FESHM 4150: RESPIRATORY PROTECTION

Revision History

Author	Description of Change	Revision Date
Jonathan Staffa	Placed technical aspects in the Technical Appendix.	August 2017
Jonathan Staffa & David Baird	Added FESHM Chapter format to document, updated links, and provided a more complete guidance on scheduled cartridge change out.	September 2014

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1.0 INTRODUCTION

PURPOSE

To establish a respiratory protection program that coordinates the selection, use and maintenance of respiratory protection.

In the control of occupational diseases and discomfort caused by breathing air that is contaminated with potentially harmful dusts, fumes, sprays, mists, fogs, smokes, vapors, or gases, the primary objective shall be to minimize workplace contamination. This shall be accomplished as far as feasible by accepted engineering or administrative control measures. When effective engineering or administrative controls are not feasible, or while they are being implemented or evaluated and the potential for overexposure exists, appropriate respiratory protection shall be used.

SCOPE

All Fermilab divisions, sections and projects.

2.0 DEFINITIONS

Airline respirator – An atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.

Air-purifying respirator – 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) - The workplace level of respiratory protection that a respiratory protection that a respirator or class of respirators is expected to provide to employees when the employer implements a continuing, effective respiratory protection program. Fermilab will use the Occupational Safety and Health Administration (OSHA) APF values published in August 2006.

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

Ceiling – The concentration that should not be exceeded during any part of the working exposure.

Certified - Evaluated and listed as permissible by the National Institute for Occupational Safety and Health (NIOSH), the Mine Safety and Health Administration (MSHA), or the Bureau of Mines.

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

Disposable respirator - See Filtering facepiece.

End-of-service-life indicator (ESLI) – 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 - A respirator intended only for use during emergency egress from a hazardous atmosphere.

Fermilab prescribed exposure limit (FPEL) - The maximum allowable concentration of a contaminant in air which an individual may be exposed. These may be time weighted averages, short term limits, or ceiling limits. The prescribed exposure limit for a particular chemical is the lowest published value from American Conference of Governmental Industrial Hygienists (ACGIH)or OSHA.

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. A respirator which maintenance is not intended, but discarded after a single use.

Fit factor – 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 – The protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual. (See also Qualitative Fit Test and Quantitative Fit Test).

Hazardous atmosphere - An atmosphere that contains a contaminant(s) in excess of the exposure limit or that is oxygen deficient.

Helmet – A rigid respiratory inlet covering that also provides head protection against impact and penetration.

Hood – 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) – 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.

Loose-fitting facepiece - A respiratory inlet covering that is designed to form a partial seal with the face. Types include helmet and hood.

Maximum use concentration – The maximum atmosphere concentration of a hazardous substance from which an employee can be expected to be protected when wearing a respirator, and is determined

by the assigned protection factor of the respirator or class of respirators and the exposure limit of the hazardous substance.

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

Non-required respirator user – A Fermi Research Alliance (FRA) employee who, wears a respirator however, does not have the potential to be overexposed to a hazardous atmosphere.

Oxygen deficient atmosphere – An atmosphere with oxygen content below 19.5% by volume.

Physician or other licensed health care professional (PLHCP) – 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 within this document.

Powered air-purifying respirator - An air-purifying respirator that uses a blower to force the ambient atmosphere through air-purifying elements to the inlet covering.

Positive pressure respirator – A respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator. Examples include Airline respirators and Self-Contained Breathing Apparatus (SCBA).

Pressure demand respirator – 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 - A pass/fail fit test that is used to assess the adequacy of respirator fit, and that relies on the individual's response to the test agent.

Quantitative fit test – An assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator. (See also Fit factor).

Respirator Program Report – A respirator qualification matrix located on the Environment, Safety, Health & Quality Section (ESH&Q) webpage which indicates the status of all respirator required users at Fermilab.

Respirator required user – A Fermi Research Alliance (FRA) employee who has the potential to be overexposed to a hazardous atmosphere, and is included in the Fermilab Respirator Program.

Reusable respirator - See Tight-fitting facepiece.

SCBA – An atmosphere-supplying respirator for which the breathing air source is designated to be carried by the user.

Short-Term Exposure Limit (STEL) – Typically considered to be a 15-minute Time-Weighted Average (TWA) exposure which should not be exceeded at any time during a workday even if the 8-hour Time-Weighted Average is within the appropriate exposure limits.

