ABSTRACT

KAREN E. HARVEY. An Investigation of the Management and Implementation of Large Scale Respiratory Protection Programs. (Under the direction of DR. DAVID A. FRASER)

The practical implementation of respiratory protection in a large scale industrial setting was investigated. Respiratory protection programs at the Kennedy Space Center, Norfolk Naval Shipyard, and International Business Machines Research Triangle Park were assessed for compliance with Title 29 Code of Federal Regulations 1910.134. The assessment was based on employer response to questionnaires, interviews, and personal observations. The data obtained provided an opportunity to discuss the difficulties of applying complex guidelines and regulations in a large scale industrial setting.

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I. INTRODUCTION

Living prior to 1940 was relatively inexpensive since the primary materials used in housing and transportation were manufactured from natural materials such as wood, iron and coal. Food was grown in natural gardens using organic fertilizers. A population increase after World War II with the resultant demand for more housing, food, and transportation combined with the war effort rapidly depleted the supply of these natural resources. This demand, coupled with the development of new materials and processes during and after the war years lead to an increase in the development of high strength, lightweight metals, plastics, inorganic fertilizers, and fuels. The resultant increased production of chemicals and chemical compounds has increased the need for worker protection in most industries.

The preferred and usually most economical method of providing protection is to design the work station for minimum hazard, i.e., to select design features such as containment, isolation, elimination or the use of appropriate safety factors. Where elimination or control by design is not feasible, exposure to known hazards may be controlled by the use of detection and warning devices or, least satisfactory because it introduces the human element,

the use of special protective devices or clothing (4).

Regardless of which of the preceding methods are employed, some form of personal protective equipment may be required while servicing or maintaining the processing equipment or for emergency use if the primary protective system fails. Also, while most potential hazards can be eliminated or controlled by engineering methods, there are times when management cannot justify these expenditures and personal protective equipment is used as the only feasible method. Foremost among personal protective equipment are the various types of respiratory protective devices on the market today (Table 1) (4).

Respiratory protection devices considered in this report are any device covering the nose/or mouth in order to protect the wearer from inhaling harmful airborne contamination. Such devices have existed in various forms for many years. Early face masks consisted of cloth or handkerchiefs held over the nose and mouth to filter out dust from the herding cattle. In the early part of this century, gas masks were developed as a protective device against poisonous gases (5). These masks have evolved into sophisticated devices with many types and manufacturers. In 1970 the Occupational Safety and Health Administration (OSHA) chose to implement and enforce federal regulations for the respiratory protection of the health of workers.

Table 1

General Types of Respirators

Device	Protects Against
AIR PURIFYING	
Mechanical Filter	Dusts, fumes, mists, smokes
Chemical Cartridge	Low concentrations of organic vapors or gases, acid and alkaline gases, paint vapors, pesticides
FACE PIECE TYPE	
Gas Masks	High concentrations of organic vapors or gases, acid and alkaline gases, paint vapors, pesticides
AIR SUPPLIED	
Air-line	All airborne contaminants in concentrations not immediately dangerous to life or health
Self-Contained Breathing Apparatus	Unknown airborne contaminants and oxygen deficiency

The OSHA Respiratory Program

The basic requirement of the OSHA regulation in Title 29 Code of Federal Regulation (CFR) 1910.134 is that the employer establish a program which provides respirators which are suitable for the purpose intended and provide adequate protection for the worker. If an employer elects to use respirators to comply with OSHA standards, the respiratory protection program must be documented by written procedures governing respirator selection and use, medical testing, training of employees in the use, handling, and care of the respirators, as well as the monitoring of employee exposure and the periodic evaluation of the program. These requirements are further described below:

Written Operating Procedures

Written operating procedures must clearly define the responsibilities and authority for the program (12). These written procedures become the cornerstone on which the entire program is based.

Selection and Use of Equipment

It is essential that those responsible for establishing a respiratory protection program understand the various operational and environmental factors that influence the selection of respirators. Among the factors to be considered are:

1) The physical and chemical properties, concentration likely to be encountered, and Permissible Exposure Limits (PEL) and physiologic effects of the contaminant.

2) The nature of the operation, such as materials used during the process and the workers' physical actions and duties.

3) The location of the area with respect to a source of uncontaminated, respirable air to plan emergency routes to safety or placement of a backup system.

4) The characteristics of the respirator such as size and weight.

5) The type and concentration of contaminants the respirator must protect against.

