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Simplifying Respiratory Safety at Nurseries and Greenhouses:

How to use the new MSU Respiratory Protection Toolkit

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Disclaimer

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MICHIGAN DEPARTMENT OF LABOR & ECONOMIC OPPORTUNITY

MIOSHA Michigan Occupational Safety and Health Administration

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Respiratory Hazards

- ***Dusts* & fibers**
  - Wood, grain, dirt (silica)
- **Welding Fume**
- ***Mists*** } Pesticides, painting, disinfectants, manure pits, silos
- ***Gases*** } Pesticides, painting, disinfectants, manure pits, silos
- ***Vapors*** } Pesticides, painting, disinfectants, manure pits, silos
- **Biological Hazards**
  - Mold spore, bacteria, fungi
- **Oxygen deficiency**
- **Temperature extremes**

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Why Respiratory Protection is Important

Asthma

Bronchitis

COPD

Farmer's lung
- **Inhalation of mold spores**, typically from moldy hay, grain or straw, triggers this allergic disease.
- a.k.a. farmer's hypersensitivity pneumonitis (FHP)

Silo filler's disease
- Breathing nitrogen dioxide, a **silo gas produced during silage fermentation**, can react to form nitric acid in the lungs.
- Asphyxiation (acute) and pulmonary edema (chronic)

Grain fever
- toxic alveolitis or pulmonary mycotoxicosis
- Exposure often occurs in areas such as cotton processing areas, grain storage, and poultry & hog barns. Can lead to lung damage.
- a.k.a organic dust toxicity syndrome

Farmer's lung, Michael McFadden, MSU Extension (April 29, 2011) https://www.canr.msu.edu/news/farmers_lung

Respiratory hazards on the farm Southern Illinois University (August 1, 2022) https://www.siumed.edu/blog/respiratory-hazards-farm

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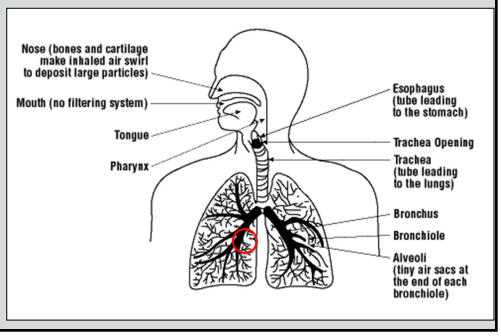
Deposition in the Lung



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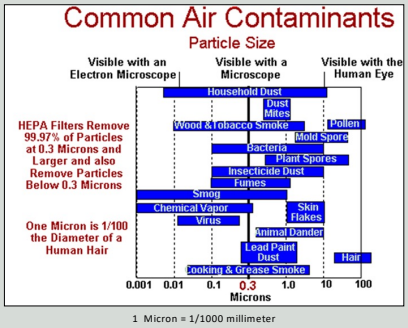
Filter Effectiveness



1 Micron = 1/1000 millimeter

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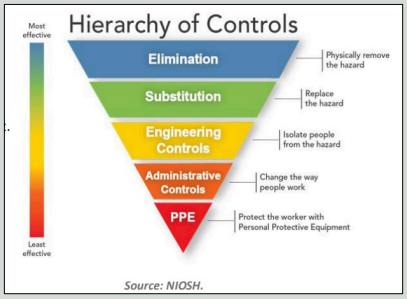
Respirator Effectiveness



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Required before wearing a respirator:

- Medical Evaluation
- Fit Test for Tight-Fitting Respirators

Photo: Heidi Lindberg, MSU Extension

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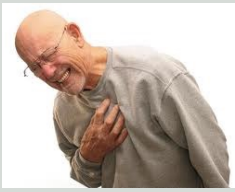
Medical Evaluation: Respirators and Physical Fitness

