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Personal Protective Equipment Guide

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Personal Protective Equipment Guide

Introduction:

This guide is being provided to you as a brief overview of the types of personal protective equipment available, suggested uses and protective capabilities. It is by no means exhaustive in content. Where appropriate, sources for further research are provided in order to enable you to select the appropriate ensemble that will provide sufficient protection against an anticipated hazard.

In order to initiate this process, you must have some idea of the hazard(s) that will present themselves during the research procedures you will be using. In special cases where the hazards are not fully known, then selection should be made only after consulting with the Chemical Safety Officer, the Biosafety Officer, the Radiation Officer, or in the rarest cases, all three.

In order to safely use a respirator, you *must have* a physical evaluation by a licensed health care provider, as required by the Occupational Safety and Health Administration, in the Standard 29 CFR 1910. 134. See: http://osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=12716&p_text_version=FALSE.

You must also participate in an eleven-point respirator maintenance program that ensures that the respirator will serve its purpose when required.

If at any time, any of the material is not clear to you, or you want specific, hands-on training, please contact the Biosafety Officer at extension 41451.

Types of Garments

There are many types of garments for different uses in the laboratory setting. There are multiple-use items such as aprons, lab coats, smocks, house coats, made of natural fiber which can be laundered and re-used over and over. There are single use items such as the paper or single-layer equivalents of the garments mentioned above, which are intended to be disposed of immediately after use. It is important to identify what garment will work for you, provide the protection required of it, and do this in the most economical application possible. Obviously, you will not dispose of a cotton / polyester lab-coat after each use...but it may not be as obvious that some of the disposable garments can be used several times before disposal, depending again, on what agents, hazards are present, and what protection is needed from the garment.

Lab coats, smocks, and aprons go a long way to protect individuals in a routine clinical or low hazard biomedical laboratory from soiling and spattering. The usual concentrations and quantities of chemicals or clinical materials pose no unusual hazards that cannot be protected against by these garments.

If one is handling extremely corrosive materials such as HF, or working with moderate-to-high risk microbial agents, or working with large scale quantities of low-risk agents, then the cotton / poly garments or single-layer mentioned above will not provide you much protection, when these materials come out of containment.

Then you will need to use a garment such as the plastic-coated Tyvek coveralls, which are water resistant, or something even more impervious, if a solvent is involved in the procedures.

The gradations of categories are further broken down with respect to the manufacture of the actual material (fiber) and the coatings and seams used in the construction of the garment.

A brief list is offered here:

<u>Material</u>	<u>Type of Garment</u>	<u>Common Use</u>
Cotton/ Natural Fiber/ Blends	coveralls;labcoats,sleeve protectors;aprons	for dry dusts, particulates and aerosols
Tyvek:	coveralls;labcoats,sleeve protectors;aprons hoods;	for dry dusts and aerosols
Saranax / Tyvek SL	coveralls;labcoats,sleeve protectors;aprons hoods;Level B Suits	aerosols; liquids; solvents
Polyethylene	barrier gowns ; aprons	body fluids
Polypropylene	Clean Room suits; coveralls;Labcoats	for dry dusts; non-toxic particulates
Polyethylene/ Tyvek (QC)	coveralls; aprons; labcoats; shoe covers	moisture; solvents
Polypropylene	coveralls; labcoats; shoe covers; caps; clean room suits	non-toxic particulates; dry dusts
Tychem BR; Tychem TK	full Level A and Level B Suits	highly toxic chemicals, gases, aerosols
CPF	full Level A and B suits; splash suits;	highly toxic chemicals; gases, aerosols
PVC	Full Level A suits	highly toxic chemicals; gases, aerosols

The hazardous nature of the chemical or solvent, the physical state of the material, the amount of the material and the duration of exposure all factor into selecting a garment. Breakthrough times must be considered, since none of the garments mentioned above are completely impervious to chemical action and penetration. With biological agents, since the majority are suspended in aqueous media, physiological saline, or body fluids, garments that are impervious to aqueous preparations will offer protection against a biological agent. This changes, if a material such as DNA is being prepared in Phenol / Chloroform. If the container should break, the DNA splattered onto an individual is now suspended in two chemicals that can easily penetrate a water-protective garment, and allow contact with the skin. Clearly, a garment protective for both chemicals is required to prevent the exposure from occurring.