OSHA regulations require that approved respirators be used when available. The National Institute for Occupational Safety and Health (NIOSH) in conjunction with the Mine Safety and Health Administration (MSHA), have been named by OSHA as the testing and certifying agencies for respirators (13). An approved respirator is one that has been tested and found to meet the requirements set forth in Title 30 CFR 11-Respiratory Protective Devices; Tests for Permissibility. These procedures require testing of all component parts as well as the complete respirator. When all requirements are fulfilled, the respirator is "approved" and given a NIOSH/MSHA certification number. Since the respirator and its components are tested and approved as an entity, the

approval is void if component parts are interchanged. A respirator which is not found in the NIOSH Certified Equipment List is considered to be "non-approved" and may not provide the same degree of protection as the "approved" respirator (9).

Medical Testing

Since the use of respirators may place excessive stress on those with debilitating conditions such as respiratory or cardiovascular diseases, workers should not be assigned to tasks requiring respiratory protection until they have been examined by a physician. However, a recent study on the effects of respirator wear on female subjects with restrictive lung disease concluded that the main stress to the body was from the exercise performed and not from the use of the respirator (6). A properly documented physical examination also provides protection for the company in the unfortunate instance of litigation by the employee or his survivors.

Training

Training is perhaps the most important factor in the comprehensive respirator program required by OSHA (7). Without proper instruction, the employee may underestimate the hazards of exposure and perform the operation without proper protection. Many of the hazards which are associated with jobs that require respiratory protection, such as

oxygen deficiencies, are not apparent to the untrained employee, i.e., a dangerous atmosphere may look and smell "safe". Training must include information on the following topics:

1) The need for respiratory protective equipment, including a description of engineered controls.

2) The steps used in selecting an appropriate respirator, including identification of the specific hazard.

3) Proper fitting of the respirator either qualitatively - where the response by the wearer to a test chemical released outside the facepiece is observed, or quantitatively - where the concentration of the test chemical is measured both inside and outside the facepiece. Qualitative testing is most frequently used because it is less expensive and easier to perform.

4) Limitations of the respirator use which may include the wearing of eye glasses or lenses, the effect of facial hair, and the length of time the respirator may be used.

In some instances, such as exposure to hydrazine, a single misuse may have deleterious health effects so it is important that the reason why the respirator is needed be stressed and that employees become confident of the ability of the respirator to provide the necessary protection. Employees must know that they are wearing respirators to protect themselves, not only because of compliance with an OSHA requirement (8).

Maintenance

To ensure the success of the respiratory protection program, proper inspection, maintenance and repair of the respirators is necessary. A defective device may be more dangerous than not using a respirator at all because the employee believes adequate protection is being provided when it is not (3). In some instances, the worker is responsible for maintaining his respirator, therefore he should be instructed in the inspection, cleaning, disinfecting and storing of the respirator (12). The supervisor, in addition to assuring that his employees are properly trained, should follow up to assure employee compliance with maintenance procedures. When using chemical cartridge respirators, employees must have available proper replacement components. Employees should be aware that only a cartridge of the same brand as the respirator body may be used. The use of disposable respirators is becoming more common because they are lightweight, economical, and more comfortable than reuseable chemical cartridge respirators. Maintenance of disposable respirators is minimal, however, the employee must be aware that they are to be used only under the conditions and limitations specified by the manufacturer (13).

Monitoring

Two types of monitoring, work area surveillance and program evaluation, are required in respiratory protection

programs (9). Industrial hygiene surveillance of work area conditions and worker exposure is necessary at the initial stage of the program to aid in the respirator selection process, and should continue thereafter to verify that the conditions under which the respirators were selected are still valid. Any change in the operation, process or ventilation should also include an industrial hygiene survey. Work area surveillance by the supervisor should be employed to be certain that the limitations of the respirator are not being exceeded (31,14). Program evaluation, performed at least annually, should include a review of compliance with each of the previously discussed requirements.

II. PURPOSE OF STUDY

Difficulties in the management of respiratory protection programs increase as the number of workers requiring protection and/or types of hazardous materials increase presenting the need for developing a systematic approach to meeting requirements and assuring compliance. The purpose of this study was to develop a method that could be used by a large manufacturing organization to determine the effectiveness of its respiratory protection program and its compliance with both the letter and spirit of the applicable OSHA regulation. The methodology utilized in this study was:

A) Obtain information from 1) Employer responses to questionnaires based on the requirements of 29 CFR 1910.134. 2) Interviews with administrators for respirator programs, 3) Personal observations of individual workers and work areas.

B) Determine the areas of non-compliance by preparing a matrix of the information obtained.

C) Recommend changes in current practices based on the results of the program assessment.

III. EVALUATION OF CURRENT RESPIRATORY PROTECTION PROGRAMS

A) Background

The John F. Kennedy Space Center (KSC) is the National Aeronautics and Space Administration's (NASA) primary site for launchings of the manned reuseable Space Shuttle and unmanned expendable vehicles for the purpose of delivering scientific experiments into space.