Tight-fitting facepiece – A respiratory inlet covering that is designed to form a complete seal with the face. A respirator for which maintenance is required and that is designed for repeated use.

Time-Weighted Average (TWA) – The time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek.

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

3.0 RESPONSIBLILITIES

3.1 ESH&Q Section

a. The responsibility and authority for the respirator program shall be assigned to a single individual in the Industrial Hygiene Group of the ESH&Q Section titled the Respirator Program Administrator.

b. Update program, as necessary, to comply with Department of Energy, OSHA and Department of Transportation regulations, American National Standards Institute (ANSI) and NIOSH standards, and ACGIH Threshold Limit Values.

c. A biennial written review of Fermilab's respiratory protection program shall be performed by the Respirator Program Administrator. The review may include, but not limited to the following areas; review of FESHM Chapter 4150, periodic reviews of the Respirator Program Report on the ESH&Q Webpage, distribution of the Industrial Hygiene Training Past Due Assessment, Division and Section tripartite reviews, discussions with employees and supervisors during required annual training and fit-testing campaigns.

d. Make any necessary changes to the program when they become apparent.

e. Maintain quantitative fit testing equipment.

f. Stock supply of NIOSH approved filtering facepieces and reusable air-purifying respirators with appropriate filtering media.

g. Develop training programs and lesson plans for employee use of respiratory protection. Provide training upon request and enter it into the TRAIN database.

h. Maintain Respirator Program Report database.

i. Investigate malfunctions of respiratory protection equipment to determine cause and assure corrective measures are taken.

j. Select and issue the correct type of respirator. Develop cartridge change out schedules for exposures to chemicals. If the cartridge does not have an end of service life indicator (ESLI), the Respirator Program Administrator is to consult with the manufacturer to determine an appropriate change out schedule.

k. Conduct quantitative fit testing, as needed, for employees issued reusable, tight fitting respiratory protection. Enter fit testing records into the Respirator Program Report database.

l. Evaluate work areas and recommend procedures to maintain personal exposure below Fermilab prescribed exposure limits.

a. Assess the need for respiratory protection. If respirator protection is required, complete the Medical Surveillance Request for and send to the Occupational Medical Department.

b. Ensure that employees have received medical approval and training before reusable respiratory protection is issued.

3.2 Supervisors

a. Assess the need for respiratory protection. If respirator protection is required, complete the Medical Surveillance Request for Respiratory Protection Usage Form and send to the Occupational Medical Department.

b. Ensure respirators are used in accordance with instructions and training received.

c. Ensure respirators are cleaned, disinfected and stored in a clean, sanitary condition.

d. Ensure respirators are in good working condition.

e. Notify Division Safety Officer (DSO) of any changes in personnel enrolled in the program and any changes in working conditions that may change workers' need for respirator protection. The employee's Individual Training Needs Assessment (ITNA) shall be revised as well.

3.3 Employees

a. Use respirators in accordance with instructions and training received.

b. Maintain, clean, inspect, and store respirators as instructed.

c. Report any malfunction of a respirator to supervisor.

d. Immediately discontinue use if respirator malfunctions and go to an area with respirable air.

3.4 Occupational Medical Office

a. With the aid of OSHA's respiratory protection standard, 29 Code of Federal Regulations (CFR) 1910.134, medical questionnaire Appendix C, the PLHCP shall determine what health and physical conditions are pertinent for assuring the respirator wearer is capable of performing work while wearing respiratory protection.

b. Conduct medical surveillance of respirator wearers every two years.

4.0 PROCEDURES

4.1 Evaluation

For those operations for which respiratory protection is considered, a DSO or an Industrial Hygienist must determine the nature and degree of hazard posed by the exposure. Refer to Technical Appendix 6.1 for selection factors to consider.

4.2 Issuance

a. Only knowledgeable ES&H personnel are permitted to select and issue respiratory protection. Guidelines such as ANSI Z88.2 -1992, the NIOSH Selection Guide, applicable OSHA regulations, or other reputable source should be used as an aid in the selection process.

b. Before a reusable respirator is issued, the individual must receive clearance from the Occupational Medicine Office. This includes non-required reusable respirator usage.

c. Tight-fitting respirators shall not be issued to required respirator users if facial hair comes between the sealing surface of the facepiece and the face or if facial hair interferes with valve function.

d. Disposable respirators may be used ONLY when the estimated exposure level is less than half of the Fermilab prescribed exposure limit.