Types of Gloves

Similar observations are also made with glove use, that there is a large selection of gloves available, from latex examination gloves up to Teflon gloves which are virtually resistant to most chemicals. Care in selecting a glove and using it properly cannot be overstated. Recently, a world-renowned researcher in Toxicology expired from an exposure to dimethyl mercury which was acquired when the chemical passed through the latex gloves she was using and entered her bloodstream after penetrating her skin. The latex gloves were not protective, and there were few other choices that would have prevented the exposure from occurring, as well.

Latex surgical and examination gloves should be used for those specific purposes, and other activities that pose the risk of exposure to blood and body fluids. Basically, these are the best types of gloves for these applications. In the event that individuals have developed allergies either to the powders or the actual latex, there are non-latex substitutes available.

For chemical use, there are other materials available that are better suited for protection. There are also different deniers that the gloves come in that allow various degrees of movement and tactile sensation. Gloves can come in lined, unlined versions, and can also be doubled-up to maximize protection, such as using a Silvershield glove over a butyl or nitrile glove.

Various makers test their gloves against different panels of chemicals, so the best information to obtain is directly from the manufacturer. Do not use a glove that appears to be abraded or damaged. Check for pinholes and "leakers" by filling the glove with air, or water, and twisting tight. If the glove deflates or springs "leakers", discard immediately.

The following list presents some of the glove materials available and uses:

Glove Material	Resistant to:
Viton	PCBs, chlorinated solvents, aromatic solvents
Viton/Butyl	acetone, toluene, aromatics, aliphatic hydrocarbons, chlorinated solvents, ketones, amines and aldehydes
SilverShield and 4H (PE/EVAL)	morpholine, vinyl chloride, acetone, ethyl ether, many toxic solvents and caustics
Barrier	Wide range of chlorinated solvents, aromatics, acids
PVA	ketones, aromatics, chlorinated solvents, xylene, MIBK, trichloroethylene; <i>DO NOT USE WITH WATER /AQUEOUS SOLUTIONS</i>
Butyl	aldehydes, ketones, esters, alcohols, most inorganic acids, caustics, dioxane
Neoprene	oils, grease, petroleum-based solvents, detergents, acids, caustics, alcohols, solvents
PVC	acids, caustics, solvents, solvents, grease, oil
Nitrile	oils, fats, acids, caustics, alcohols
Latex	body fluids, blood, acids, alcohols and alkalis
Vinyl	body fluids, blood, acids, alcohols and alkalis
Rubber	organic acids, some mineral acids, caustics, alcohols; <i>not recommended for aromatic solvents, chlorinated solvents</i>

Types of Respirators

In the introduction, the OSHA requirements were given with respect to using a respirator. It is preferable to use engineering controls such as chemical fume hoods, biological safety cabinets and other containment controls, before using a respirator. There is a physical strain that is placed on the lungs, the respiratory system and the heart. Any underlying disease or conditions can be exacerbated by using a respirator. It is imperative that you receive evaluation by a physician or licensed health care practitioner *before* using respirators.

There is an hierarchy of conditions that must be considered before using a respirator. Once all options are exhausted, then one can resort to using a respirator. The nature of the hazard must be considered first, i.e. is the material a gas or vapor? Is it a simple asphyxiant, chemical asphyxiant, irritant, anesthetic, sensitizer, systemic poison, or carcinogen? Is it a particulate and is it a nuisance dust, or fibrosis-producing, or carcinogen, or irritant, or poison material? Is the material inert or reactive, acidic or basic, organic or inorganic, or an organometallic compound?

The following conditions *will allow* respirator use under the OSHA Standard:

- engineering and work practices are not feasible
- engineering and work practices not adequate
- during implementation of engineering or work practice controls
- specific operations involving short, intermittent exposures
- emergencies

Selection

Once you are cleared to use a respirator, the type of respirator selected will depend on the type of material, its physical state, the hazards associated with the material, the anticipated amount of material per unit volume of air, and the duration of exposure to this concentration over a given period of time. This material is compared to the working conditions given above. The correct respirator is then chosen based on the following criteria:

- Purification efficiency, capacity of the filter medium
- Positive vs. negative pressure within the mask
- Full-face vs. oral-nasal type mask
- Protection factor of the respirator
- Oxygen deficiency potential of the working area

