

## FESHM 4150: RESPIRATORY PROTECTION

### Revision History

<b>Author</b>	<b>Description of Change</b>	<b>Revision Date</b>
Matthew Spaw	- Revised program to align with Z88.2-2015 <ul style="list-style-type: none"> <li>• Updated 6.1.3.a. Particulate Cartridge List</li> <li>• Replaced “user” with “wearer”</li> </ul> - Added guidance to Section 4.2 Issuance Procedure - Added 6.1.3.b. 3M Chemical Cartridge list - Specified filter/sorbent maintenance per mfg. spec in section 6.2.c.	June 2018
Jonathan Staffa	Placed technical aspects in the Technical Appendix.	August 2017
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## 1.0 PURPOSE AND SCOPE

To establish a respiratory protection program that coordinates the selection, use and maintenance of respiratory protection. This chapter applies to operations and activities at the main site in Batavia, Illinois. Leased spaces will follow the programs established by the local organization.

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.

## 2.0 DEFINITIONS

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

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 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 wearer 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 wearer of the approach of the end of adequate respiratory protection, for example that the sorbent is approaching saturation or is no longer effective.

45 Escape-only respirator - A respirator intended only for use during emergency egress from a hazardous  
46 atmosphere.

47  
48 Fermilab prescribed exposure limit (FPEL) - The maximum allowable concentration of a contaminant  
49 in air which an individual may be exposed. These may be time weighted averages, short term limits,  
50 or ceiling limits. The prescribed exposure limit for a particular chemical is the lowest published value  
51 from American Conference of Governmental Industrial Hygienists (ACGIH), OSHA, or other  
52 consensus standard.

53  
54 Filtering facepiece – (dust mask) – means a negative pressure particulate respirator with a filter as an  
55 integral part of the facepiece or with the entire facepiece composed of the filtering medium. A  
56 respirator which maintenance is not intended, but discarded after a single use.

57  
58 Fit factor – A quantitative estimate of the fit of a particular respirator to a specific individual, and  
59 typically estimates the ratio of the concentration of a substance in ambient air to its concentration  
60 inside the respirator when worn.

61  
62 Fit test – The protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual.  
63 (See also Qualitative Fit Test and Quantitative Fit Test).

64  
65 Hazardous atmosphere - An atmosphere that contains a contaminant(s) in excess of the exposure limit  
66 or that is oxygen deficient.

67  
68 Helmet – A rigid respiratory inlet covering that also provides head protection against impact and  
69 penetration.

70  
71 Hood – A respiratory inlet covering that completely covers the head and neck and may also cover  
72 portions of the shoulders and torso.

73  
74 Immediately dangerous to life or health (IDLH) – An atmosphere that poses an immediate threat to  
75 life, would cause irreversible adverse health effects, or would impair an individual's ability to escape  
76 from a dangerous atmosphere.

77  
78 Loose-fitting facepiece - A respiratory inlet covering that is designed to form a partial seal with the  
79 face. Types include helmet and hood.

80  
81 Maximum use concentration – The maximum atmosphere concentration of a hazardous substance  
82 from which an employee can be expected to be protected when wearing a respirator, and is determined  
83 by the assigned protection factor of the respirator or class of respirators and the exposure limit of the  
84 hazardous substance.

85  
86 Negative pressure respirator (tight fitting) – A respirator in which the air pressure inside the facepiece  
87 is negative during inhalation with respect to the ambient air pressure outside the respirator.

88

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

91  
92 Oxygen deficient atmosphere – An atmosphere with oxygen content below 19.5% by volume.

93  
94 Physician or other licensed health care professional (PLHCP) – An individual whose legally permitted  
95 scope of practice (i.e., license, registration, or certification) allows him or her to independently  
96 provide, or be delegated the responsibility to provide, some or all of the health care services required  
97 within this document.

98  
99 Powered air-purifying respirator - An air-purifying respirator that uses a blower to force the ambient  
100 atmosphere through air-purifying elements to the inlet covering.