e. Fit testing must be performed for all respirator-required users. NOTE: Emergency escape-only air-supplied respirators and filtering facepieces worn for personal comfort (voluntary use), are excluded from this requirement.

f. Records that document fit testing and issuance must be submitted to the ESH&Q Sections for inclusion into the Respirator Program Report database. The Quantitative Respirator Fit-testing Record form is available on the ESH&Q Section Webpage.

g. Issuance of respirators, including disposables, shall be documented. The issuance of disposables or non-required tight-fitting respirators shall be recorded on the Respirator Log Sheet. The Respirator Log Sheet shall be maintained by the ESH&Q Section's Safety and Health Group and kept where the respirators are stored. Employees will be given a copy of Appendix D of the OSHA standard 1910.134 (see DocDB 1602). The Respirator Program Report on the ESH&Q TRAIN Webpage serves as the required reusable respirator user issuance record.

4.3 Medical Qualification

Persons shall not be issued a reusable respirator until it has been determined by the Fermilab Physician or Licensed Health Care Provider that they are physically and psychologically able to wear a respirator under working conditions as specified by OSHA CFR 1910.134. The D/S requesting the respirator must provide the physician with meaningful work-related information to assist in the evaluation (i.e., the Medical Surveillance Request for Respiratory Protection Usage Form). The medical evaluation shall be repeated every two years.

For disposable respirators, the person issuing the respirator shall ask the employee if they have any medical conditions that may prohibit their use of the respirator. If there is, the person shall be referred to the Occupational Medicine Office before the respirator is issued. The log shall indicate if a referral was necessary.

4.4 Training

Required and non-required reusable respirator wearers shall complete respiratory protection training (FN00024/CR) to ensure proper respirators use. Training shall be documented per procedures in Fermilab ES&H Manual Chapter 2070, ESH Training Program. Respiratory protection training requires an annual requalification.

Supervisors of reusable respirator wearers shall receive initial training on the proper use of respirators. The training shall include as a minimum:

- Basic respiratory protection practices (see above).
- Nature & extent of respiratory hazards to which persons under their direction may be exposed.
- Recognition and resolution of respirator problems.
- Basic elements of the respirator program.

4.5 Fit Testing

a. Quantitative fit testing must be completed for all tight-fitting, required respirator users. This includes all negative pressure air-purifying respirators, powered air-purifying respirators, and

self-contained breathing apparatus. Positive pressure respirators with a tight seal to the face shall be fit tested in the negative pressure mode. Instructions for quantitative fit testing and the fit-testing form are contained on the ESH&Q Section Webpage under Industrial Hygiene. If exposure is estimated to be below 1/2 the Fermilab prescribed exposure limit, qualitative fit testing may be performed.

b. Fit testing shall be repeated annually or whenever significant facial changes may affect the facepiece seal (e.g., facial scarring, cosmetic surgery, dental changes, surgery, obvious changes in body weight, etc.).

c. Fit testing shall not be performed, and tight-fitting respiratory protective equipment shall not be issued if facial hair comes between the sealing surface of the facepiece or the face or if facial hair interferes with valve function.

d. When a respirator user must wear corrective lenses, a protective spectacle or goggle, a face shield, a welding helmet, or other eye and face protective devices, the item shall be fitted to provide good vision and shall be worn in such a manner as not to interfere with the seal of the respirator.

e. Spectacles with straps or temple bars that pass through the sealing surface of negative or positive pressure, tight fitting, and full facepiece respirators shall not be used, unless 1) the device is specifically designed for that purpose and 2) the individual successfully passes the fit test while wearing the device.

f. Contact lenses may be worn with respirators, provided the individual has previously demonstrated that he or she has had successful experience wearing contact lenses.

4.6 Maintenance

Respiratory protection devices must be maintained to retain their original effectiveness.

a. All reusable respirators must be routinely inspected before and after each use. See inspection checklist for reusable respirators, see DocDB 1602.

b. Self-contained breathing apparatus and emergency escape respirators shall be at least inspected monthly and before and after use. Air cylinders shall be fully charged per the manufacturer's instructions. It shall be determined through inspection that the regulator and warning devices function properly. There must be a log kept of all monthly inspections.

c. Clean and disinfect each reusable respirator after each use. The ESH&Q Section stocks materials for cleaning and disinfecting respiratory protection equipment. See DocDB 1602 for the OSHA Respirator Cleaning Procedures (Appendix B-2, 1910.134).

d. Properly store reusable respirators. Following inspection, cleaning, and necessary repair, respirators shall be stored to protect against dust, sunlight, heat, extreme cold, excessive moisture, or damaging chemicals. Respirators shall be placed in re-sealable plastic bags for storage. Respirators should not be stored in such places as lockers or toolboxes unless they are in carrying cases or cartons. Respirators should be packed or stored so that the facepiece and exhalation valves rest in a normal position and function will not be impaired by the elastomer setting in an abnormal position.

e. Disposable respirators should be disposed of after one day of use, or more frequently, if necessary.

