods.

OSHA agrees with these commenters that the necessary frequency for cleaning a respirator can range from several times a day to less than daily. Therefore, OSHA has restated paragraph (h)(1)(i) in performance-based language, which will provide employers with flexibility in maintaining clean and sanitary respirators when the respirator is used exclusively by a single employee. Final paragraph (h)(1)(i) now reads as follows: ''Respirators issued for the exclusive use of an employee shall be cleaned and disinfected as often as necessary to be maintained in a sanitary condition.'' Final paragraph (h)(1)(i) is complemented by the respirator use provision in final paragraph (g)(2)(ii)(A), which requires that employers ensure that workers leave the respirator use area to wash their faces as necessary to prevent eye or skin irritation. OSHA believes that compliance with final paragraphs (h)(1)(i) and (g)(2)(ii)(A), as well as the training provisions in paragraph (k) regarding maintenance of the respirator, will provide effective employee protection against hazardous substances that accumulate on the respirator, interfere with facepiece seal, and cause irritation of the user's skin.

Proposed paragraphs (h)(1)(ii)–(iii) specified that respirators used by more than one employee or respirators issued for emergency use be cleaned and disinfected after each use and were the subject of a number of comments (See, e.g., Exs. 54–67, 54–234, 54–361, 54–408, 54–424 and Tr. 695). For example, the Service Employees International Union (Ex. 54–455) suggested that OSHA replace the phrase ''after each use'' with ''before they are worn by another user.'' OSHA agrees with this suggestion as it applies to the shared use of respirators in non-emergency situations, and has revised final paragraph (h)(1)(ii) to require cleaning and disinfecting of respirators prior to their use by other individuals. OSHA believes that this modification provides flexibility in those areas where respirators are assigned to more than one employee. This requirement is also consistent with the parallel provision of ANSI Z88.2–1992. However, if the respirator is to be used in an emergency situation, it should be in a clean and sanitary condition and immediately ready for use at all times. Emergency personnel cannot waste time cleaning and sanitizing the respirator prior to responding to an emergency. Thus, if the respirator is one that is maintained for emergency use, the final standard in paragraph (h)(1)(iii) retains the requirement to clean and disinfect the respirator after each use.

Final paragraph (h)(1)(iv) requires the cleaning and disinfecting of respirators used in fit testing and training exercises. This provision was added in response to a recommendation made by the Public Service Company of Colorado (Ex. 54–179) that respirators be cleaned and disinfected after each fit test. Additionally, representatives of Electronic and Information Technologies (Ex. 54–161) pointed out that, although the proposal addressed cleaning and disinfecting procedures for respirators worn during routine and emergency use, it did not specify how respirators should be cleaned/disinfected during fit testing or training activities. Since these conditions involve shared use, OSHA has emphasized in final paragraph (h)(1)(iv) the need to properly clean and disinfect or sanitize respirators used for training and fit testing after each use.

OSHA noted in the proposal that it was not stating who should do the cleaning and disinfecting, only that it be done (59 FR 58924). However, as with all other provisions of the standard, the employer is responsible for satisfying the cleaning and disinfecting requirements. The final standard requires that the employer ensure that cleaning is done properly, and that only properly cleaned and disinfected respirators are used. The employer is allowed to choose the cleaning and disinfecting program that best meets the requirements of the standard and the particular circumstances of the workplace. Richard Uhlar, an industrial hygienist for the International Chemical Workers Union (ICWU), commented that workers should be given paid time to clean, disinfect, and inspect respirators; otherwise, in the view of

this commenter, respirators will not be taken care of properly (Ex. 54–427). OSHA notes that if the employer elects to have employees clean their own respirators, the employer must provide the cleaning and disinfecting equipment, supplies, and facilities, as well as time for the job to be done.

Commenting on a preproposal draft of the standard, the United Steelworkers of America (USWA) (Ex. 36–46) recommended that OSHA require the employer to clean and repair respirators. The USWA stated that programs in which employers require employees to return their respirators at the end of each shift to a central facility for inspection, cleaning, and repairs by trained personnel are more effective than programs in which employees are responsible for cleaning their own respirators. OSHA agrees that such a centralized cleaning and repair operation can ensure that properly cleaned and disinfected respirators are available for use, but this approach is not the only way to fulfill this requirement. For example, central facilities may be inappropriate in workplaces where respirator use is infrequent, or where the number of respirators in use is small.