101  
102 Positive pressure respirator – A respirator in which the pressure inside the respiratory inlet covering  
103 exceeds the ambient air pressure outside the respirator. Examples include Airline respirators and Self-  
104 Contained Breathing Apparatus (SCBA).

105  
106 Pressure demand respirator – A positive pressure atmosphere-supplying respirator that admits  
107 breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.

108  
109 Qualitative fit test - A pass/fail fit test that is used to assess the adequacy of respirator fit, and that  
110 relies on the individual's response to the test agent.

111  
112 Quantitative fit test – An assessment of the adequacy of respirator fit by numerically measuring the  
113 amount of leakage into the respirator. (See also Fit factor).

114  
115 Respirator Program Report – A respirator qualification matrix located on the Environment, Safety,  
116 Health & Quality Section (ESH&Q) webpage which indicates the status of all respirator required  
117 wearers at Fermilab.

118  
119 Respirator required wearer – A Fermi Research Alliance (FRA) employee who has the potential to be  
120 overexposed to a hazardous atmosphere, and is included in the Fermilab Respirator Program.

121  
122 Reusable respirator - See Tight-fitting facepiece.

123  
124 SDS – Safety Data Sheets, (formerly known as Material Safety Data Sheets or MSDSs) are supplied  
125 by the manufacturer/distributor of a product to communicate hazards of hazardous chemical products.

126  
127 SCBA – Self-Contained Breathing Apparatus, An atmosphere-supplying respirator for which the  
128 breathing air source is designated to be carried by the wearer.

129  
130 Short-Term Exposure Limit (STEL) – Typically considered to be a 15-minute Time-Weighted  
131 Average (TWA) exposure which should not be exceeded at any time during a workday even if the  
132 8-hour Time-Weighted Average is within the appropriate exposure limits.

133  
134 Tight-fitting facepiece – A respiratory inlet covering that is designed to form a complete seal with the  
135 face. A respirator for which maintenance is required and that is designed for repeated use.  
136

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

139  
140 Wearer seal check – An action conducted by the respirator wearer to determine if the respirator is  
141 properly seated to the face.  
142

### 143 **3.0 RESPONSIBILITIES**

#### 144 **3.1 ESH&Q Section**

- 145  
146  
147 a. The responsibility and authority for the respirator program shall be assigned to a single  
148 individual in the Industrial Hygiene Group of the ESH&Q Section titled the Respirator Program  
149 Administrator.  
150  
151 b. Update program, as necessary, to comply with Department of Energy, OSHA and Department  
152 of Transportation regulations, American National Standards Institute (ANSI) and NIOSH  
153 standards, and ACGIH Threshold Limit Values.  
154  
155 c. A biennial written review of Fermilabs respiratory protection program shall be performed by  
156 the Respirator Program Administrator. The review may include, but not limited to the following  
157 areas; review of FESHM Chapter 4150, periodic reviews of the Respirator Program Report on  
158 the ESH&Q Webpage, distribution of the Industrial Hygiene Training Past Due Assessment,  
159 Division and Section tripartite reviews, discussions with employees and supervisors during  
160 required annual training and fit-testing campaigns.  
161  
162 d. Make any necessary changes to the program when they become apparent.  
163  
164 e. Maintain quantitative fit testing equipment.  
165  
166 f. Stock supply of NIOSH approved filtering facepieces and reusable air-purifying respirators  
167 with appropriate filtering media.  
168  
169 g. Develop training programs and lesson plans for employee use of respiratory protection. Provide  
170 training upon request and enter it into the TRAIN database.  
171  
172 h. Maintain Respirator Program Report database.  
173  
174 i. Investigate malfunctions of respiratory protection equipment to determine cause and assure  
175 corrective measures are taken.  
176