1. Breathing through a tight-fitting air purifying respirator is *work*
2. Respirators can be hazardous to people with heart or lung problems
3. Before fit test or use
4. Not Required Annually
   - If there are any changes in health
   - Symptoms during use or fit test
   - Different respirator
   - Changes in work – working harder
   - Environmental conditions changed



http://www.hexdoctor.com/dyspnea-shortness-of-breath.aspx

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Medical Evaluation: Process

1. Complete medical questionnaire
2. A physician or licensed healthcare professional (PLHCP) reviews questionnaire
3. PLHCP decides if you need a medical exam

Employers do not see the questionnaire or medical exam results

Employers receive written determination whether the individual is medically fit to wear a respirator

RESPIRATOR MEDICAL EVALUATION QUESTIONNAIRE

Example: U.S. Department of Commerce

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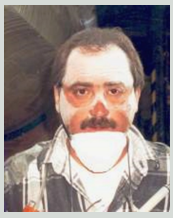
Why Fit Test?

Doesn't fit → won't protect

When to Fit Test:

- Before Use
- Annually
- New respirator
- Change in body weight (± 20lbs)
- Extensive dental work
- Facial surgery
- Scarring



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Qualitative Fit Testing

Photo: Heidi Lindberg, MSU Extension

Quantitative Fit Testing

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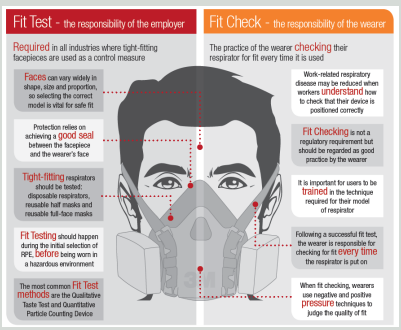

Fit Check

≠

Fit Test

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Air Purifying Respirators

- ✓ Tight Fitting **(~~Beards~~)**
- ✓ Mechanical Filtration
- ✓ Chemical Adsorption




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Powered Air Purifying Respirators (PAPR)



Tight Fitting

~~Beards~~

Protection Factor
1000 Full Face
50 Half Mask

Loose Fitting

✓ Beards yes!

Protection Factor
25 loose fitting
1000 with neck seal & testing

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Atmosphere Supplying Respirators

Full Facepiece Supplied-Air Respirator (SAR) with an auxiliary Escape Bottle	Full Facepiece abrasive blasting Continuous Flow (can be hooded)	Full Facepiece Self-Contained Breathing Apparatus (SCBA)
Protection Factors 50 demand 1,000 positive pressure 10,000 escape SCBA	Protection Factors 25 loose fitting 1000 neck seal w/ approval	Protection Factors 50 demand 10,000 pressure demand/positive pressure

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Introduction to The Guide to Respiratory Protection in Agriculture Tool Kit

Simplifying respiratory safety on the farm - Farm Safety

Respiratory Protection Requirements in Agriculture

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Respiratory Tool Kit Features

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Program Elements At A Glance

Pesticide Respirator Program Elements At-A-Glance		
1	Rules	EPA 40 CFR 152 (Pesticide registration and classification procedures) and 40 CFR 170.507 (Worker Protection Standard [WPS]); MDARD Regulation 637 Rule 4 (Pesticide Use), **Ag Use:** Must Use WPS, Safety Data Sheets (SDS) **Non-Ag Use:** use label, SDS
2	Selection	**Label prescribes NIOSH respirator type**: **TC-84A** – N, R, P filtering facepiece, air purifying respirator (APR) with particulate or chemical cartridge with particulate filter. **TC-23C** – Powered APR (PAPR) with chemical cartridges. **TC-21C** – PAPR with particulate filter (HE). **TC-19C** – Supplied air respirator (SAR). **TC-13F** – Self-contained breathing apparatus (SCBA) or SAR with a SCBA escape bottle.
3	Medical Evaluation	Must occur before fit testing or use. Medical questionnaire completed by healthcare professional. (Sections 1 and 2, part A of Appendix C in MIOSHA Part 451\1910.134.)
4	Fit Testing	Initial (before use) and annually for each type used per WPS. Use MIOSHA Part 451, 1910.134 Appendix A test procedures.
5	Training & Information	Before use and annually per WPS. Training should cover routine use, emergency use, and limitations of use.