4.7 Inspection Procedures

a. General

The OSHA Standard requires a respirator inspection include a check of tightness of connections, facepiece, headbands, valves, tubes, filters or cartridges. Further, all rubber and elastomer parts of respirators must be inspected for pliability and signs of deterioration. Refer to Technical Appendix 6.2 for specific inspection procedures.

5.0 REFERENCES

American Conference of Governmental Industrial Hygienists (ACGIH) - Threshold Limit Values for Chemical Substances and Physical Agents (2017)

American National Standards Institute (ANSI) Z88.2 - 1992 Respiratory Protection

ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-1989

Department of Transportation 49 CFR part 173 and 178

National Institute of Occupational Safety and Health (NIOSH) 42 CFR part 84

NIOSH 30 CFR part 11

NIOSH Publication 87-116 Guide to Industrial Respiratory Protection

Occupational Safety and Health Administration (OSHA) General Industry Standard
29 Code of Federal Regulations (CFR) 1910.134

OSHA General Industry Standards 29 CFR 1910.1000

OSHA General Industry Standards 29 CFR 1910.1020

6.0 TECHNICAL APPENDICES

6.1 Respirator Selection

6.1.1. Determining Factors

The selection of the proper type of respirator entails consideration of the following factors:

a. What is the nature of the contaminants?
b. Are the contaminants dusts, mists, fumes, vapors or gases or combinations?
c. What are the anticipated exposure concentrations?
d. What is the Fermilab prescribed exposure limit (FPEL)?
e. Is there a potential for oxygen deficiency?
f. Does the contaminant have adequate warning properties?
g. Is there an oil mist present in the work environment?
h. Could concentrations be deemed to be immediately dangerous to life and health (IDLH)?
i. Will the contaminant irritate eyes?
j. Can the contaminant be absorbed through the skin?
k. How long will the respirator be worn?
l. What impact will the respirator have on the worker?
m. What are the assigned protection factors for the respirator?
n. Does the respirator offer comfort of fit?
o. What filter efficiency is necessary due to governmental regulation?
p. Will the use be voluntary or mandatory?

6.1.2. Factor Analyses

a. Nature of the Hazard

In selecting a particular respirator, consideration of the process and the materials involved is warranted. The contaminant's physical, chemical and toxicological properties are to be investigated and a determination made as to the potential for oxygen deficiency or IDLH atmospheres.

b. Oxygen Deficiency or IDLH Atmospheres

Appropriate respirator selection initially involves a determination as to whether an oxygen deficient atmosphere (less than 19.5% by volume) or an IDLH atmosphere exists or could exist in the area where work is to be performed. Supplied air full facepiece respirators with escape provisions or self-contained breathing apparatuses (SCBA) must be used. OSHA has stated that if the concentration is unknown, but the atmosphere is unlikely to be IDLH, the employer may rely on professional judgment, past history and knowledge of the operation to select the proper respirator.

c. Physical and Chemical Properties

This factor involves determining if the contaminants are dusts, mists, fumes, vapors, or

gases. The selection of an air-purifying respirator must also consider the classification of the contaminant into a physical form. A dust is a solid mechanically produced particle or fiber. A fume is a condensed solid formed from the melting and vaporization of a metal. A mist is liquid droplet particles. A vapor is a gas, which evolves from a liquid or a solid at normal conditions. Gases are formless fluids at normal conditions. Particulate respirators remove contaminants by filtering the air through a fibrous material. Vapor and gas respirators remove contaminants by interaction of molecules with a sorbent material.

d. Warning Properties

If a negative pressure respirator is used for protection against a gas or a vapor, the contaminant must have adequate warning properties. A contaminant having an odor or a threshold of irritation above the FPEL is considered to have poor warning properties. The following compounds are a partial listing of contaminants that may be present at Fermilab and are considered to have poor warning properties: carbon monoxide, carbon dioxide, hydrogen sulfide, ozone. However, if a cartridge has an end of service life indicator or a change schedule has been implemented that is based upon documented service life data, airborne exposures, and duration of exposure, a negative pressure respirator may be used to protect against materials deemed to have poor warning properties.