- 177 j. Select and issue the correct type of respirator. Develop cartridge change out schedules for  
178 exposures to chemicals. If the cartridge does not have an end of service life indicator (ESLI),  
179 the Respirator Program Administrator is to consult with the manufacturer to determine an  
180 appropriate change out schedule.  
181
- 182 k. Conduct quantitative fit testing, as needed, for employees issued reusable, tight fitting  
183 respiratory protection. Enter fit testing records into the Respirator Program Report database.  
184
- 185 l. Evaluate work areas and recommend procedures to maintain personal exposure below Fermilab  
186 prescribed exposure limits.  
187
- 188 m. Assess the need for respiratory protection. If respiratory protection is required, complete the  
189 Medical Surveillance Request form and send it to the Fermilab Occupational Medical  
190 Department.  
191
- 192 n. Ensure that employees have received medical approval and training before reusable respiratory  
193 protection is issued.  
194

### 195 3.2 Supervisors

- 196
- 197 a. Assess the need for respiratory protection. If respiratory protection is required, complete the  
198 [Respiratory Protection Usage Form](#) and send to the Occupational Medical Department.  
199
- 200 b. Ensure respirators are used in accordance with instructions and training received.  
201
- 202 c. Ensure respirators are cleaned, disinfected and stored in a clean, sanitary condition.  
203
- 204 d. Ensure respirators are in good working condition.  
205
- 206 e. Notify Division Safety Officer (DSO) of any changes in personnel enrolled in the program and  
207 any changes in working conditions that may change workers' need for respiratory protection.  
208 The employee's Individual Training Needs Assessment (ITNA) shall be revised as well.  
209

### 210 3.3 Employees

- 211
- 212 a. Use respirators in accordance with instructions and training received.  
213
- 214 b. Maintain, clean, inspect, and store respirators as instructed.  
215
- 216 c. Report any malfunction of a respirator to supervisor.  
217
- 218 d. Immediately discontinue use if respirator malfunctions and go to an area with respirable air.  
219

220 **3.4 Fermilab Occupational Medical Office**

- 221
- 222 a. With the aid of OSHA’s respiratory protection standard, 29 Code of Federal Regulations (CFR)
- 223 1910.134, medical questionnaire Appendix C, the PLHCP shall determine what health and
- 224 physical conditions are pertinent for assuring the respirator wearer is capable of performing
- 225 work while wearing respiratory protection.
- 226
- 227 b. Conduct medical surveillance of respirator wearers every two years.
- 228

229 **4.0 PROCEDURES**

230

231 **4.1 Evaluation**

232

233 For those operations for which respiratory protection is considered, a DSO or an Industrial

234 Hygienist must determine the nature and degree of hazard posed by the exposure. Refer to

235 Technical Appendix 6.1 for selection factors to consider.

236

237 **4.2 Issuance**

- 238
- 239 a. Only knowledgeable ES&H personnel are permitted to select and issue respiratory protection.
- 240 Guidelines such as ANSI Z88.2, “American National Standard for Respiratory Protection” -
- 241 2015, the NIOSH Selection Guide, applicable OSHA regulations, or other reputable source
- 242 should be used as an aid in the selection process. A Safety Data Sheet (SDS) should be used
- 243 for product specific information about respiratory hazards, and recommended respiratory
- 244 protection.
- 245
- 246 b. Before a reusable respirator is issued, the individual must receive clearance from the Fermilab
- 247 Occupational Medicine Office. This includes non-required reusable respirator usage.
- 248
- 249 c. Tight-fitting respirators shall not be issued to required respirator wearers if facial hair comes
- 250 between the sealing surface of the facepiece and the face or if facial hair interferes with valve
- 251 function.
- 252
- 253 d. Disposable respirators may be used ONLY when the estimated exposure level is less than half
- 254 of the Fermilab prescribed exposure limit.
- 255
- 256 e. Fit testing must be performed for all respirator-required wearers. NOTE: Emergency escape-
- 257 only air-supplied respirators and filtering facepieces worn for personal comfort (voluntary
- 258 use), are excluded from this requirement.
- 259
- 260 f. Records that document fit testing are maintained by the ESH&Q Section for inclusion into
- 261 the Respirator Program Report database. The [Quantitative Respirator Fit-testing Record form](#)
- 262 is available on the ESH&Q Section Webpage.
- 263

264 g. Issuance of respirators, including disposables, shall be documented. The issuance of  
 265 disposables or non-required tight-fitting respirators shall be recorded on the [Respirator Log](#)  
 266 [Sheet](#). The Respirator Log Sheet shall be maintained by the ESH&Q Section's Industrial  
 267 Hygiene Group and kept where the respirators are stored. Employees will be given a copy of  
 268 Appendix D of the OSHA standard 1910.134 (see [DocDB 1602](#)). The Respirator Program  
 269 Report on the ESH&Q TRAIN Webpage serves as the required reusable respirator wearer  
 270 issuance record.