Major products at KSC are accomplished by the use of contractors responsible for specific tasks such as propulsion, navigation, assembly and testing of the vehicles. Approximately thirteen thousand people are employed at the Kennedy Space Center by NASA and the twelve contractors (Table 2). They use many chemicals (Table 3) including a broad spectrum of chemical asphyxiants, irritants, systemic poisons, potential carcinogens as well as dusts capable of producing pulmonary fibrosis and other processes which may produce oxygen deficient or otherwise hazardous atmospheres. Thus the Kennedy Space Center provided an opportunity to collect data for the evaluation of several respiratory protection programs.

Kennedy Space Center has approximately fifteen hundred employees whose job assignments frequently require respiratory protective equipment for chemical vapors, dusts,

Table 2

Contractors Investigated at the Kennedy Space Center as of June 1985

Contractor	Employees	Respirator Users
Aerojet General Corp.	50	0
Bionetics Corp.	100	10
Boeing Services International Inc.	500	25
EG&G Florida Inc.	1500	250
General Dynamics Corp.	300	10
Hughes Aircraft Co.	150	20
Lockheed Space Operation Co.	6000	600
McDonnell Douglas Astronautics Co.	200	10
McDonnell Douglas Technical Services Inc.	500	60
Morton Thiokol Inc.	750	100
United Space Boosters Inc.	500	75
Wiltech Corp.	100	10

Table 3

Chemicals in Major Use at KSC*

Chemical	Amount Stored on Site	TLV
Monomethylhydrazine	55,000 gallons	1 ppm
Nitrogen tetroxide	50,000 gallons	
Hydrazine	1,000 gallons	1 ppm
Methyl ethyl ketone	1,000 gallons	200 ppm
Methyl chloroform	500 gallons	350 ppm
Freon 21	12,000 pounds	
Freon 113	5,000 gallons	
Anhydrous ammonia	1,000 pounds	50 ppm

* Source - Office of Environmental Health< EG&G, Kennedy Space Center, Fl. (Personal communication).

fumes, and mists produced by the various rocket propellants being stored, transferred, or burned as well as dusts and fumes generated by materials utilized in brakes and thermal protection systems. Due to the proximity of the ocean, sandblasting and painting are routinely required to maintain structures and equipment in this corrosive atmosphere.

For comparison, information on similar programs at the Norfolk Naval Shipyard (NNSY) and International Business Machines (IBM) was also obtained.

Norfolk Naval Shipyard is a single, large (approximately 10,000 employees) government organization. Kennedy Space Center is approximately the same size (13,000 employees) of which only 2,000 are government employees while the balance of the workforce is comprised of employees of the various contractors performing the many tasks necessary to assemble, process, and launch the rockets and spacecraft. The IBM facility at the Research Triangle Park is also large (approximately 11,000 employees), and manufacturers relatively clean, high technology products utilizing some hazardous chemicals in their processing.

Norfolk Naval Shipyard has approximately three thousand employees whose job assignments frequently require respiratory protective equipment for dusts, fumes, mists and solvent vapors produced by welding, grinding, sandblasting, and painting.

IBM has approximately forty employees whose job assignments sometimes require respiratory protective equipment for chemical vapors.

IBM and Norfolk Naval Shipyard are essentially homogenous companies who control internally all aspects of their programs such as engineering, procurement, medical testing, training, and environmental health and safety. The National Aeronautics and Space Administration at the Kennedy Space Center, on the other hand, serves as a "host agency" which requires that their tenants or contractors comply with the various laws and programs, but cannot dictate their internal procedures. Thus, the twelve Kennedy Space Center companies are also independent, homogenous companies who control all aspects of their programs.

B) Protocol

To determine the adequacy of current respiratory protection programs at the Kennedy Space Center, a survey of the twelve major contractors was initiated. This survey examined in detail program documentation, training and equipment procurement and use.

1) A checklist (Figure 1) of key requirements as defined by the 29 CFR 1910.134, was developed and distributed to the contractors. The checklist was used as a guideline for contractor management to collect the necessary information. This was followed by personal contact with program administrators requesting the assembled information.

2) To organize the information, matrices were developed (Figure 2). As information was received from the

Figure 1
Respirator Program Checklist

How many and what type respirators do you have? _____

_____

Who are the manufacturers? _____

_____

What is the nature of the hazardous operations? _____

_____

_____

Are the respirators NIOSH approved for this hazard? _____

_____

Are there written operating procedures which govern the selection and use of these respirators? _____

Does the employee receive training in the use of the respirators? _____

Does the training of employees who use respirators include proper fit testing? _____

Are the respirators stored in a convenient and easily accessible location? _____

Are the respirators cleaned and disinfected on a regular basis? _____

Are the respirators inspected during cleaning and deteriorated parts replaced? _____

Are records maintained of inspection and maintenance dates?