There are different types of respirators available depending on the presence of any / all of the characteristics listed above for the material in question. The two basic types are Air Purifying, and Atmosphere Supplying. Under the air purifying, there are several sub-categories:

Air Purifying Respirators:

Gas and Vapor Removing

- non-powered
- powered

Particulate Removing

- non-powered
- powered

Combination Particulate and Gas/Vapor Removing

- non-powered
- powered

The Atmosphere-Supplying Respirators are further categorized as follows:

Atmosphere-Supplying Respirators:

Self-Contained Breathing Apparatus

Closed circuit

Compressed or Liquid Oxygen; Oxygen Generating

Open Circuit

Demand; Pressure-Demand; Continuous Flow

Supplied Air Respirators

Hose Mask

With or Without Blower

Airline Respirator

Demand; Pressure-Demand; Continuous Flow

Combination Airline Respirator with auxiliary air supply

A simple example for demonstration purposes would be the use of a respirator for protection against animal dander. Since the animal dander is a solid, particulate, and can be considered to be everywhere within a room, one has little choice but to use a respirator. What type should be used?

An Air-Purifying respirator can be used since we are using the respirator in normal atmospheric, (no oxygen deficiency) conditions. Since there are no other gases or vapors to be considered, a particulate-removing respirator can be used.

An oral-nasal (or half-face) type mask can be used, unless an individual has allergies, which may require eye protection as well. In this case a full face respirator should be recommended. A simple dust-mist fume mask would be sufficient protection in this example.

The Gas-Vapor and Particulate-Removing respirators have further sub-categories each, which are of more interest to you as the wearer. Each of these categories addresses the filtering medium that is used to provide protection. The gas-vapor respirators use filtration media specific for organic vapors, or acid gases, or for specific chemicals such as mercury, or formaldehyde.

The particulate-removing respirators are rated as to the ability of the respirator to exclude a certain percentage of a particulate of a given size, either in the presence of oil or not. Common terms that will be seen with the particulate-removing respirator are; "N", "R", "P"-types, and numbers such as "95", "99" and "100". The NIOSH descriptions are provided below:

1. The selection of N-, R-, and P-series filters depends on the presence or absence of oil particles, as follows:

- If no oil particles are present in the work environment, use a filter of any series (i.e., N-, R- or P-series).
- If oil particles (e.g., lubricants, cutting fluids, glycerine, etc.) are present, use an R- or P-series filter. **Note:** N-series filters cannot be used if oil particles are present.
- If oil particles are present and the filter is to be used for more than one work shift, use only a P-series filter.

Note: To help you remember the filter series, use the following guide:

N for **Not** resistant to oil,

R for **Resistant** to oil

P for oil **Proof**

2. Selection of filter efficiency (i.e., 95%, 99%, or 99.97%) depends on how much filter leakage can be accepted. Higher filter efficiency means lower filter leakage.

3. The choice of facepiece depends on the level of protection needed--that is, the assigned protection factor (APF) needed.

Complete text of the NIOSH manual is available at: <http://www.cdc.gov/niosh/userguid.html>

Use

Once you have selected a respirator to use, you must become familiar with the proper use of the respirator. This sounds obvious, but there are many considerations that have serious impact if overlooked. If the respirator is not sealed against the face properly, unfiltered, contaminated air will enter through any openings that exist. That air may have TB, a carcinogen, or other contaminant that you are wearing the respirator to protect against .

Beards, stubble, scars, facial anomalies can also interfere with the face-to-mask seal. A size "Large" or "Small" mask on a "Medium" face will not allow proper fit and seal. Improper adjustment or mis-positioning of straps will affect proper seal.

It is also important that filter cartridges and other components be used with the specific make and model. NIOSH certifies the respirator as a complete unit, and any substitution will violate the certification.

Store the respirator, if it is not a single use item, in a clean location , in a manner that does not alter the geometry of the respirator. Damaged margins and seals may render the respirator useless, and non-repairable.

Do not use strong disinfectants, cleaning agents or solvents on respirators. A mild solution of soap and water, and a benzalkonium chloride type (quaternary ammonia) disinfectant are all that are needed to clean a multi-use respirator.