### 271 4.3 Medical Qualification

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

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

### 284 4.4 Training

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

289 Supervisors of reusable respirator wearers shall receive [initial training](#) on the proper use of  
 290 respirators. The training shall include, at minimum:

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

### 301 4.5 Fit Testing

302 a. Quantitative fit testing must be completed for all tight-fitting, required respirator wearers. This  
 303 includes all negative pressure air-purifying respirators, powered air-purifying respirators, and  
 304

- 308 SCBAs. Positive pressure respirators with a tight seal to the face shall be fit tested in the  
309 negative pressure mode. Instructions for quantitative fit testing and the fit-testing form ([DocDB](#)  
310 [1744](#), Respirator Fit-testing Procedure) are contained on the ESH&Q Section Webpage under  
311 Industrial Hygiene. If exposure is estimated to be below 1/2 the Fermilab prescribed exposure  
312 limit, qualitative fit testing may be performed.  
313
- 314 b. Fit testing shall be repeated annually or whenever significant facial changes may affect the  
315 facepiece seal (e.g., facial scarring, cosmetic surgery, dental changes, surgery, obvious changes  
316 in body weight, etc.).  
317
- 318 c. Fit testing shall not be performed, and tight-fitting respiratory protective equipment shall not  
319 be issued if facial hair comes between the sealing surface of the facepiece and the face or if  
320 facial hair interferes with valve function.  
321
- 322 d. When a respirator wearer must wear corrective lenses, a protective spectacle or goggle, a face  
323 shield, a welding helmet, or other eye and face protective devices, the item shall be fitted to  
324 provide good vision and shall be worn in such a manner as not to interfere with the seal of the  
325 respirator.  
326
- 327 e. Spectacles with straps or temple bars that pass through the sealing surface of negative or  
328 positive pressure, tight fitting, full facepiece respirators shall not be used, unless 1) the device  
329 is specifically designed for that purpose and 2) the individual successfully passes the fit test  
330 while wearing the device.  
331
- 332 f. Contact lenses may be worn with respirators, provided the individual has previously  
333 demonstrated that he or she has had successful experience wearing contact lenses.  
334

#### 335 **4.6 Maintenance**

336  
337 Respiratory protection devices must be maintained to retain their original effectiveness.  
338

- 339 a. All reusable respirators must be routinely inspected before and after each use. See inspection  
340 checklist for reusable respirators, see [DocDB 1602](#).  
341
- 342 b. SCBAs and emergency escape respirators shall be at least inspected monthly and before and  
343 after use. Air cylinders shall be fully charged per the manufacturer's instructions. It shall be  
344 determined through inspection that the regulator and warning devices function properly. There  
345 must be a log kept of all monthly inspections.  
346
- 347 c. Clean and disinfect each reusable respirator after each use. The ESH&Q Section stocks  
348 materials for cleaning and disinfecting respiratory protection equipment. See [DocDB 1602](#) for  
349 the OSHA Respirator Cleaning Procedures (Appendix B-2, 1910.134).  
350

- 351 d. Properly store reusable respirators. Following inspection, cleaning, and necessary repair,  
352 respirators shall be stored to protect against dust, sunlight, heat, extreme cold, excessive  
353 moisture, or damaging chemicals. Respirators shall be placed in re-sealable plastic bags for  
354 storage. Respirators should not be stored in such places as lockers or toolboxes unless they are  
355 in carrying cases or cartons. Respirators should be packed or stored so that the facepiece and  
356 exhalation valves rest in a normal position and function will not be impaired by the elastomer  
357 setting in an abnormal position.
- 358
- 359 e. Disposable respirators should be disposed of after one day of use, or more frequently, if  
360 necessary.
- 361