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Program Elements At A Glance

6	Cartridge Change Schedule	**Particulate:** If breathing resistance becomes excessive. If filter element has physical damage or tears. If product labeling specifies less time. Maximum = 8 hours per WPS. **Gas/Vapor:** Manufacturer advice based on known exposure level, OR Product label if less, OR Maximum = 8 hours per WPS. In addition, OEM recommends cartridge with End of Service Life Indicator (ESLI) to be used. **Tractor/Sprayer Cab Filter Cartridges:** See Part B Guidance in this document.
7	Hygiene & Condition	Procedures for cleaning, disinfecting, storing, inspecting, repairing, discarding, and maintaining PPE. Follow label precautionary statement, manufacturer, and Michigan EGLE for waste requirements. (Contact: 800-662-9278, EGLE-Assist@michigan.gov).
8	Supplied Air Systems	Must meet ANSI/CGA G-7.1-1989 Grade D Quality (oxygen 19.5 – 23.5%, hydrocarbon condensed max 5 mg/m^3, CO <10ppm, CO^2 <1000 ppm, and lack of noticeable odor). CO alarm required to ensure CO <10 ppm. Signed record of most recent sorbent bed and filter change must be attached to compressor.
9	Documentation	Minimum 2 years per WPS.
10	Program Review	OEM recommends annually

Reference: "Worker Protection Standard (WPS) Respiratory Protection Guide, Requirements for Employers of Pesticide Handlers". Pesticide Educational Resource Collaborative, Revision 2017. (https://www.pesticideresources.org/migrated/wpa/hosted/PERC-WPS-Respirator-Guide.pdf)

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Program Assistance and Checklists

Expanded Respirator Program Element Guidance

	Pesticide		Non-Pesticide	
	Agricultural Use	Non-Agricultural Use	Agricultural Process or Operation	Non-Agricultural Process or Operation
Protect Against	Pesticides used in farms, greenhouses, and nurseries in production of agricultural plants.	Pesticide(s) use not directly associated with plant production (i.e. grass, weed, vermin, insect control not part of agriculture production)	Dust, mist, vapor (i.e. Silica dust, grain dust, manure pit gas, oxygen deficiency, ammonia, mold, biologicals, plant dust.)	Dust, mist, vapor (i.e. Silica dust, paint or chemical vapor/gas, tar pitch, oil mist, welding fume.)
Work Examples	Controlling insects or fungi for crops or production plants, weed control in growing crops or production plants/trees.	Control of weeds on a golf course, insect control not on crops or production plants/trees.	Examples include: pumping out a manure pit or repairing the pump, entering enclosed or underground spaces, operating internal combustion engine in enclosed or confined areas, entry/nox ammonia fertilizer operations, disturbing of mold, rat feces, bird droppings, or inhabited plant or crop dusts or flours.	**Construction:** Crystalline silica exposure during concrete drilling, cutting, or grinding. Granite or other silica-based material work. Painting, welding, roofing coatings. Construction includes work for new construction, repairs that are not routine maintenance, and demolitions including painting. **General Industry** maintenance work, welding, painting, brake replacement, or other routine repair work involving inhalation hazards.