e. Permissible Exposure Limits (PEL) and Threshold Limit Valves (TLVs)

In selecting a respirator, an understanding of the permissible exposure limits and threshold limit values as deemed applicable is necessary. Exposure monitoring data or the results of an exposure assessment is to be used to determine the needed protection factor. Selection should also consider ceiling limits and short term limits for contaminants having such a designation.

f. Skin Absorption or Eye Irritation

Air contaminants that are eye irritants require the selection of a full facepiece respirator. Where information exists which indicates the contaminant is capable of being absorbed through the skin and systemic injury or death could result from the exposure, appropriately-selected full body protective equipment used with a SCBA must be used.

6.1.3. Types of Respirators

The following types of respiratory protective equipment are used at Fermilab:

- Filtering facepiece – (dust masks)
- Half mask air-purifying respirator
- Full face air-purifying respirator

- Powered air-purifying respirator (loose-fitting and tight-fitting)
- Airline respirator (loose-fitting)
- Escape-only air-supplied respirator
- Self-Contained Breathing Apparatus (pressure demand)

a. Particulate Filter

A particulate (mechanical) filter respirator is designed to give protection against particle air contaminants, such as non-volatile dusts, mists or metal fumes. The items to be concerned with in the selection of this type of respirator are: (1) resistance to breathing caused by the filtering element; (2) the fit of the facepiece to various sizes and shapes of faces; (3) the presence of oil mists; and (4) the necessary filtering efficiency. This type of respirator device does not offer protection against oxygen deficiency, carbon monoxide, gases, or vapors. Specifically, adaptable particulate filters are available for usage with chemical cartridge respirators where suspected air contaminants require a multiple purpose type respirator. The program administrator should consult with the manufacturer or refer to the manufacturer's technical bulletin when selecting filter medium or cartridges.

Particulate respirators are classified into the categories as follows:

Filter	Filter Type	Efficiency
N (No Oil)	N100 N95	99.97 95
R (Oil Resistant)	R95	95
P (Oil Proof)	P100 P95	99.97 95

The NIOSH service time recommendations for filter replacement are as follows:

All Filters: The service life of all filters is limited by considerations of hygiene, damage and breathing resistance.

N Series: Can be used and reused subject to considerations of hygiene, damage and increased breathing resistance. However, for dirty workplaces that could result in high filter loading, i.e., 200 milligrams (mg), service time should only be extended beyond 8 hours of continuous use or intermittent by performing an evaluation that demonstrates that the extended use will not degrade the filter efficiency below the specified level or that the total mass loading on the filter is less than 200 mg.

R Series: Should only be used for a single shift or for 8 hours of continuous or intermittent use when oil is present. However, service time for R Series filters can be

extended using the methods described above for N Series filters.

P Series: Should be used and reused in accordance with the manufacturer's time use limitation recommendations when oils are present. P Series can be used and reused subject only to considerations of hygiene, damage and increased breathing resistance if oil aerosols are not present.

Under Public Health's Approval of Respiratory Protective Devices, 42 CFR Part 84, certified particulate filters can be used without regard to aerosol size because filter testing is done with the most penetrating particle size. According to NIOSH, all filters certified will be effective against any aerosol. Therefore, the consideration of filter efficiency is not workplace dependent and the need for higher efficiency filters is primarily dictated by government regulations, e.g., lead, asbestos.

b. Chemical Cartridge Respirator

Chemical cartridge respirators normally consist of a facepiece (half-face - mouth and nose or full-face - mouth, nose and eyes) connected directly to two cartridges containing chemicals. Various chemicals are used in the cartridges and each chemical is specific as to which air contaminant will be removed. Chemical cartridge respirator usage is for non-emergency situations and is not to be used for atmospheres which are immediately hazardous to life or health, nor is it to be used in oxygen deficient atmospheres. Although NIOSH approves chemical cartridges according to 10 classifications, the selection can be narrowed into seven categories because most manufacturers offer dual-purpose cartridges. The categories are:

1) organic vapors - black
2) ammonia, methylamine - green
3) formaldehyde, hydrogen fluoride- olive green
4) acid gases (sulfur dioxide, hydrogen sulfide, hydrogen chloride, chlorine) - white
5) organic vapor/acid gas - yellow