#### 362 **4.7 Inspection Procedures**

##### 363 a. General

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

368

369

370

#### 371 **5.0 REFERENCES**

372

373 American Conference of Governmental Industrial Hygienists (ACGIH) - Threshold Limit Values for  
374 Chemical Substances and Physical Agents (2018)

375

376 American National Standards Institute (ANSI)/ASSE Z88.2 - 2015 Respiratory Protection  
377 ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-1989

378

379 Department of Transportation 49 CFR part 173 and 178

380

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

382

383 NIOSH 30 CFR part 11

384

385 NIOSH Publication 87-116 Guide to Industrial Respiratory Protection

386

387 Occupational Safety and Health Administration (OSHA) General Industry Standard  
388 29 Code of Federal Regulations (CFR) 1910.134

389

390 OSHA General Industry Standards 29 CFR 1910.1000

391

392 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

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

446  
447 **d. Warning Properties**

448  
449 If a negative pressure respirator is used for protection against a gas or a vapor, the  
450 contaminant must have adequate warning properties. A contaminant having an odor or  
451 a threshold of irritation above the FPEL is considered to have poor warning properties.  
452 The following compounds are a partial listing of contaminants that may be present at  
453 Fermilab and are considered to have poor warning properties: carbon monoxide, carbon  
454 dioxide, hydrogen sulfide, ozone. However, if a cartridge has an end of service life  
455 indicator or a change schedule has been implemented that is based upon documented  
456 service life data, airborne exposures, and duration of exposure, a negative pressure  
457 respirator may be used to protect against materials deemed to have poor warning  
458 properties.

459  
460 **e. Permissible Exposure Limits (PEL) and Threshold Limit Values (TLVs)**

461  
462 In selecting a respirator, an understanding of the PELs and TLVs as deemed applicable  
463 is necessary. Exposure monitoring data or the results of an exposure assessment is to  
464 be used to determine the needed protection factor. Selection should also consider  
465 ceiling limits and short term limits for contaminants having such a designation.

466  
467 **f. Skin Absorption or Eye Irritation**

468  
469 Air contaminants that are eye irritants require the selection of a full facepiece respirator.  
470 Where information exists which indicates the contaminant is capable of being absorbed  
471 through the skin and systemic injury or death could result from the exposure,  
472 appropriately-selected full body protective equipment used with a SCBA must be used.

473  
474 **6.1.3. Types of Respirators**

475  
476 The following types of respiratory protective equipment are used at Fermilab:

- 477 ● Filtering facepiece – (dust masks)
- 478 ● Half mask air-purifying respirator
- 479 ● Full face air-purifying respirator
- 480 ● Powered air-purifying respirator (loose-fitting and tight-fitting)

- 481
- 482
- 483
- 484
- Airline respirator (loose-fitting)
  - Escape-only air-supplied respirator
  - Self-Contained Breathing Apparatus (pressure demand)

485 a. Particulate Filter

486

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

498

499 Particulate respirators are classified into the categories as follows:

500

Particulate Cartridges			
Filter	Filter Type	Efficiency (%)	NIOSH Color
N (No Oil)	N100	99.97	Not designated
	N95	95	Not designated
R (Oil Resistant)	R100	99.97	Not designated
	R95	95	Not designated
P (Oil Proof)	P100	99.97	Magenta
	P95	95	Not designated
HE PAPR (High Efficiency PAPR)	P100	99.97	Magenta

501

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

503

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

506

507 **N Series:** Can be used and reused subject to considerations of hygiene, damage and  
 508 increased breathing resistance. However, for dirty workplaces that could result in high  
 509 filter loading, i.e., 200 milligrams (mg), service time should only be extended beyond  
 510 8 hours of continuous use or intermittent by performing an evaluation that demonstrates  
 511 that the extended use will not degrade the filter efficiency below the specified level or  
 512 that the total mass loading on the filter is less than 200 mg.

513  
 514 **R Series:** Should only be used for a single shift or for 8 hours of continuous or  
 515 intermittent use when oil is present. However, service time for R Series filters can be  
 516 extended using the methods described above for N Series filters.