Final paragraph (h)(2), which establishes storage requirements for respirators, does not differ substantively from the corresponding requirements in the proposal. However, some of the proposed provisions have been consolidated to simplify understanding and interpretation of the requirements. Final paragraph (h)(2)(i) sets forth the storage requirements for all respirators, while final paragraph (h)(2)(ii) addresses additional requirements for the storage of emergency respirators. Specifically, final paragraph (h)(2)(i) requires that all respirators be stored in a manner that protects them from damage, contamination, harmful environmental conditions and damaging chemicals, and prevents deformation of the facepiece and exhalation valve. Respirators maintained for emergency use also must be stored in accordance with the requirements of final paragraph (h)(2)(i) and, in addition, must be kept accessible to the work area, be stored in compartments or covers that are clearly marked as containing emergency respirators, and be stored in accordance with any applicable manufacturer's instructions (paragraph (h)(2)(ii)).

There was general support in the record for the performance approach that OSHA took in the proposal with regard to storage requirements. For example, the Industrial Safety Equipment Association (ISEA) commented: ''[B]ecause the degree of severity of an environmental condition that would cause deterioration would be related to the tolerance of the particular equipment in question and would thus vary from model to model, there is no need to specify conditions of storage in more detail'' (Ex. 54–363). The comment submitted by the Mobil Oil Corporation (Ex. 54–234) agreed with OSHA's proposed approach on respirator storage, but went further to state that ''[t]o place storage requirements in specific language may actually contradict specific recommendations of the manufacturer.'' Other commenters also supported OSHA's provisions as proposed (See Exs. 54–172, 54–250, 54–273, 54–408, 54–424, and 54–455).

There were, however, some suggested changes that commenters believed would clarify final paragraph (h)(2). One commenter (Ex. 54–32) suggested that, in addition to requirements for accessibility and maintenance of emergency respirators, there should be a requirement for specific '' awareness training'' to remind employees of the location of such respirators. OSHA agrees that such knowledge is vital. The training specified in paragraph (k), especially the provisions on how to use a respirator in emergency situations (final paragraph (k)(1)(iii)) and procedures for the maintenance and storage of respirators (final paragraph (k)(1)(v)), are designed to do this. In addition, paragraph (k) requires that employers retrain employees where it appears necessary to do so to ensure safe respirator use.

Two commenters recommended that employees, rather than employers, be held responsible for cleaning, sanitizing, and storing their respirators. The Grain Elevator and Processing Society (Ex. 54–226) recommended that, for most operations, the maintenance and care of respirators should be the responsibility of the employee once the employee has been trained. In another comment specific to the storage provision, the American Petroleum Institute (Ex. 54–330) pointed out that employers generally do not store respirators; instead, respirator storage is the responsibility of the employee. In response, OSHA notes that section 5(a)(2) of the OSH Act and case law interpreting that provision have specifically placed the burden of complying with safety and health standards on the employer because the employer controls conditions in the workplace. The employer is, therefore, responsible for the results of actions taken by others at the direction of the employer. For example, although an employee may physically store a respirator, a contractor may perform a fit test, or a physician may examine an employee at the employer's direction, the employer is ultimately responsible for ensuring that these actions are taken to comply with the standard.

Proposed paragraph (h)(2)(ii) would have required that compartments be built to protect respirators that are stored in locations where weathering, contamination, or deterioration could occur. The Westminster, Maryland Fire Department (Ex. 54–68) raised the following concern about this proposed provision:

> This requirement may be appropriate for manufacturing but is not practical given the operations of the fire service. * * * As OSHA is aware the fire service maintains its breathing apparatus in a ready posture on the apparatus. To require the apparatus to be placed in a compartment would eliminate the precious time saved by donning the apparatus enroute to the emergency. This operation has been the backbone of our efficiency at rescue and suppression operations.

Similar concerns were raised by the National Volunteer Fire Council (Tr. 499) and the Connecticut Fire Chiefs' Association, Inc. (Ex. 180). In response to these concerns, OSHA has crafted language that the Agency believes fulfills the purpose of this provision and maintains the efficiency of emergency response workers such as firefighters. Instead of requiring emergency respirators to be stored only in compartments, final paragraph (h)(2)(ii)(B) permits them alternatively to be stored in covers that are clearly marked as containing emergency respirators. Walk-out brackets with covers that are mounted on a wall or to a stable surface (e.g., on a fire truck) may be used so long as the respirator is covered to prevent damage when not in use. Because a cover can be removed in seconds, OSHA believes that this change addresses the needs of firefighters and other emergency responders. It is important that the walk-out brackets are mounted within the vehicle. For example, they can be mounted directly to the fire truck to enable firefighters to rapidly don the respiratory equipment when needed. However, any means of storage used must be secure. If walk-out brackets are not mounted, there is a danger that the unsecured respirators could become damaged as a result of vehicle motion.