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Program Assistance and Checklists

Expanded Respirator Program Element Guidance

	Pesticide		Non-Pesticide	
	Agricultural Use	Non-Agricultural Use	Agricultural Process or Operation	Non-Agricultural Process or Operation
Cartridge Change Schedule Required	YES 40 CFR 170.507—Use WPS criteria in next section (below). OEM Recommends End of Service Life Indicator (ESLI). Max 8 hours use per WPS—see below.	NO OEM recommends use WPS criteria in next section (below). OEM Recommends ESLI. Max 8 hours use per WPS—see below.	YES MIOSHA Part 700, Reg 325.2442 Qualified Individual to determine. OEM Recommends End of Service Life Indicator (ESLI) or Objective data in writing.	YES ESLI or objective data in writing.
Pesticide Cartridge Change 40 CFR 170.507 (WPS)	**WPS-Particulate Filter or Cartridge:** When breathing resistance becomes excessive. When the filter element has physical damage or tears. According to manufacturer's recommendations or pesticide product labeling, whichever is more frequent. *In the absence of any other instructions or indications of service life, at the end of eight hours of cumulative use.* **WPS Gas or Vapor Cartridges:** At the first indication of odor, taste, or irritation. *(note: breakthrough = exposure)* When the maximum use time is reached as determined by a change schedule conforming to the provisions of 29 CFR 1910.134(d)(3)(iii)(B)(2) (based on objective data/breathing zone personal monitoring). According to manufacturer's recommendations or pesticide product labeling instructions, whichever is more frequent. *In the absence of any other instructions or indications of service life, at the end of eight hours of cumulative use.* When breathing resistance becomes excessive.			

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Choosing the Right Respirator and …

- Filter (N, R, P, HE)
- Chemical Cartridge
- Gas Mask Canister
- Atmosphere Supplying System

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Outdated Label Language

Outdated Respirator Terms. In some cases, obsolete language may be used on pesticide labels. These are pesticide labels where the label language was approved by the EPA prior to 1995. Older labels will include the phrase "MSHA/NIOSH". The translation to the updated (post 1995) respirator and cartridge type are provided below. If the outdated terms are on the label, use the current terms and the tables in Part B-4 and B-5 of this document to select the correct respirator.

OUTDATED Respirator terms used on EPA pesticide labels	Current NIOSH respirator terms used on labels*
NIOSH/MSHA	NIOSH
Dust/Mist	Use a particulate filter
Pre-filter approved for pesticides	N, R or P filter (particulate), to be used in combination with a chemical cartridge
Canister approved for pesticides	Use a gas mask with a contaminant specific canister. For many pesticides this will be a black organic vapor (OV) **or** black and pink (P100) combination canister.
N, R, P or HE filters	N, R or P (particulate) filter **or** HE filters (can only be used on Powered Air-Purifying Respirators [PAPR]).

*For liquid pesticides, MSU recommends always using a P100 oil rated filter, in combination with an organic vapor cartridge or canister. Check with the manufacturer for the correct combination cartridge or canister for your mask.

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Air Purifying Cartridge Options – Hazard Based

PART B-2: Choosing an Air-Purifying Respirator and Cartridge Based on Agricultural Hazards

Protection From	NIOSH TC #	Respirator Type	Color	Photo	Cartridge/Canister Type
Liquid Pesticide Painting, Feed or Grain Dust, Mold, Organic Dust, poultry, Welding, Grinding, Sanding.	TC-84A	Non-Powered–Elastomeric • Half or Full-Face • Tight-fitting	Black Pink		Combination organic vapor (OV) and P100** (particulate) filter cartridge
	TC-14G	Non-Powered–Gas Mask • Full Face • Tight-fitting	Olive Pink		Combination multi-gas with organic vapor and P100** filter canister
	TC-23C	Powered Air Purifying (PAPR) • Tight-fitting • Loose-fitting*	Black Pink		Combination organic vapor cartridge plus HE filter
Solid Pesticide Feed or Grain Dust, Mold, Organic Dust, Welding, Grinding, Sanding.	TC-84A	Non-Powered–Elastomeric or Filtering Facepiece (dust mask) • Half or Full-Face • Tight-fitting	Pink		N, R or P** 100 particulate filter Note: If > No oily present in mixtures, if oil is present, the R or P filter is required
	TC-21C	Powered Air Purifying (PAPR) • Tight-fitting • Loose-fitting*	Pink		HE filter
	TC-14G	Non-Powered–Gas Mask • Full Face • Tight-fitting	Olive Pink		Combination multi-gas with organic vapor and P100** filter canister
Liquid + Solid Pesticide Disinfectants, Bleach, Anhydrous Ammonia, ammonia from livestock, hogs, poultry, formaldehyde, organic vapors.	TC-84A	Non-Powered–Elastomeric • Full or Half Face • Tight-fitting	Olive Pink		Combination multi-gas with organic vapor and P100** cartridge Multi-gas = Ammonia, Certain Organic Vapors, Chlorine, Chlorine Dioxide, Formaldehyde, Hydrogen Chloride, Hydrogen Fluoride, Hydrogen Sulfide, Methylamine, Sulfur Dioxide
Anhydrous Ammonia, ammonia from livestock, hogs, poultry.	TC-23C	Non-Powered–Elastomeric • Full or Half Face • Tight-fitting	Green		Ammonia chemical cartridge†
Disinfectants, Bleach	TC-23C	Non-Powered–Elastomeric • Full or Half Face • Tight-fitting	Yellow		Acid gas chemical cartridge†