517  
 518 **P Series:** Should be used and reused in accordance with the manufacturer's time use  
 519 limitation recommendations when oils are present. P Series can be used and reused  
 520 subject only to considerations of hygiene, damage and increased breathing resistance  
 521 if oil aerosols are not present.

522  
 523 Under Public Health's Approval of Respiratory Protective Devices, 42 CFR Part 84,  
 524 certified particulate filters can be used without regard to aerosol size because filter  
 525 testing is done with the most penetrating particle size. According to NIOSH, all filters  
 526 certified will be effective against any aerosol. Therefore, the consideration of filter  
 527 efficiency is not workplace dependent and the need for higher efficiency filters is  
 528 primarily dictated by government regulations, e.g., lead, asbestos.

529  
 530 b. Chemical Cartridge Respirator

531  
 532 Chemical cartridge respirators normally consist of a facepiece (half-face - mouth and nose or  
 533 full-face - mouth, nose and eyes) connected directly to two cartridges containing chemicals.  
 534 Various chemicals are used in the cartridges and each chemical is specific as to which air  
 535 contaminant will be removed. Chemical cartridge respirator usage is for non-emergency  
 536 situations and is not to be used for atmospheres which are immediately hazardous to life or  
 537 health, nor is it to be used in oxygen deficient atmospheres. Although NIOSH approves  
 538 chemical cartridges according to 10 classifications, the selection can be narrowed into seven  
 539 categories because most manufacturers offer dual-purpose cartridges. Some 3M brand cartridge  
 540 categories are:

3M Chemical Cartridges		
Chemical	Color	
Organic Vapor	Black	
Acid Gases	White	
Organic Vapor/Acid Gases	Yellow	
Ammonia/Methylamine	Green	
Formaldehyde/Organic Vapor	Olive/Black	
Multi-gas/Vapor	Olive	
Mercury Vapor/Chlorine Gas	Orange	

541  
 542  
 543 The Industrial Hygiene Representative shall review the manufacturer's technical bulletin to  
 544 determine the appropriate cartridge or cartridges. In addition, the limitations of each cartridge  
 545 with respect to maximum concentrations must be considered in the selection process. If the  
 546 cartridge does not have an end of service life indicator (ESLI), the DSO or industrial hygienist  
 547 is to utilize the manufacturer's cartridge change out schedule calculator. The 3M respirator

548 selection and cartridge change out calculator may be accessed here: [3M Service Life](#)  
549 [Calculator](#). Chemical cartridge change-out schedules shall be included in Job Procedures,  
550 Hazard Analysis, and IH Field Forms.

551  
552 c. Air-Line Respirator  
553  
554 The only air-line respirator at Fermilab is an abrasive-blasting unit located within the Technical  
555 Division at Industrial Building 2. The air-line respirator is connected to a suitable breathing air  
556 source by a hose which delivers the breathable air to the wearer continuously in sufficient  
557 volume to meet breathing requirements. The loose-fitting helmet provides full-face (mouth,  
558 nose and eye) coverage.

559  
560 Note: Airline respirators without escape capabilities are only to be used in atmospheres where  
561 air contaminant concentrations are not IDLH. This limitation is necessary because the air  
562 supply is solely dependent upon an outside source, which is not readily available to the wearer.

563  
564 The compressor is located and constructed to avoid entry of contaminated air. The air system  
565 is equipped with filters, sorbent beds and alarm systems as necessary to ensure Grade D  
566 breathing air is supplied. The oil lubricated compressor is equipped with a carbon monoxide  
567 alarm which monitors the air to prevent the carbon monoxide in the breathing air from  
568 exceeding 10 parts per million (ppm). The air is dried. This fixed system is equipped with a  
569 compressor capable of supplying air at 110-115 pounds per square inch gauge (psig) at the  
570 outlet of the purification system. The system is equipped with a low-pressure alarm when  
571 buffer tank pressure drops below 85 psig.