Fit-Testing

Respirators must be fit-tested prior to use as per the OSHA Respiratory Protection Standard. The testing uses your specific respirator and challenges it with a irritant smoke for particulates, or with a solvent such as Methyl Salicylate or IsoAmyl Acetate for organic respirators and SCBAs. This is performed in order to verify that you have the correct fit on your respirator and that the face-to mask seal is protective. This test is performed when you are initially assigned a respirator, and any time that a change has occurred to your face, i.e. accident, weight gain / loss, dental surgery.

Conclusion

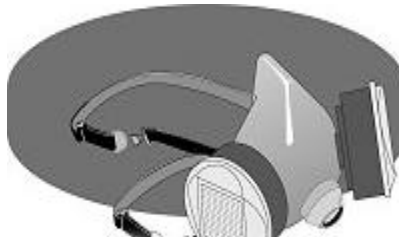
As stated in the introduction, the material presented here is a brief over-view of the selection, evaluation and use of personal protective equipment. Each topic presented could encompass a volume of its own, in order to cover it any detail. Eye-wear, goggles, face shields, and shoes, have been omitted for brevity, but should be taken into account in any risk evaluations

If you are not clear on any of the topics presented, please contact the Biosafety Officer at 241-1451. If you would like specific hands-on training on your particular equipment, or require a fit-test, this will be performed for you at no charge to you or your department.

REPRESENTATIVE RESPIRATOR TYPES**



Disposable Half-facepiece Respirator



Elastomeric Half-facepiece Mask



Powered Air-purifying Respirator



Full-facepiece Respirator



Supplied-air Respirator



Self-contained Breathing Apparatus

Respirator type	NIOSH assigned protection factor⁽⁸³⁾	Advantages	Disadvantages	Cost range (1997 dollars)
Disposable	5 - 10	<ul style="list-style-type: none"> • light weight • no maintenance • no effect on mobility 	<ul style="list-style-type: none"> • no eye protection • can add to heat burden • breathing resistance increases with use • inward leakage at gaps in facepiece seal • some do not have an exhalation valve • some do not have adjustable head straps 	\$1 to \$10
Elastomeric half-facepiece	10	<ul style="list-style-type: none"> • low maintenance • reusable facepiece • no effect on mobility • all have an exhalation valve 	<ul style="list-style-type: none"> • no eye protection • can add to heat burden • inhalation breathing resistance increases with use • inward leakage at gaps in facepiece seal 	facepiece: \$10 to \$30 filters: \$4 to \$8 each

Respirator type	NIOSH assigned protection factor⁽⁸³⁾	Advantages	Disadvantages	Cost range (1997 dollars)
Elastomeric full facepiece	50	<ul style="list-style-type: none"> • reusable facepiece • no effect on mobility • eye protection • more reliable seal than disposable or elastomeric half-facepieces 	<ul style="list-style-type: none"> • can add to heat burden • inhalation breathing resistance increases with use • inward leakage at gaps in facepiece seal • facepiece lens can fog without nose cup or treatment 	facepiece: \$90 to \$200 filters: \$4 to \$8 each nose cup: \$30
Powered with half-facepiece or full facepiece	50	<ul style="list-style-type: none"> • eye protection • low breathing resistance • facepiece leakage is outward • airflow creates cooling effect • full facepiece does not fog 	<ul style="list-style-type: none"> • added weight of battery and blower • awkward for some tasks • no eye protection with half-facepiece 	unit: \$400 to \$900 filters: \$15 to \$40

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Appendix 1: NIOSH Guidance For Respirator Use*

II. DETAILED GUIDELINES FOR USE

A. PURPOSE

The purpose of this user's guide is (1) to familiarize respirator users with the new Part 84 certification regulations for particulate respirators, and (2) to provide guidance for the selection and use of the new particulate respirators. The new regulation became effective on July 10, 1995, and replaces the old Part 11 regulation under which NIOSH and the Mine Safety and Health Administration (MSHA) jointly certified respirators before that date.

These guidelines are written for those responsible for establishing and administering an acceptable respiratory protection program. These individuals should be knowledgeable about the basic elements of a respiratory protection program as required in the OSHA respiratory protection standard [29 CFR 1910.134] and as recommended in the *NIOSH Guide to Industrial Respiratory Protection* [NIOSH 1987], the *American National Standard for Respiratory Protection* (ANSI Z88.2-1992) [ANSI 1992], and the *American Industrial Hygiene Association Respiratory Protection Manual* [AIHA 1993].