_____

Is the medical status of each employee who wears a respirator checked periodically? _____

Is the effectiveness of the respiratory program determined through regular evaluation? _____

Figure 2. Program Evaluation Matrix

PROGRAM EVALUATION COMPANY

CATEGORY	EQUIPMENT TYPE	WRITTEN SOP	USE ROUTINE/EMER	MEDICAL APPROVAL	TRAINING	FIT TEST QUAL/QUAN

contractors, it was filled into each company's matrix and any missing information was noted.

3) The collection of this information was followed by in depth interviews with program administrators. These interviews were used to obtain any information missing from the company matrix, and to discover company practices or policies that may not have been included in the documented program. Three companies stated that they had no program documentation because there was no requirement for the use of respiratory protection equipment by their personnel. Another company was a member of a contracting "team" and as such was covered under the policy of the prime contractor who had previously responded to the survey. To ensure that nonparticipating contractors understood the purpose of the survey, a letter requiring acknowledgement was prepared and distributed to each of the three companies. Only one of the three contractors signed and returned the letter. The remaining two acknowledged they did have periodic respirator use, but neither had any written procedures or program documentation.

4) At the time of the interviews visits were made to observe many of the operations and procedures requiring respiratory protection. This allowed verification of the existence of and compliance with program requirements. The completed collection of program documentation was analyzed for compliance with the eleven minimum requirements of Title 29 Code of Federal Regulations 19010.134.

5) Finally, unannounced walkthroughs were conducted to assess procurement, issuance, use and maintenance practices. Several training sessions were audited to determine if the required topics were addressed and proper fit testing performed.

C) Results

Analysis of the information from the contractors was performed using the OSHA Instruction of Compliance 2-2.20A (11) to aid in interpretation of the Code with the following results:

1) Only three of the eleven contractors were in compliance with all requirements of 29 CFR 1910.134.

2) Two contractors were not in compliance due to the absence of written procedures and documentation.

3) One contractor indicated there were no operations requiring the use of respirators by his employees.

4) Five contractor programs did not address one or more of the following: work area surveillance, medical examinations, employee training, fit testing, or program evaluation.

5) The Norfolk Naval Shipyard and IBM/Research Triangle Park programs were in compliance with all requirements of 29 CFR 1910.134.

To inform the management within each contractor organization, individual letters detailing the results of the investigation with recommendations to bring each program

into compliance were transmitted. Included as an enclosure was a listing of the eleven minimum requirements and the contractor's procedure that fulfilled each requirement. When a requirement was not fulfilled it was noted in the listings.

In addition to the preceding program problems, the following deficiencies were noted during personal interviews and visits of the areas: (1) inadequate procurement of respirators and replacement parts, (2) lack of medical approval of employees required to wear respiratory protection, (3) inadequate training of employees, and (4) unsupervised issue of respirators.

(1) Difficulties with respirator procurement involve NASA as well as the contractors. There are two main contractors at the Center, the Shuttle Processing Contractor (SPC) and the Base Operations Contractor (BOC) each of which are responsible for their own procurement. However, both contractors are ultimately accountable to the federal government and therefore must abide by government procurement policies.

To promote competition and obtain the best quality for the lowest price, the government requires the phrase "or equivalent" be included in the published specifications for an item. This policy, when applied to the procurement of respirators, has resulted in the stocking of different manufacturers brands, models and replacement parts with similar capabilities and functions (Table 4). Contractors

ordering respirators from their respective stock system have received replacement parts of different manufacture which if used would, as previously noted, void NIOSH/MSHA approval. As of March 1983, contractors ordering respiratory protection equipment may specify the manufacturer they prefer, in effect nullifying the "or equivalent" requirement. This policy had not as yet been implemented into the respirator procurement system at the Kennedy Space Center. It was also noted that two different respirators were stocked under the same Federal Stock Number. Thus when a contractor ordered through Federal Stock, he could not be certain which brand he would receive and could obtain a brand for which he had no matching replacement parts. Several contractors pointed out that this practice required them to expend large amounts of money to maintain adequate replacement parts.

(2) Several of the programs investigated addressed the requirement for medical approval before use of respirators. However, in practice, none of the eleven contractors that use respirators verify that their employees received medical approval before using respirators. As a result there are over 1000 employees at the Center currently using respirators who have had no medical examination.