572  
573 d. Self-Contained Breathing Apparatus

574  
575 Scott Air Pack

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

580  
581 The Fermilab Fire Department (FFD) uses an air compressor (not oil lubricated) to fill a 4-  
582 cylinder (6000 psig each) cascade unit. This cascade unit is used to fill the 4500 SCBA  
583 cylinders. Only pressure demand SCBA respirators are used at Fermilab.

584  
585 The FFD has a service contract to test the air quality of the compressor unit on a quarterly  
586 basis. The compressor is serviced annually (i.e., sorbent bed and filter changes) by the factory  
587 authorized service technician, per manufacturer's specifications, and cylinders are  
588 hydrostatically tested as required. SCBAs are checked daily and thoroughly inspected monthly  
589 by FFD personnel. The SCBAs are flow tested, inspected and calibrated annually by a factory  
590 authorized service contractor. All records are kept on file at the Fire Department.

591

592 BioMarine

593 The BioMarine BioPak 240 is a NIOSH/MSHA approved closed-circuit four hour SCBA. The  
594 unit is intended for long duration use such as mine or tunnel rescue operations. It is not  
595 designed for firefighting. The unit operates by removing the carbon dioxide from the wearer's  
596 exhaled breath by means of a chemical scrubber. A 3000 psig oxygen cylinder provides  
597 makeup oxygen on demand. A frozen gel canister provides cooling of the respirable air. The  
598 cooling canisters are stored in a dedicated freezer at the fire station. The units and supplies are  
599 stored in a controlled atmosphere area at the fire station.

600  
601 The Fire Department is trained to use and maintain the units. Benchmen training is conducted  
602 by the manufacturer. The trained FFD personnel are then qualified to train the wearers  
603 annually. FFD personnel trained by Benchmen must be recertified every three years.

604  
605 Benchmen trained FFD personnel also perform repairs and testing of the units. The oxygen  
606 cylinders are hydro-tested every 5 years. A compressed gas vendor fills the cylinders to 3000  
607 psig with medical grade oxygen.

608  
609 All wearers undergo annual training in which the units are setup, tested, worn and used for  
610 two-hours, referred to as being "under oxygen". Training includes cleaning, drying and storage.

611  
612 e. Emergency Escape Respirators

613  
614 Emergency escape respirators are used for oxygen deficient hazard (ODH) areas at Fermilab.  
615 See FESHM [4240, Oxygen Deficiency Hazards](#), for more information on the Fermilab ODH  
616 Program.

617  
618 ELSA (Emergency Life Support Apparatus)

619 The ELSA emergency escape units provide a 5-minute supply of air and are required to be  
620 brought into areas that are ODH class 1 or 2. These units are only permitted for escape purposes  
621 and are not to be used for entry into an IDLH atmosphere under any circumstances. The 5-  
622 minute escape packs are inspected monthly. The 5-minute escape pack plastic hoods are  
623 checked for cracks and discoloration and the gauges are checked for pressure.

624  
625 Ocenco

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

635

636 f. Assigned Protection Factor (APF)  
 637

 638 The APF is used to select the appropriate respirator based on the expected workplace level of  
 639 respiratory protection that would be provided by a properly functioning respirator or a class of  
 640 respirators to properly fitted and trained wearers. The OSHA assigned protection factors are:  
 641

 642 Table 1. -- Assigned Protection Factors<sup>5</sup>  
 643

Type of respirator <sup>1, 2</sup>	Quarter mask	Half mask	Full facepiece	Helmet/hood	Loose-fitting facepiece
1. Air-Purifying Respirator	5	10 <sup>3</sup>	50	.....	.....
2. Powered Air-Purifying Respirator (PAPR)	.....	50	1,000	25/1,000 <sup>4</sup>	25
3. Supplied-Air Respirator (SAR) or Airline Respirator					
• Demand mode	.....	10	50	.....	.....
• Continuous flow mode	.....	50	1,000	25/1,000 <sup>4</sup>	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	.....

 644 **Notes:**

 645 <sup>1</sup>Employers may select respirators assigned for use in higher workplace concentrations of a hazardous substance  
 646 for use at lower concentrations of that substance, or when required respirator use is independent of concentration.