The Industrial Hygiene Representative shall review the manufacturer's technical bulletin to determine the appropriate cartridge or cartridges. In addition, the limitations of each cartridge with respect to maximum concentrations must be considered in the selection process. If the cartridge does not have an end of service life indicator (ESLI), the DSO or industrial hygienist is to utilize the manufacturer's cartridge change out schedule calculator. The 3M respirator selection and cartridge change out calculator may be accessed here: 3M Service Life Calculator. Chemical cartridge change-out schedules shall be included in Job Procedures, Hazard Analysis, and IH Field Forms.

c. Air-Line Respirator

The only air-line respirator at Fermilab is an abrasive-blasting unit located within the Technical

Division at Industrial Building 2. The air-line respirator is connected to a suitable breathing air source by a hose which delivers the breathable air to the user continuously in sufficient volume to meet breathing requirements. The loose-fitting helmet provides full-face (mouth, nose and eye) coverage.

Note: Airline respirators without escape capabilities are only to be used in atmospheres where air contaminant concentrations are not IDLH. This limitation is necessary because the air supply is solely dependent upon an outside source, which is not readily available to the wearer.

The compressor is located and constructed to avoid entry of contaminated air. The air system is equipped with filters, sorbent beds and alarm systems as necessary to ensure Grade D breathing air is supplied. The oil lubricated compressor is equipped with a carbon monoxide alarm which monitors the air to prevent the carbon monoxide in the breathing air from exceeding 10 parts per million (ppm). The air is dried. This fixed system is equipped with a compressor capable of supplying air at 110-115 pounds per square inch gauge (psig) at the outlet of the purification system. The system is equipped with a low pressure alarm when buffer tank pressure drops below 85 psig.

d. Self-Contained Breathing Apparatus

Scott Air Pack

A self-contained breathing apparatus (SCBA) provides 15 to 30 minutes of breathable air from a self-contained cylinder. For this reason, it is ideally suited for emergency rescue operations but the limitation on air supply makes it a less desirable source of air for normal work operations of extended duration.

The Fermilab Fire Department uses an air compressor (not oil lubricated) to fill a 4-cylinder (6000 psig each) cascade unit. This cascade unit is used to fill the 4500 SCBA cylinders. Only pressure demand SCBA respirators are used at Fermilab.

The Fire Department has a service contract to test the air quality of the compressor unit on a quarterly basis. The compressor itself is serviced annually (i.e., sorbent bed and filter changes) by the factory authorized service technician per manufacturer's specifications and cylinders are hydrostatically tested as required. SCBAs are checked daily and thoroughly inspected monthly by Fire Department personnel. The SCBAs are flow tested, inspected and calibrated annually by a factory authorized service contractor. All records are kept on file at the Fire Department.

BioMarine

The BioMarine BioPak 240 is a NIOSH/MSHA approved closed-circuit four hour self-contained breathing apparatus (SCBA). The unit is intended for long duration use such as mine or tunnel rescue operations. It is not designed for firefighting. The unit operates by removing the carbon dioxide from the user’s exhaled breath by means of a chemical scrubber. A 3000 psig oxygen cylinder provides makeup oxygen on demand. A frozen gel canister provides cooling of the respirable air. The cooling canisters are stored in a dedicated freezer at the fire

station. The units and supplies are stored in a controlled atmosphere area at the fire station.

The Fire Department is trained to use and maintain the units. Benchmen training is conducted by the manufacturer. The trained FFD personnel are then qualified to train the users annually. FFD personnel trained by Benchmen must be recertified every three years.

Benchmen trained FFD personnel also perform repairs and testing of the units. The oxygen cylinders are hydro-tested every 5 years. A compressed gas vendor fills the cylinders to 3000 psig with medical grade oxygen.

All users undergo annual training in which the units are setup, tested, worn and used for two-hours. This is called being "under oxygen". This training includes cleaning, drying and storage.

e. Emergency Escape Respirators

Emergency Life Support Apparatus (ELSA)
Emergency escape respirators are used for oxygen deficient hazard (ODH) areas at Fermilab. The emergency escape units provide a 5-minute supply of air and are required to be brought into areas that are ODH class 1-4. These units are only permitted for escape purposes and are not to be used for entry into an IDLH atmosphere under any circumstances. The 5-minute escape packs are inspected monthly. The 5-minute escape pack plastic hoods are checked for cracks and discoloration and the gauges are checked for pressure. See FESHM Chapter 4240, Oxygen Deficiency Hazards, for more information on the Fermilab ODH Program.