(3) Of the eleven contractors surveyed, five train their own employees, the employees of four contractors are instructed by the Base Operations Contractor and employees of two contractors are instructed by the Shuttle Processing

Table 4

Types of Respirators Available for Routine Use KSC

Dust,Fume,Mist	Chemical Cartridge	Self Contained Breathing Apparatus
3M 8742	Norton 7500	Scott Sling Pack II
3M 8710	Norton 1001	Scott AirPak
3M 9920	MSA Comfo II	Survivair Mark I
	MSA 461846	Survivair 30 Minute
	3M 8712	ISI Ranger
	3M 8714	
	3M 8727	
	Cesco 95RC25	
	Cesco 95RC55	
	Binks 40-128	
	American Optical R5051	

Contractor (Table 5). Because there are seven different training classes, there is a wide diversity in the instruction given to employees. When fit testing was performed, it was found in most cases the brand an employee was fit tested with was not the brand he would be using on the job. In some instances, fit testing was not performed, the employee was given the respirator, instructed in its use, and qualified.

(4) Many of the problems found with the issuance of respirators stem from the difficulties in training. There is no uniform way to identify an employee who has been trained in the use of respirators. Upon completion of training, the Base Operation Contractor issues certification cards which are carried by the employee and produced before a respirator will be issued. The employee is allowed to receive and use only those respirators for which the certification card shows he has received training. Other contractors provide a list of qualified employees to those responsible for issuing respirators. This is cumbersome and sometimes costly due to the delay between an employee being certified and the list reaching the tool crib so that the employee may obtain a respirator. Individual issue of respirators was common, however, in most cases there was no follow up to ensure proper maintenance and storage of the respirator by the employee.

Table 5

Divisions of Contractor Respirator Training Classes at the Kennedy Space Center

INDEPENDENT TRAINING	EMPLOYEES TRAINED
United Space Boosters Inc	75
McDonnell Douglas Astronautics Co	10
McDonnell Douglas Technical Services Co	60
Hughes Aircraft Co	20
Wiltech Co	10
BASE OPERATIONS CONTRACTOR TRAINING	
EG&G Florida Inc	250
Boeing Service Inc	25
General Dynamics Co	10
Bionetics Co	10
SHUTTLE PROCESSING CONTRACTOR TRAINING	
Lockheed Space Operations Co	600
Morton Thiokol Inc	100

IV. CONCLUSIONS

There is a wide variation in interpretation and application of respiratory protection requirements among contractors. This seems to be due to the following factors:

1) The Code (29 CFR 1910.134) is not specific enough in that:

a) Qualification requirements for administrators of respiratory protection programs are not defined.

b) Psychologic evaluation of the employee's ability to perform tasks while wearing a respirator is not included in 29 CFR 1910.134 as it is in ANSI Z88.2.

c) Physical examinations are suggested (should) but not mandatory (shall).

d) The Code assumes that a local physician is available who is familiar with work area conditions and therefore can determine what health and physical conditions are applicable, when actually very few physicians are familiar with work area conditions.

e) The Code assumes that all employers have the services of an industrial hygienist available to determine and perform such things as, "appropriate surveillance of

work area conditions and degree of employee exposure or stress".

2) The NASA/KSC respiratory protection program has not been visible enough in the past for contractors to understand their responsibilities. The program has suffered from the same inadequacies as the Code in that it was not stringent enough in requirements and enforcement. Further direction defining specific responsibilities and explaining penalties for infractions are essential for implementation.

3) Administration of the respiratory protection programs has not been consistent among contractors.

4) Respirator program requirements are not adequately defined and enforced.

5) Federal procurement practices have resulted in the proliferation of respiratory protection equipment, increasing costs by necessitating increase in stock of replacement/repair parts, and increasing the possibility of the installation of incorrect replacement parts.

6) Respirator training classes are not standardized and do not always provide the employee with instruction/ familiarization with the equipment to be used.

7) There is no uniform way to identify an employee who has been trained in the proper use and maintenance of a respirator.

V. RECOMMENDATIONS

As a result of the study there are two categories of recommendations, general and specific:

General

Not only should the Federal Code be revised to make it more inclusive but also a strong training and motivation program should be developed to convince exposed workers of the need for respiratory protection.

Specific

1) Title 29 CFR 1910.134 should be revised to incorporate the newly written (February 1984) American National Standards Institute (ANSI) Z88.6 - Respirator Use - Physical Qualifications for Personnel, which would standardize physical examinations.

2) Title 29 CFR 1910.134 should be revised to define "appropriate surveillance of work are conditions."