*Loose fitting does not require fit testing and facial hair is allowed.
**P filters are rated for exposure to oils and are recommended for liquid pesticide and any additives.
†Can add N95 pre filter for particulates like dust or mist (not for use with oil) OR can use a combination with P100 cartridge (for use with oil).

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Air Purifying Cartridge Options – Type and TC Number

PART B-4: Air-Purifying Respirator Options by NIOSH Testing & Control (TC) Number

Type	NIOSH prefix	Facepiece	Fit	Reusable	Protects against particulates	Oil resistant	Protects against OV	Protects against fumigants	For use in IDLH atmospheres	Requires fit test	Offers eye protection	Can be worn with facial hair
Gas Mask	TC-14G	Elastomeric	Tight	Yes	With combo canister	With P100 canister	With OV canister	Some, at very low levels	Emergency escape only	Yes	Yes	No
Chemical Cartridge Respirators	TC-23C	Powered hood/helmet	Loose	Yes	With HE filter	With HE filter	With OV cartridges	No	No	No	Yes	Yes
		Powered elastomeric	Tight	Yes	With HE filter	With HE filter	With OV cartridges	No	No	Yes	If full-mask	No
		Non-powered elastomeric	Tight	Yes	No	No	With OV cartridges	No	No	Yes	If full-mask	No
Powered Particulate Respirators	TC-21C	Hood/ helmet	Loose	Yes	Yes, HE filters	No	No	No	No	No	Yes	Yes
		Elastomeric	Tight	Yes	Yes	Yes, HE filters	No	No	No	Yes	If full-mask	No
Non-powered Particulate Respirators	TC-84A	Elastomeric	Tight	Yes	Yes	With R or P rating	With OV combo cartridges	No	No	Yes	If full-mask	No
		Filtering Facepiece	Tight	No	Yes	With R or P rating	No	No	No	Yes	No	No

Abbreviations: HE = High efficiency; IDLH = Immediately Dangerous to Life or Health; OV = Organic Vapor
Table source: Adapted from Bernard K. Respirators and Pesticides I. The Right Respirator: Types, NIOSH Numbers, Filter Codes, and Cartridge Colors. University of Maine Cooperative Extension. (https://extension.umaine.edu/ipm/respirators-and-pesticides-i-the-right-respirator-types-niosh-numbers-filter-codes-and-cartridge-colors/)

*Note that the following four respirator selections provide protection for liquid pesticide (combination of organic vapor and particulates):
- Gas mask (TC-14G) elastomeric with combination organic vapor and RI/P100 canister.
- Powered (PAPR) hood/helmet loose-fitting Chemical Cartridge Respirator (TC-23C) with a HE filter.
- Powered (PAPR) elastomeric tight-fitting Chemical Cartridge Respirator (TC-23C) with a HE filter.
- Elastomeric Non-Powered Particulate Respirator (TC-84A) with OV combo cartridges and R/P100 filter.