OCENCOs
Emergency escape respirators (OCENCO) are used for Main Injector/Main Injector Neutrino Oscillation Search (MINOS).underground areas **and** ODH areas at Fermilab. The OCENCO and M20.2 are belt worn, compressed oxygen, self-contained self-rescuers (SCSRs). The units instantly provide breathable air, independent of the surrounding atmosphere, to a person escaping from any area of toxic gas or oxygen deficiency. The emergency escape units provide a 10-minute supply of air and are available at the following locations; bottom of the elevator at Main Injector Enclosure 65 (MI-65), bottom of elevator at MINOS, and at the Fire Door at the Absorber Hall. These units are inspected and maintained per manufacturer requirements by ESH&Q.

f. Assigned Protection Factor (APF)

The APF is used to select the appropriate respirator. The APF is the expected workplace level of respiratory protection that would be provided by a properly functioning respirator or a class of respirators to properly fitted and trained users.

The OSHA assigned protection factors are as follows:

Table 1. -- Assigned Protection Factors[5]

Type of respirator[1], [2]	Quarter mask	Half mask	Full facepiece	Helmet/ hood	Loose-fitting facepiece
1. Air-Purifying Respirator	5	10[3]	50	.....	.....
2. Powered Air-Purifying Respirator (PAPR)	.....	50	1,000	25/1,000[4]	25
3. Supplied-Air Respirator (SAR) or Airline Respirator					
• Demand mode	.....	10	50	.....	.....
• Continuous flow mode	.....	50	1,000	25/1,000[4]	25
• Pressure-demand or other positive-pressure mode	.....	50	1,000	.....	.....
4. Self-Contained Breathing Apparatus (SCBA)					
• Demand mode	.....	10	50	50	.....
• Pressure-demand or other positive-pressure mode (e.g., open/closed circuit)	.....	.....	10,000	10,000	.....

Notes:

[1]Employers may select respirators assigned for use in higher workplace concentrations of a hazardous substance for use at lower concentrations of that substance, or when required respirator use is independent of concentration.

[2]The assigned protection factors in Table 1 are only effective when the employer implements a continuing, effective respirator program as required by this section (29 CFR 1910.134), including training, fit testing, maintenance, and use requirements.

[3]This APF category includes filtering facepieces, and half masks with elastomeric facepieces.

[4]The employer must have evidence provided by the respirator manufacturer that testing of these respirators demonstrates performance at a level of protection of 1,000 or greater to receive an APF of 1,000. This level of performance can best be demonstrated by performing a WPF or SWPF study or equivalent testing. Absent such testing, all other PAPRs and SARs with helmets/hoods are to be treated as loose-fitting facepiece respirators, and receive an APF of 25.

[5]These APFs do not apply to respirators used solely for escape. For escape respirators used with specific substances covered by 29 CFR 1910 subpart Z, employers must refer to the appropriate substance-specific standards in that subpart. Escape respirators for other IDLH atmospheres are specified by 29 CFR 1910.134 (d)(2)(ii).

6.2 Inspection of Respirators

a. Air-Purifying Respirator Inspection

The following items are to be examined during the inspection:

Examine the facepiece for:

- Excessive dirt.
- Cracks, tears, holes, or distortion from improper storage.
- Inflexibility of rubber facepiece (stretch and massage to restore flexibility).

- Cracked or badly scratched lenses in full facepieces.
- Incorrectly mounted full facepiece lenses or broken or missing mounting clips.
- Cracked or broken air-purifying element holder(s).
- Badly worn threads or missing gasket(s).

Examine the head straps or head harness for:

- Breaks.
- Loss of elasticity.
- Broken or malfunctioning buckles and attachments.
- Excessively worn serration on head harness, which might permit slippage.

Examine the exhalation valve for the following after removing its cover:

- Blockage.
- Foreign material, such as detergent residue, dust particles or human hair under the valve seat.
- Cracks, tears or distortion in the valve material.
- Improper insertion of the valve body in the facepiece.
- Cracks, breaks or chips in the valve body, particularly in the sealing surface.
- Missing or defective valve cover.
- Improper installation of the valve in the valve body.