Final paragraph (h)(3) requires regular inspections to ensure the continued reliability of respiratory equipment. The frequency of inspection and the procedures to be followed depend on whether the respirator is intended for non-emergency, emergency, or escape-only use.

(b) * * *

(2) * * *

(v) At a level not to exceed 0.2 percent by weight of the suture material for coloring glycolide/dioxanone/trimethylene carbonate tripolymer absorbable sutures for use in general surgery.

* * * * *

Dated: April 16, 1998.

William K. Hubbard,

Associate Commissioner for Policy Coordination.

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DEPARTMENT OF LABOR

Occupational Safety and Health Administration

29 CFR Parts 1910 and 1926

[Docket No. H–049]

RIN 1218–AA05

Respiratory Protection; Correction

AGENCY: Occupational Safety and Health Administration (OSHA), Department of Labor.

ACTION: Final rule; correction.

SUMMARY: OSHA is correcting errors in the regulatory text of the Respiratory Protection final rule that appeared in the **Federal Register** on January 8, 1998 (63 FR 1152).

DATES: These corrections become effective on April 23, 1998.

FOR FURTHER INFORMATION CONTACT: Bonnie Friedman, Director, OSHA Office of Public Affairs, Room N–3647, U.S. Department of Labor, 200 Constitution Avenue, N.W., Washington, D.C. 20210; Telephone: (202) 219–8148.

SUPPLEMENTARY INFORMATION: On January 8, 1998 (63 FR 1152), OSHA promulgated revised regulations for respiratory protection in general industry (part 1910), shipyards (part 1915), marine terminals (part 1917), longshoring (part 1918), and construction (part 1926).

Subsequently, technical and typographic errors were discovered in the regulatory text. This notice is being published to correct these errors. With the exception of the explanations discussed below, these corrections are self-explanatory.

In paragraph (i)(1)(ii), *Breathing air quality and use,* the reference to ''Type 1—Grade D breathing air'' has been corrected to read ''Grade D breathing air'' to conform to the ANSI/Compressed Gas Association Commodity Specification for Air, G–7.1–1989.

Paragraph (n)(3) is corrected to state that the respiratory protection provisions of the previous standard, 29 CFR 1910.134 as contained in the 29 CFR parts 1900 to 1910.999 edition of the Code of Federal Regulations published July 1, 1997, will continue in effect until October 5, 1998, the date for full compliance with the revised standard, rather than April 8, 1998, the effective date of the revised standard.

In Appendix A, in the protocol for the Bitrex qualitative fit test, the part numbers for the fit test hood assembly now match the part numbers given in the saccharin qualitative fit test protocol. Also, in the generated aerosol quantitative fit testing protocol, a reference for using P100 filters as one of the methods to filter exhaust air flow from the fit test chamber is incorrect and is deleted. In the condensation nuclei counter quantitative fit test protocol, the requirement in paragraph (a)(1) that a high-efficiency filter be fitted has been revised to allow for the fit testing of additional types of filters as appropriate. For the controlled negative fit test protocol, the pressure setting for the default test pressure has been changed from −1.5 mm to the correct value of −15 mm.

In Appendix C a typographic error in Part A, Section 2, question 11(e) has been corrected to read ''d. Any other eye or vision problem: Yes/No''.

Appendix D has been entitled ''mandatory'' since the employer is required by paragraph (k)(6) of the standard to provide the basic advisory information on respirators presented in Appendix D to any employees who voluntarily use respirators.

Since some of the 13 carcinogens are vapors, language has been added to paragraph (c)(4)(iv) of § 1910.1013 permitting the use of air-purifying canisters or cartridges, in addition to particulate filters. This provision requires appropriate respirator filters for these carcinogens.

This correction removes the provision in the revised Lead standard (§ 1910.1025(f)(1)(i)) that limits respirator use to a maximum of 4.4 hours per day. The 4.4 hour requirement had been removed earlier by OSHA (see 60 FR 52859).