3) Contractors should be allowed to specify the manufacturer when procuring respiratory protection equipment or replacement parts to assure the best quality, standardized equipment is procured.

4) Training should be standardized to include all required aspects and include a uniform method of identification of employees who have been instructed in the proper use and maintenance of respirators.

5) Program evaluation should be performed annually, and include respirator selection, use, and maintenance as well as employee satisfaction with the program.

The results of this investigation lead one to the conclusions that the theoretical and practical aspects of respiratory protection programs are not always one and the same. Practical implementation of a large scale respiratory protection program presents many obstacles not only to the program administrator but also to management. Often there is a wide discrepancy between the written requirements of a program and the actual implementation of those requirements in the workplace. This is even more apparent when more than one contractor is employed at the same worksite.

REFERENCES

1. American National Standard, For Respiratory Protection-Respirator Use - Physical Qualifications for Personnel. ANSI Z88.6-1984, American National Standards Institute, New York, NY, 1984.

2. American National Standard, Practices for Respiratory Protection, ANSI Z88.2-1980, American National Standards Institute, New York, NY, 1982.

3. Birkner, L. R., Respiratory Protection-A Manual and Guideline, 1st ed., American Industrial Hygiene Association, Akron, OH, 1980.

4. Firenze, R. J., The Process of Hazard Control, Kendall/Hunt, Dubuque, IA, 1978.

5. Held, B. J., "Personal Protection," Patty's Industrial Hygiene and Toxicology, Vol. III, John Wiley & Sons, 1979, pp. 649-662.

6. Houdus, T. K. et al., "Effects of Industrial Respirator Wear During Exercise in Subjects with Restrictive Lung Disease," Clinical Investigation Branch, NIOSH, Morgantown, WV.

7. Lundin, A. M., "Respiratory Protective Equipment," Fundamentals of Industrial Hygiene, 2nd ed., National Safety Council, Chicago, IL, 1979, pp. 709-756.

8. McElroy, F. E., "Personal Protective Equipment," Accident Prevention Manual for Industrial Operations, 8th ed., Vol. 1, National Safety Council, Chicago, IL, 1981, pp. 497-516.

9. National Institute for Occupational Safety and Health, NIOSH Certified Equipment List, U.S. Dept. HHS, Pub. No. (NIOSH) 83-122, September 1985.

10. National Institute for Occupational Safety and Health, Respiratory Protection: An Employer's Manual, HEW Publication No. (NIOSH) 78-193A, Cincinnati, OH, 1978.

11. Office of Health Compliance Assistance, "Respiratory Protection," OSHA Instruction of Compliance 2-2.20A, Chapter V, pp. V1-V21.

12. Pritchard, J. A., A Guide to Industrial Respiratory Protection, HEW Publication No. (NIOSH) 76-189, Cincinnati, OH, 1976.

13. Rajhans, G. S., "Employee education, management support can halt respirator abuse," Occupational Safety and Health, Vol. 4, pp. 30-34, July/August, 1978.

14. United States Code of Federal Regulations, Title 29, Part 1910.134, U.S. Government Printing Office, Washington (1982).

15. United States Code of Federal Regulations, Title 30, Part 11, U.S. Government Printing Office, Washington (1979).

Summary of Eleven Minimum Requirements for Acceptable Respiratory Protection Program
(Extracted from 29 CFR 1910.134)

1. Written standard operating procedures governing the selection and use of respirators shall be established.
2. Respirators shall be selected on the basis of the hazards to which the workers is exposed.
3. The user shall be instructed in the proper use and limitations of the respirators.
4. Where practicable, the respirator should be issued to individuals for their exclusive use.
5. Respirators shall be regularly cleaned and disinfected.
6. Respirators shall be stored in a clean and sanitary location.
7. Respirators used routinely shall be inspected during cleaning.
8. Appropriate surveillance of work area conditions and degree of employee exposure or stress shall be maintained.
9. There shall be regular evaluation of the effectiveness of the program.
10. Persons should not be assigned to tasks requiring use of respirators unless it has been determined they are physically able to perform the work and use of the equipment
11. Approved or accepted respirators shall be used when available.