B. BACKGROUND

The old Part 11 respirator certification regulation [30 CFR 11] was promulgated in 1972. Some of the particulate filter certification tests dated from Bureau of Mines procedures during the 1930s and were never significantly updated. New research, testing, and manufacturing technology have made the particulate filter certification procedures in Part 11 outdated.

Only certifications of nonpowered, air-purifying, particulate-filter respirators are affected by this change from Part 11 to Part 84. Powered, air-purifying, particulate-filter respirators will be addressed in a future revision to Part 84. The remaining portions of Part 11 are incorporated into Part 84 without change. This limited revision provides for certification tests using a worst-case penetrating aerosol (i.e., an aerosol that produces maximum filter penetration) so that the new certified filters can be used against any size of particulate in the workplace. Other respirator testing and certification procedures will be addressed through a series of future changes to Part 84.

On July 10, 1995, 30 CFR 11 was replaced by 42 CFR 84 as an active regulation. As of that date, NIOSH no longer accepts applications for new approvals or for extension of approvals under Part 11 regulations. All nonpowered, air-purifying, particulate-filter respirators approved under Part 84 must meet the new performance standard. However, the new regulation permits the manufacture and sale of nonpowered particulate respirators certified under Part 11 until July 10, 1998. This 3-year period will provide time for manufacturers to have new respirators approved and manufactured to meet demand. OSHA, MSHA, and other regulatory agencies have the authority to set a use deadline for 30 CFR 11 filters purchased before July 10, 1998.

A new sequence of approval numbers (TC-84A-xxxx) is used for nonpowered particulate respirators certified under Part 84. All other respirator types will continue to use the sequence of approval numbers previously used for Part 11 because the requirements for these other types have not changed. For example, the number series TC-13F-xxxx indicates an SCBA that is certified under the provisions of either the old Part 11 or the new Part 84. Similarly, PAPRs for

particulates that are certified under the new Part 84 will continue to be numbered with the sequence TC-21C-xxxx (as they were numbered under Part 11) because the certification requirements have not yet changed. [Appendix A](#) shows examples of the old Part 11 and the new Part 84 certification labels.

All particulate respirators approved under Part 84 will have a certification label bearing the NIOSH and the Department of Health and Human Services (DHHS) emblems, whereas those approved under Part 11 have the emblems of NIOSH and MSHA. This allows the user to distinguish particulate respirators certified before July 10, 1995, under Part 11 from particulate respirators certified after that date under Part 84.

The revised testing requirements for particulate filters are much more demanding than the old Part 11 tests, and they provide much better evidence of the filter's ability to remove airborne particles. The new requirements are consistent with 20 years of advances in respiratory protection technology.

C. 42 CFR 84 FILTER CLASSES

The Part 84 certification regulation provides for nine classes of filters (three levels of filter efficiency, with three categories of resistance to filter efficiency degradation). The three levels of filter efficiency are 95%, 99%, and 99.97%. The three categories of resistance to filter efficiency degradation are labeled N (**N**ot resistant to oil), R (**R**esistant to oil), and P (oil **P**roof) (see Table 1). **These new certification categories apply only to nonpowered, air-purifying, particulate-filter respirators.** PAPRs for particulates will be approved only with high-efficiency filters. PAPRs will not be approved with DM or DFM filters under Part 84. This rule also eliminates the combination categories of paint spray and pesticide respirator approvals; however, other combination respirators (e.g., particulates and acid gases or organic vapors) will be certified under Part 84.

Table 1.-Description of filter classes certified under 42 CFR 84

Class of Filter	Efficiency (%)	Test agent	Test maximum loading (mg)	Type of contaminant	Service time*
N-series	_____	NaCl [†]	200	Solid and water-based particulates (i.e., non-oil aerosols)	Nonspecific ^{†§}
N100	99.7				
N 99	99				
N 95	95				
R-series	_____	DOP oil**	200	Any	One work shift ^{†,††}
R100	99.7				
R 99	99				
R 95	95				
P-series	_____	DOP oil efficiency	Stabilized	Any	Nonspecific [†]
P100 ^{††}	99.7				
P 99	99				
P 95	95				

*NIOSH will be conducting and encouraging other researchers to conduct studies to assure that these service time recommendations are adequate. If research indicates the need, additional service time limitations may be recommended by NIOSH for specific workplace conditions.