Typographic errors in provisions in the Benzene standard (§ 1910.1028 (g)(2)(i)), Acrylonitrile standard (§ 1910.1045 (h)(2)(i)), and the Formaldehyde standard (§ 1910.1048 (g)(2)(i)) that referenced § 1910.134 (d)(3)(iii)(b)(1) have been corrected to read (d)(3)(iii)(B)(1).

Appendix E of the Methylenedianiline standard (§ 1910.1050), which specifies fit testing protocols, has been removed to match changes made to other substance specific standards. These changes require the use of the fit testing protocols in Appendix A of the revised respiratory protection standard.

The Methylene chloride standard limits respiratory protection to supplied-air respirators except for emergency escape. Paragraphs (d)(3)(iii)(B) (1) and (2) of the revised respiratory protection standard address the use of end-of-service-life indicators or change schedules for cartridges and canisters, and do not apply to supplied-air or emergency escape respirators. Accordingly, these paragraphs have been removed from the respiratory protection program required by the Methylene chloride standard to be in compliance with the revised § 1910.134 respiratory protection standard.

The correction to paragraph (h)(2)(iv) of the Asbestos standard for the construction industry reinstates an earlier revision made by OSHA to this standard. This revision permitted the use of PAPRs with HEPA filters or supplied-air respirators with HEPA egress cartridges under the conditions specified in this paragraph (see 60 FR 33985).

All these corrections to the standard are deemed to be ''minor'' amendments within the meaning of 29 CFR 1911.5. OSHA finds good cause, pursuant to 29 CFR 1911.5 and the Administrative Procedure Act, for promulgating the corrections without notice and opportunity for public comment.

Correction of Publication

The following corrections are made in the final rule for Respiratory Protection published in the **Federal Register** on January 8, 1998 (63 FR 1152).

Respiratory Protection [Correction]

§ 1910.134 [Correction]

1. On page 1275, first column, paragraph (i)(1)(ii), lines 2 and 3, are corrected to read ''meet at least the requirements for Grade D breathing air described in''.

2. On page 1275, first column, paragraph (i)(4)(ii), line 4, is corrected to read ''requirements for Grade D''.

3. On page 1276, second column, paragraph (n)(3), line 2, the date ''April 8, 1998'' is corrected to read ''October 5, 1998''.

4. On page 1278, third column, paragraph (a)(1), line 10, the reference ''parts #14 and #15'' is corrected to read ''parts # FT 14 and # FT 15''.

5. On page 1280, first column, paragraph (11), lines 3 and 4, are corrected to read ''filter (i.e., high efficiency particulate filter) before release.''

6. On page 1280, third column, following the equation, paragraph (a)(1) is revised to read: ''(1) Check the respirator to make sure the sampling probe and line are properly attached to the facepiece and that the respirator is fitted with a particulate filter capable of preventing significant penetration by the ambient particles used for the fit test (e.g., NIOSH 42 CFR 84 series 100, series 99, or series 95 particulate filter) per manufacturer's instruction.''

7. On page 1281, second column, paragraph (a)(2), line 2, the reference ''−1.5 mm'' is corrected to read ''−15 mm''.

8. On page 1283, second column, question 11, lines 6 and 7, are corrected to read ''d. Any other eye or vision problem: Yes/No''.

9. On page 1284, second column, line 17, is corrected to read ''Appendix D to § 1910.134 (Mandatory)''.

§ 1910.1003 13 Carcinogens [Correction]

10. On page 1286, first column after Table 1, paragraph (c)(4)(iv), lines 5 and 6 are corrected to read: ''use a half-face filter-type respirator with filters for dusts, mists, and fumes, or air-purifying canisters or cartridges. A respirator''.

§ 1910.1025 Lead [Correction]

11. On page 1287, second column following Table II, paragraph (f)(1)(i) is revised to read: ''(i) Periods necessary to install or implement engineering or work-practice controls.''

§ 1910.1028 Benzene [Correction]

12. On page 1289, third column following Table 2, paragraph (g)(2)(i), line 2, the reference ''(d)(3)(iii)(b)(1)'' is corrected to read ''(d)(3)(iii)(B)(1).''

§ 1910.1045 Acrylonitrile [Correction]

13. On page 1291, second column following Table 1, paragraph (h)(2)(i), line 5, the reference ''(d)(3)(iii)(b)(1)'' is corrected to read ''(d)(3)(iii)(B)(1)''.