MATRIX DEFINITION

CATEGORY-CC-Chemical cartridge; DFM-dust, fume, mist

EQUIPMENT TYPE - Brand and model

WRITTEN SOP - Written Standard Operating Procedure

USE ROUTINE/EMER - Use of respiratory routine or emergency

MEDICAL APPROVAL - Medical examination specific for respirator use

TRAINING - Adequate training of employees in respirator use

FIT TEST QUAL/QUAN - Method of fit testing either qualitative or quantitative

INDIVIDUAL ISSUE - Respirator issued to individual for exclusive use

REGULAR MAINTENANCE - Maintenance of respirator by user or shop

PERIODIC RESPIRATOR INSPEC - Inspection of respirator performed

WORK AREA SURVEIL - Work area surveillance of hazard

PROGRAM EFFECTIVENESS - Based on personal observation: GOOD =program is enforced and effective; POOR =program not enforced

EMPLOYEE ACCEPTANCE/COMPLAINTS - Based on personal observation and interviews

PROGRAM EVALUATION COMPANY
Boeing

CATEGORY	EQUIPMENT TYPE	WRITTEN SOP	USE ROUTINE/EMER	MEDICAL APPROVAL	TRAINING	FIT TEST QUAL/QUAN
CC	Norton 7500	Yes	Routine	No	Yes	Qual
CC	MSA 7201		Routine		Yes	Qual
CC	Binks 40-128		Routine		Yes	Qual
CC	CESCO		Routine		Yes	Qual

PROGRAM EVALUATION COMPANY

Boeing

INDIVIDUAL ISSUE	REGULAR MAINTENANCE	PERIODIC RESPIRATOR INSPEC.	WORK AREA SURVEIL.	PROGRAM EFFECTIVENESS	EMPLOYEE ACCEPTANCE/COMPLAINTS
No	By User	By User	No	Poor	Good/None
No	By User	By User			
Yes	By User	By User			
Yes	By User	By User			

PROGRAM EVALUATION COMPANY

EG&G

CATEGORY	EQUIPMENT TYPE	WRITTEN SOP	USE ROUTINE/EMER	MEDICAL APPROVAL	TRAINING	FIT TEST QUAL/QUAN
CC	Norton	No	Routine	No	Yes	Qualitative
CC	3M-8741		Routine		Yes	Qualitative
CC	Norton 7731		Routine		Yes	Qualitative
CC	American Optical		Routine		Yes	Qualitative
DFM	3M-8710		Routine		No	-
DFM	3M-8742		Routine		No	-
CC	MSA Comfo II		Routine		Yes	Qualitative

PROGRAM EVALUATION COMPANY

EG&G

INDIVIDUAL ISSUE	REGULAR MAINTENANCE	PERIODIC RESPIRATOR INSPEC.	WORK AREA SURVEIL.	PROGRAM EFFECTIVENESS	EMPLOYEE ACCEPTANCE/COMPLAINTS
Yes	By User	By User	No	Poor	Good/Some
Yes	By User	By User			
Yes	By User	By User			
Yes	By User	By User			
Yes	By User	Disposable			
Yes	By User	Disposable			
Yes	By User	By User			

PROGRAM EVALUATION COMPANY

General Dynamics

CATEGORY	EQUIPMENT TYPE	WRITTEN SOP	USE ROUTINE/EMER	MEDICAL APPROVAL	TRAINING	FIT TEST QUAL/QUAN
CC	American Optical	Yes	Routine	No	No	None

PROGRAM EVALUATION COMPANY

General Dynamics

INDIVIDUAL ISSUE	REGULAR MAINTENANCE	PERIODIC RESPIRATOR INSPEC.	WORK AREA SURVEIL.	PROGRAM EFFECTIVENESS	EMPLOYEE ACCEPTANCE/COMPLAINTS
Yes	By User	By User	No	Poor	-/-

PROGRAM EVALUATION COMPANY

Hughes Aircraft

CATEGORY	EQUIPMENT TYPE	WRITTEN SOP	USE ROUTINE/EMER	MEDICAL APPROVAL	TRAINING	FIT TEST QUAL/QUAN
CC	MSA Comfo II	Yes	Routine	Yes	Yes	Qualitative

PROGRAM EVALUATION COMPANY

Hughes Aircraft

INDIVIDUAL ISSUE	REGULAR MAINTENANCE	PERIODIC RESPIRATOR INSPEC.	WORK AREA SURVEIL.	PROGRAM EFFECTIVENESS	EMPLOYEE ACCEPTANCE/COMPLAINTS
Yes	By User	By User	Yes	Good	Good/None

PROGRAM EVALUATION COMPANY

Lockheed & Morton Thiokol

CATEGORY	EQUIPMENT TYPE	WRITTEN SOP	USE ROUTINE/EMER	MEDICAL APPROVAL	TRAINING	FIT TEST QUAL/QUAN
CC	Norton 7500	Yes	Routine	In process of getting	Yes	Qualitative
CC	Norton 7731		Routine		Yes	Qualitative
CC	Norton		Routine		Yes	Qualitative
CC	MSA Comfo II		Routine		Yes	Qualitative
CC	MSA 461846		Routine		Yes	Qualitative
CC	3M 8712		Routine		Yes	Qualitative
CC	3M 8714		Routine		Yes	Qualitative
DFM	3M 8710		Routine			Qualitative