Examine the air-purifying elements for:

- Incorrect filter, cartridge or canister for the hazard.
- Incorrect installation, loose connections, missing or worn gaskets, or cross-threading in holder.
- Expired shelf-life date on the cartridge or canister.
- Cracks or dents in the outside case of the filter, cartridge or canister, indicated by the absence of sealing material, tape, foil, etc., over the inlet.

If the device has a corrugated breathing tube, examine it for:

- Broken or missing end connectors.
- Missing or loose hose clamps.
- Deterioration, determined by stretching the tube and looking for cracks.

b. Atmosphere-Supplying Respirator Inspection

If the device has a tight fitting facepiece, the wearer is to follow the procedures outlined above for air-purifying respirators, except those pertaining to the air-purifying elements. Additionally, the wearer shall check:

- Integrity and condition of air supply lines and hoses, including attachment and end fittings.

- Tightness of connections.
- Correct operation and condition of all regulators and valves.
- All fittings and connections to ensure no deviations from design specifications have been made.
- Breathing air couplings are incompatible with outlets of non-respirable air or other gas systems.

If the device is a hood, helmet, blouse, or full suit, the wearer shall use the following inspection procedure.

- Examine the hood, blouse or full suit for rips and tears, seam integrity, etc.
- Examine the protective headgear, if required, for general condition with emphasis on the suspension inside the headgear.
- Examine the protective face shield, if any, for cracks or breaks or impaired vision due to rebounding abrasive particles.
- Make sure the protective screen is intact and secured correctly over the face shield or abrasive blasting hoods and blouses.

c. Air-Line System Inspection

Inspection of the airline systems is to include the following checks:

- Intake area situated to ensure the quality of intake air cannot be jeopardized.
- Calibration and function of alarm systems – carbon monoxide, high temperature, low air pressure, etc.
- Operating pressure to determine if the system is within normal range.
- All air filters on air system.
- Inspection tag is at compressor.

Maintenance and replacement or refurbishment of the compressor and associated parts is to be performed by trained personnel following manufacturer's instructions and recommendations. Breathing air must meet Grade *D* specifications as described in the Compressed Gas Association Commodity Specification G-7.1-1989 (oxygen content of 19.5-23.5% condensed hydrocarbons of 5 mg per cubic meter of air or less, carbon monoxide of 10 ppm or less and carbon dioxide of 1000 ppm or less). The dew point of air is to be -10° F below the ambient temperature.

d. Self-Contained Breathing Apparatus Inspection

1) General

All inspections are to be conducted by qualified persons. Air from the respective self-contained breathing apparatus shall not be used for performing tests requiring air consumption. The person performing the inspection must provide an auxiliary air supply. Whenever practical, defects should be corrected in the field. If the unit must be removed from service, it is the responsibility of the person making the inspection to replace the unit.

2) Facepieces
The facepieces of self-contained breathing apparatus should be checked using procedures outlined under air-purifying respirators.

3) Accessories
Manufacturer's instructions are to be followed and generally include:

- Hose connectors, hoses, head harnesses, backpack components; and gauges should be inspected for bulges, wrinkles, or tears.
- Alarms should be checked by closing the air valve and slowly bleeding excess pressure from the regulator by breathing down the remaining air.
- The air cylinder should be checked to determine whether it is filled to 90% of capacity and the valve is in closed position. The hydrostatic test date should be checked for expiration and the cylinder examined for damage, corrosion, chipping, or cracking and air tightness.
- The regulator checked by opening the cylinder valve, donning the facepiece with the unit in the positive pressure mode and inhaling and exhaling. The regulator pressure is to be compared to the cylinder pressure and a positive pressure observed in the mask.
- The operation of the reducing valve and the bypass valve of the regulator should be tested.
- Check the diaphragm by gently inhaling through the regulator outlet and hold for ten seconds. Negative pressure is to be maintained. Gently exhale through the regulator outlet and hold for ten seconds. Positive pressure should be maintained.
- Examine all straps, clips and buckles for damage and operability. All buckles must readily clasp and unclasp and locking mechanism on the cylinder holder must operate properly. Straps are to be adjusted out fully and are to be untwisted and smooth.
- Check the regulator housing for damage. The cover is to be seated and secured. Ensure the regulator hose coupling is hand tightened to the cylinder valve outlet.
- Regulator controls are in proper position.

e. Emergency Escape-Only Supplied-Air Respirators Inspection

- Inspect before being carried into the workplace.
- Examine the plastic hood for cracks or discoloration.
- Check the gauge for adequate pressure. The pressure gauge should read full (within the green (full) zone).