§ 1910.1048 Formaldehyde [Correction]

14. On page 1293, second column, paragraph (g)(2)(i), line 5, the reference ''(d)(3)(iii)(b)(1)'' is corrected to read ''(d)(3)(iii)(B)(1)''.

§ 1910.1050 Methylenedianiline [Correction]

15. On page 1293, first column following Table 1, paragraph 28, is revised to read ''28. Section 1910.1050 is amended by removing Appendix E, and revising paragraph (h) and the first paragraph of Section III to Appendix A to read as follows:''.

§ 1910.1052 Methylene chloride [Correction]

16. On page 1295, second column following Table 1, paragraph (g)(1)(i), is revised to read ''(i) Periods when an employee's exposure to MC exceeds the 8-hour TWA PEL, or STEL (for example, when an employee is using MC in a regulated area).''

17. On page 1295, third column following Table 1, paragraph (g)(2)(i), line 5, the reference ''(d)(1)(iii))'' is corrected to read ''(d)(1)(iii) and (d)(3)(iii)(B)(1) and (2)).''

§ 1926.1101 Asbestos [Correction]

18. On page 1298, first and second columns following Table 1, paragraph (h)(3)(iv) is revised to read:

''(iv) In addition to the above selection criteria, when employees are in a regulated area where Class I work is being performed, a negative exposure assessment of the area has not been produced, and the exposure assessment of the area indicates the exposure level will not exceed 1 f/cc as an 8-hour time weighted average, employers must provide the employees with one of the following respirators:

(A) A tight-fitting powered air-purifying respirator equipped with high efficiency filters;

(B) A full facepiece supplied-air respirator operated in the pressure-demand mode equipped with HEPA egress cartridges; or

(C) A full facepiece supplied-air respirator operated in the pressure-demand mode equipped with an auxiliary positive pressure self-contained breathing apparatus. A full facepiece supplied-air respirator operated in the pressure-demand mode equipped with an auxiliary positive pressure self-contained breathing apparatus must be provided under such conditions when the exposure assessment indicates exposure levels above 1 f/cc as an 8-hour time weighted average.''

Dated: April 15, 1998.

Charles N. Jeffress,

Assistant Secretary of Labor for Occupational Safety and Health.

[FR Doc. 98–10795 Filed 4–22–98; 8:45 am]

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DEPARTMENT OF THE TREASURY

Fiscal Service

31 CFR Part 357

[Department of the Treasury Circular, Public Debt Series, No. 2–86]

Regulations Governing Book-Entry Treasury Bonds, Notes, and Bills; Determination Regarding State Statute

AGENCY: Bureau of the Public Debt, Fiscal Service, Treasury.

ACTION: Determination of substantially identical state statute.

SUMMARY: The Department of the Treasury is announcing that it has reviewed the recently enacted South Dakota law adopting Revised Article 8 of the Uniform Commercial Code—Investment Securities (''Revised Article 8'') and has determined that it is substantially identical to the uniform version of Revised Article 8 for purposes of interpreting the rules in 31 CFR Part 357, Subpart B (the ''TRADES'' regulations). Therefore, that portion of the TRADES rule requiring application of Revised Article 8 if a state has not adopted Revised Article 8 will no longer be applicable for South Dakota.

EFFECTIVE DATE: April 23, 1998.

FOR FURTHER INFORMATION CONTACT: Lisa A. Crosby, Attorney-Advisor, (202) 219–3320, or Cynthia E. Reese, Deputy Chief Counsel, (202) 219–3320.

SUPPLEMENTARY INFORMATION: On August 23, 1996, The Department published a final rule to govern securities held in the commercial book-entry system, now referred to as the Treasury/Reserve Automated Debt Entry System (''TRADES''). 61 FR 43626.

In the commentary to the final regulations, Treasury stated that for the 28 states that had by then adopted Revised Article 8, the versions enacted were ''substantially identical'' to the uniform version for purposes of the rule. Therefore, for those states, that portion of the TRADES rule requiring application of Revised Article 8 was not invoked. Treasury also indicated in the commentary that as additional states adopt Revised Article 8, notice would be provided in the **Federal Register** as to whether the enactments are substantially identical to the uniform version so that the federal application of Revised Article 8 would no longer be in effect for those states. Treasury adopted this approach in an attempt to provide certainty in application of the rule in response to public comments. This notice addresses the recent adoption of Article 8 by South Dakota.