[†]NaCl = sodium chloride.

[‡]Limited by considerations of hygiene, damage, and breathing resistance.

[§]High (200 mg) filter loading in the certification test is intended to address the potential for filter efficiency degradation by solid or water-based (i.e., non-oil) aerosols in the workplace. Accordingly, there is no recommended service time limit in most workplace settings. However, in dirty workplaces (high aerosol concentrations), service time should only be extended beyond 8 hours of use (continuous or intermittent) by performing an evaluation in specific workplace settings that: a) demonstrates extended use will not degrade the filter efficiency below the certified efficiency level, or (b) demonstrates the total mass loading of the filter is less than 200 mg (100 mg per filter for dual-filter respirators).

**DOP oil = dioctyl phthalate

^{††}No specific service time limit when oil aerosols are not present. In the presence of oil aerosols, service time may be extended beyond 8 hours of use (continuous or intermittent) by (a) demonstrating that extended use will not degrade the filter efficiency below the certified efficiency level, or (b) demonstrating that the total mass loading of the filter is less than 200 mg (100 mg per filter for dual-filter respirators).
^{‡‡}The P100 filter must be color-coded magenta. The Part 84 Subpart KK HEPA filter on a PAPR will also be magenta, but the label will be different from the P100 filter, and the two filters cannot be interchanged.

NIOSH established the new test criteria to simulate worst-case respirator use and very severe test conditions. These filters can be used without particle size analysis or filter penetration testing in the workplace. R- or P-series filters should be selected if there are oil (e.g., lubricants, cutting fluids, glycerine) or non-oil aerosols in the workplace. N-series filters should be used only for non-oil (i.e., solid and water-based) aerosols.

Note: To help you remember the filter series, use the following guide:

N for **N**ot resistant to oil,

R for **R**esistant to oil

P for oil **P**roof

The filter certification test is called worst-case (i.e., it produces maximum filter penetration) because the test conditions are the most severe that are likely to be encountered in a work environment. These conditions are:

- Air flow that simulates a high work rate (85 ± 4 liters per minute for single filters, 42.5 ± 2 liters per minute through each filter for paired filters)
- The most penetrating aerosol size (approximately 0.3 micrometer)
- Charge-neutralized particles
- The most filter-degrading test aerosol for R- and P-series filters
- Measurement of instantaneous (not average) penetration
- High total filter loading (up to 200 mg for N- and R-series filters, and continued loading until there is no further decrease in efficiency for P filters)

The degradation categories (N-, R-, and P-series) will be determined by using either sodium chloride (NaCl) or dioctyl phthalate (DOP) as the test aerosol. NaCl is only slightly degrading to filter efficiency, whereas DOP is very degrading. Respirators tested with NaCl (i.e., N-series filters) are not resistant to efficiency degradation by oils and should be used only in workplaces free of oil aerosols. Filters passing DOP oil tests (i.e., R- and P-series filters) are resistant to efficiency degradation and can be used for protection against any aerosols (including oil-based particulates) in the workplace.

D. USE LIMITATIONS

The service life of all three categories of filters efficiency degradation (i.e., N-, R-, and P-series) is limited by considerations of hygiene, damage, and breathing resistance. All filters should be replaced whenever they are damaged, soiled, or causing noticeably increased breathing resistance (e.g., causing discomfort to the wearer).

R- or P-series filters can be used for protection against oil or non-oil aerosols. N-series filters should be used only for non-oil aerosols. Use and reuse of the P-series filters would be subject only to considerations of hygiene, damage, and increased breathing resistance. Generally, the use and reuse of N-series filters would also be subject only to considerations of hygiene, damage, and increased breathing resistance. However, for dirty workplaces that could result in high filter loading (i.e., 200 mg), service time for N-series filters should be extended beyond 8 hours of use (continuous or intermittent) by performing an evaluation in specific workplace settings that: (a) demonstrates extended use will not degrade the filter efficiency below the efficiency level specified in Part 84, or (b) demonstrates the total mass loading of the filter(s) is less than 200 mg. The R-series filters should be used only for a single shift (or for 8 hours of continuous or intermittent use) when oil is present. However, service time for the R-series filters can be extended using the same two methods described above for N-series filters. These determinations would need to be repeated whenever conditions change or modifications are made to processes that could change the type of particulate generated in the user's facility.