If adding surfactants, adjuvants or other additives, the respirator required for protection may be different than the label. Surfactants, adjuvants or other additives may contain oil requiring an oil-resistant respirator (R or P rating).

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Atmosphere Supplying Respirator Options – Hazard Based

PART B-3: Choosing an Atmosphere-Supplying Respirator Based on Agricultural Hazards

Hazards	NIOSH TC #	Respirator Type	Photo	Special Instructions
Organic Gas Pesticide Used in Enclosed Areas (space and soil fumigants) Manure Pits or Silo or Enclosed Process Areas • Carbon Monoxide • Hydrogen Sulfide • Carbon Dioxide • Methane • Oxygen Deficiency Paint Spraying • Enclosed Isocyanates • Urethane • Sensitizers	TC-19C	Atmosphere-Supplying Supplied-Air Respirator (SAR) • Full Face • Tight-fitting • Air Cylinders* • Air Compressors**		**If concentrations are unknown, immediately dangerous to life or health (IDLH) conditions may be present due to air contaminant concentrations OR oxygen deficiency, additional equipment and training shall include use of:** • A positive pressure or pressure demand regulator (TC-19 and TC-13F) • An emergency escape backup bottle of breathing air (TC-19) Air monitoring equipment capable of determining IDLH conditions should be used. Rescue: See MIOSHA Part 451 Respiratory Protection, 1910.134(g)(3) Procedures for IDLH Atmospheres. At least one employee located outside the IDLH area who is equipped as in with backup bottle or SCBA level of protection (with pressure-demand or positive pressure regulator) shall be positioned to provide rapid rescue of any affected individual in a dangerous atmosphere. Retrieval equipment shall be used where it will contribute to the rescue of the worker. Other mandatory requirements apply including the communications and notification requirements found in MIOSHA Part 451, 1910.134(g)(3). The full requirements and training must be met for safe use and rescue from potentially IDLH atmospheres.
	TC-13F	Atmosphere Supplying Self-Contained Breathing Apparatus (SCBA) • Full Face • Tight-fitting		

*Reference: MIOSHA Part 451, 1910.134(i)(5) Air cylinders must have a Grade D breathing air certificate of analysis. (Oxygen 19.5% – 23.5%, Condensed Hydrocarbon max 5 mg/m³, CO max 10 ppm, CO² max 1000 ppm, lack of noticeable odor.)

**Reference: MIOSHA Part 451, 1910.134(i)(6) Air compressors must be designed to prevent entry of contaminated air into the air-supply system and have suitable in-line purifying sorbent beds and filters to ensure breathing air quality. Sorbent beds and filters must be maintained or replaced following manufacturer instructions. A tag with the most recent change date and signature of the person who changed it must be maintained at the compressor. For non-oil lubricated compressors, CO levels must be kept below 10 ppm. Oil lubricated compressors must have a high temperature or CO alarm or both to monitor CO levels. CO must not exceed 10 ppm in breathing air. Ensure compressor air intakes are not in contaminated areas. Ensure rented equipment has proper filters, sorbent beds and CO alarm.

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Tool Kit Atmosphere Supplying Respirator Options – TC Number

PART B-5: Atmosphere-Supplying Respirator Options by NIOSH Testing & Control (TC) Number

Type	NIOSH prefix	Facepiece	Fit	Reusable	Protects against particulates	Oil resistant	Protects against OV	Protects against fumigants	For use in IDLH atmospheres	Requires fit test	Offers eye protection	Can be worn with facial hair
Self-contained Breathing Apparatus (SCBA)	TC-13F	Hood/ helmet*	Loose	Yes	Yes	Yes	Yes	Escape only	No	No	Yes	Yes
		Elastomeric	Tight	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Supplied-air Respirator (SAR)	TC-19C	Hood/ helmet	Loose	Yes	Yes	Yes	Yes	No**	No	No	Yes	Yes
		Elastomeric	Tight	Yes	Yes	Yes	Yes	At lower than IDHL levels	If full-face pressure demand with auxiliary escape SCBA	Yes	If full-face mask	No