PROGRAM EVALUATION COMPANY

Lockheed & Morton Thiokol

INDIVIDUAL ISSUE	REGULAR MAINTENANCE	PERIODIC RESPIRATOR INSPEC.	WORK AREA SURVEIL.	PROGRAM EFFECTIVENESS	EMPLOYEE ACCEPTANCE/COMPLAINTS
Yes	By User	By User	In Process of Getting	Good	Good/None
Yes	By User	By User			
Yes	Disposable	Disposable			
Yes	By User	By User			
Yes	By User	By User			
Yes	Disposable	Disposable			
Yes	Disposable	Disposable			
Yes	Disposable	Disposable			

PROGRAM EVALUATION COMPANY

MDAC

CATEGORY	EQUIPMENT TYPE	WRITTEN SOP	USE ROUTINE/EMER	MEDICAL APPROVAL	TRAINING	FIT TEST QUAL/QUAN
DFM	3M 8710	Yes	Routine	No	Yes	Qual
CC	3M 8712		Routine		Yes	Qual
CC	MSA-CE		Routine		Yes	Qual
CC	Norton 7500		Routine		Yes	Qual
CC	Norton 10003		Routine		Yes	Qual

PROGRAM EVALUATION COMPANY

MDAC

INDIVIDUAL ISSUE	REGULAR MAINTENANCE	PERIODIC RESPIRATOR INSPEC.	WORK AREA SURVEIL.	PROGRAM EFFECTIVENESS	EMPLOYEE ACCEPTANCE/COMPLAINTS
Yes	Disposable	By User	No	Poor	-/-
Yes	Disposable	By User			
Yes	By User	By User			
Yes	By User	By User			
Yes	Disposable	By User			

PROGRAM EVALUATION COMPANY

USBI

CATEGORY	EQUIPMENT TYPE	WRITTEN SOP	USE ROUTINE/EMER	MEDICAL APPROVAL	TRAINING	FIT TEST QUAL/QUAN
DFM	3M 8710	Yes	Routine	No	Yes	Qual
CC	3M 8712		Routine		Yes	Qual
CC	3M 8714		Routine		Yes	Qual
CC	3M 8727		Routine		Yes	Qual
CC	Cesco 95RC25		Routine		Yes	Qual
CC	Cesco 95RC65		Routine		Yes	Qual
CC	Cesco 95RC55		Routine		Yes	Qual
CC	Norton 1001		Routine		Yes	Qual

PROGRAM EVALUATION COMPANY

USBI

INDIVIDUAL ISSUE	REGULAR MAINTENANCE	PERIODIC RESPIRATOR INSPEC.	WORK AREA SURVEIL.	PROGRAM EFFECTIVENESS	EMPLOYEE ACCEPTANCE/COMPLAINTS
Yes	Disposable	By User	No	Good	Good/None
Yes	Disposable	By User			
Yes	By User	By User			
Yes	Disposable	By User			
Yes	By User	By User			
Yes	By User	By User			
Yes	By User	By User			
Yes	Disposable	By User			

PROGRAM EVALUATION COMPANY

Norfolk Naval Shipyard

CATEGORY	EQUIPMENT TYPE	WRITTEN SOP	USE ROUTINE/EMER	MEDICAL APPROVAL	TRAINING	FIT TEST QUAL/QUAN
All	All Types	Yes	Routine	Yes	Yes	Qualitative

PROGRAM EVALUATION COMPANY

NNSY

INDIVIDUAL ISSUE	REGULAR MAINTENANCE	PERIODIC RESPIRATOR INSPEC.	WORK AREA SURVEIL.	PROGRAM EFFECTIVENESS	EMPLOYEE ACCEPTANCE/COMPLAINTS
Yes	By Shop 06	By User and Safety Personnel	Yes	Good	

CATEGORY	EQUIPMENT TYPE	WRITTEN SOP	USE ROUTINE/EMER	MEDICAL APPROVAL	TRAINING	FIT TEST QUAL/QUAN
All	All Types	Yes	Routine	Yes	Yes	Qualitative

PROGRAM EVALUATION COMPANY

IBM/Research Triangle Park

INDIVIDUAL ISSUE	REGULAR MAINTENANCE	PERIODIC RESPIRATOR INSPEC.	WORK AREA SURVEIL.	PROGRAM EFFECTIVENESS	EMPLOYEE ACCEPTANCE/COMPLAINTS
Yes	By User	By User	Yes	Good	