E. PARTICULATE RESPIRATOR SELECTION

To select the correct respirator for protection against particulates, the following conditions must be known:

- The identity and concentration of the particulates in the workplace air
- The OSHA or MSHA permissible exposure limit (PEL), the NIOSH recommended exposure limit (REL), or other occupational exposure limit for the contaminant
- The hazard ratio (HR) (i.e., the airborne particulate concentration divided by the exposure limit)
- The [APF^s](#) for the class of respirator (the APF should be greater than the HR)
- The immediately dangerous to life or health (IDLH) concentration, including oxygen deficiency [NIOSH 1994]
- Any service life information available for combination cartridges or canisters

Multiplying the occupational exposure limit by the APF for a respirator gives the maximum workplace concentration in which that respirator can be used. For example, if the commonly accepted APF for a half-mask respirator is 10 and the PEL is 5 mg/m³, then 50 mg/m³ is the highest workplace concentration in which a half-mask respirator can be used against that contaminant. If the workplace concentration is greater than 50 mg/m³, a more protective respirator (with a higher APF) should be used. In no case should an air-purifying respirator be used in IDLH concentrations.

[Appendix B](#) presents a simplified guideline that can be used to identify an appropriate Part 84 particulate respirator when a properly selected Part 11 respirator is already in use.

[Appendix C](#) presents a flow chart that can be used to select the appropriate Part 84 particulate filters.

[Appendix D](#) presents some substance-specific examples of Part 84 respirator selection.

[Appendix E](#) answers questions commonly asked about Part 84 respirators.

Note Concerning Part 11 Particulate Filters

Because research shows that particles sized 2 micrometers or smaller can penetrate some DM and DFM filters, these Part 11 filters should be used only when the mass median aerodynamic diameter (MMAD) is known to be greater than 2 micrometers [NIOSH 1995]. If this diameter is less than 2 micrometers or is unknown, a Part 11 HEPA filter or **any** Part 84 filter should be used.

Note on Respirator Fit

OSHA requires that all respirators be properly **fit-tested** using a quantitative or qualitative fit test when initially assigned to a user and periodically thereafter. In addition to fit-testing, your respirator manufacturer has recommended **fit-checking** procedures that should be followed by the user each time the respirator is worn.

F. RESPIRATORY PROTECTION FOR TUBERCULOSIS

The only respirators certified by NIOSH under Part 11 that meet CDC filtration efficiency performance criteria for protection against tuberculosis (TB) are those with HEPA filters. All nine classes of nonpowered, air-purifying, particulate-filter respirators certified under Part 84 meet or exceed the CDC filtration efficiency performance criteria [CDC 1994]. Several of the Part 84 particulate-filter respirators will be less expensive and more comfortable than Part 11 HEPA-filter respirators, and they are likely to be more readily accepted by health care facilities and workers.

Health care delivery settings are generally free of oil aerosols that would be degrading to filter efficiency. Therefore, N-, R-, or P-series respirators are appropriate for protection against TB in health care settings and other workplaces in which oil aerosols are absent; these respirators are subject to replacement as necessary by considerations of hygiene, damage, and breathing resistance.

Current OSHA policy permits the use of a Part 11 HEPA filter or *any* Part 84 particulate filter for protection against TB [Miles 1995]. Pending completion of a final TB standard, respiratory protection against TB will be regulated by OSHA under the current unrevised respirator standard [29 CFR 1910.134] and compliance policy directives.

Additional information about respiratory protection for exposure to TB is found in *Guidelines for Preventing the Transmission of Mycobacterium Tuberculosis in Health-Care Facilities* [CDC 1994] and in *Protect Yourself Against Tuberculosis--A Guide for Health Care Workers*, [NIOSH 1996].

§The APF (assigned protection factor) is the minimum anticipated level of protection provided by each type of respirator worn in accordance with an adequate respiratory protection program. For example, an APF of 10 means that the respirator should reduce the airborne concentration of a particulate by a factor of 10 (or to 10% of the workplace concentration).

OSHA currently sets APFs in some substance-specific standards. OSHA is now conducting rulemaking [29 CFR 1910.134] that will set uniform APFs for all respirator types

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The complete text of this manual is available at: <http://www.cdc.gov/niosh/userguid.html>*

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