Abbreviations: HE = High efficiency; IDLH = Immediately Dangerous to Life or Health; OV = Organic Vapor
*There is currently no NIOSH certified TC-13F loose fitting SCBA except for escape use only.
**While some pesticide labels may allow for the use of a loose-fitting SAR at lower than IDLH levels, OEM does not recommend TC-19C loose fitting SAR be used to protect against fumigants.
Table source: adapted from Bernard K. Respirators and Pesticides I. The Right Respirator: Types, NIOSH Numbers, Filter Codes and Cartridge Colors. University of Maine Cooperative Extension. (https://extension.umaine.edu/ipm/respirators-and-pesticides-i-the-right-respirator-types-niosh-numbers-filter-codes-and-cartridge-colors/)

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Cab Filter Selection

When do I need to change my cab filter and what kind should I be using?

Cab Filter Checklist

- ☐ Use a combination particulate and activated carbon filter (original equipment may only include a particulate filter without activated carbon).
- ☐ Use only activated carbon filters that meet the ASABE S613-3.1 chemical filter service life testing standard.
- ☐ Replace the organic vapor/particulate combination filter based on the filter manufacturer replacement interval. This is often 400 hours or 12 months, whichever is less.
- ☐ If the cab air tightness and filtration system does not prevent exposure, wear a respirator inside the cab. Use an organic vapor (OV) cartridge with R or P rated filter.
- ☐ Always have respiratory protection required by the pesticide label in the cab for emergencies and leaving the cab. Wear respiratory protection in the cab if required by the label or Worker Protection Standard (WPS) guidance. (See PART B-9 in this document)

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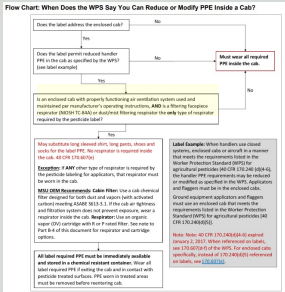
WPS Reduced PPE Requirements For Cab Enclosures



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Program Assistance and Checklists

Explanation of Filter Efficiency and Oil Resistance Ratings (N, R, P and HE)

Respirator Use, Reuse, Cleaning and Disposal Considerations
- Pesticide WPS and Non-Pesticide MIOSHA criteria

Consultation, Education and Training Resources
- Formal training courses
- Online resources to develop training content

Table of Assigned Respirator Protection Factors

Record of Fit Testing Form

Abbreviations List

Glossary of Terms

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Program Assistance and Checklists

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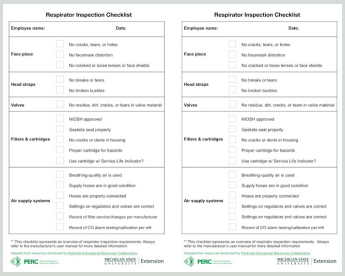
Program Assistance and Checklists



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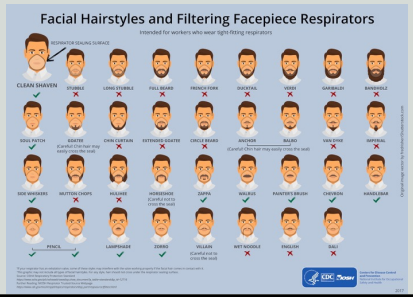
Posters



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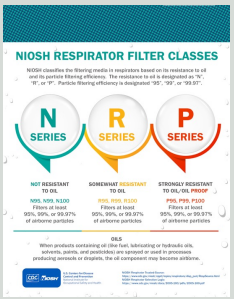

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Thank you for having us!
Questions??

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