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

 650 <sup>3</sup>This APF category includes filtering facepieces, and half masks with elastomeric facepieces.

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

 656 <sup>5</sup>These APFs do not apply to respirators used solely for escape. For escape respirators used with specific substances  
 657 covered by 29 CFR 1910 subpart Z, employers must refer to the appropriate substance-specific standards in that  
 658 subpart. Escape respirators for other IDLH atmospheres are specified by 29 CFR 1910.134 (d)(2)(ii).  
 659

 660 **6.2 Inspection of Respirators**

 661 a. Air-Purifying Respirator Inspection  
 662

 663 The following items are to be examined during the inspection:  
 664

 665 *Examine the facepiece for:*

- 666
- 667 • Excessive dirt.
  - 668 • Cracks, tears, holes, or distortion from improper storage.

- 669 • Inflexibility of rubber facepiece (stretch and massage to restore flexibility).
- 670 • Cracked or badly scratched lenses in full facepieces.
- 671 • Incorrectly mounted full facepiece lenses or broken or missing mounting clips.
- 672 • Cracked or broken air-purifying element holder(s).
- 673 • Badly worn threads or missing gasket(s).

674  
 675 *Examine the head straps or head harness for:*

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

680  
 681 *Examine the exhalation valve for the following after removing its cover:*

- 682 • Blockage.
- 683 • Foreign material, such as detergent residue, dust particles or human hair under the valve seat.
- 684
- 685 • Cracks, tears or distortion in the valve material.
- 686 • Improper insertion of the valve body in the facepiece.
- 687 • Cracks, breaks or chips in the valve body, particularly in the sealing surface.
- 688 • Missing or defective valve cover.
- 689 • Improper installation of the valve in the valve body.

690  
 691 *Examine the air-purifying elements for:*

- 692 • Incorrect filter, cartridge or canister for the hazard.
- 693 • Incorrect installation, loose connections, missing or worn gaskets, or cross-threading in holder.
- 694
- 695 • Expired shelf-life date on the cartridge or canister.
- 696 • 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.

697  
 698  
 699 *If the device has a corrugated breathing tube, examine it for:*

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

703  
 704 b. Atmosphere-Supplying Respirator Inspection

705  
 706 If the device has a tight fitting facepiece, the wearer is to follow the procedures outlined above  
 707 for air-purifying respirators, except those pertaining to the air-purifying elements.  
 708 Additionally, the wearer shall check:

- 709
- 710
- 711
- 712
- 713
- 714
- 715
- 716
- 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.

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

718 *procedure.*

- 719
- 720
- 721
- 722
- 723
- 724
- 725
- 726
- 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.

727 c. Air-Line System Inspection

728

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

- 730
- 731
- 732
- 733
- 734
- 735
- 736
- 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.

737 Maintenance and replacement or refurbishment of the compressor and associated parts (e.g.

738 sorbent bed, filters, etc.) is to be performed by trained personnel following manufacturer's

739 instructions and recommendations. Breathing air must meet Grade *D* specifications as described

740 in the ANSI/Compressed Gas Association Commodity Specification G-7.1-1989 (oxygen content

741 of 19.5-23.5% condensed hydrocarbons of 5 mg per cubic meter of air or less, carbon monoxide

742 of 10 ppm or less and carbon dioxide of 1000 ppm or less). The dew point of air is to be -10° F

743 below the ambient temperature.

744

745 d. Self-Contained Breathing Apparatus Inspection

746

747 1) General

748 All inspections are to be conducted by qualified persons. Air from the respective self-

749 contained breathing apparatus (SCBA) shall not be used for performing tests requiring air

750 consumption. The person performing the inspection must provide an auxiliary air supply.

751 Whenever practical, defects should be corrected in the field. If the unit must be removed

752 from service, it is the responsibility of the person making the inspection to replace the unit.

753

754 2) Facepieces

755 The facepieces of SCBAs should be checked using procedures outlined under air-purifying  
756 respirators.

757

758 3) Accessories

759 Manufacturer's instructions are to be followed and generally include:

760

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

782

783 e. Emergency Escape-Only Supplied-Air Respirators Inspection

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