

Enhancing Respiratory Protection in Mining

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Enhancing Respiratory Protection in Mining

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About this training:

- Funded by an MSHA Brookwood-Sago Mine Safety Grant.
- Materials can be downloaded from <https://www.dri.edu/miner-training-program/>
- **Free** on-demand training contacts:
 - DRI (Reno): Xiaoliang Wang (xiaoliang.wang@dri.edu)
 - Best in the West Safety (Las Vegas): Diane Hale (dhale@biwsafety.com)
 - Sonoma Health & Safety Center (Winnemucca): James Lage (sonomahealthsafety@yahoo.com)



Objectives

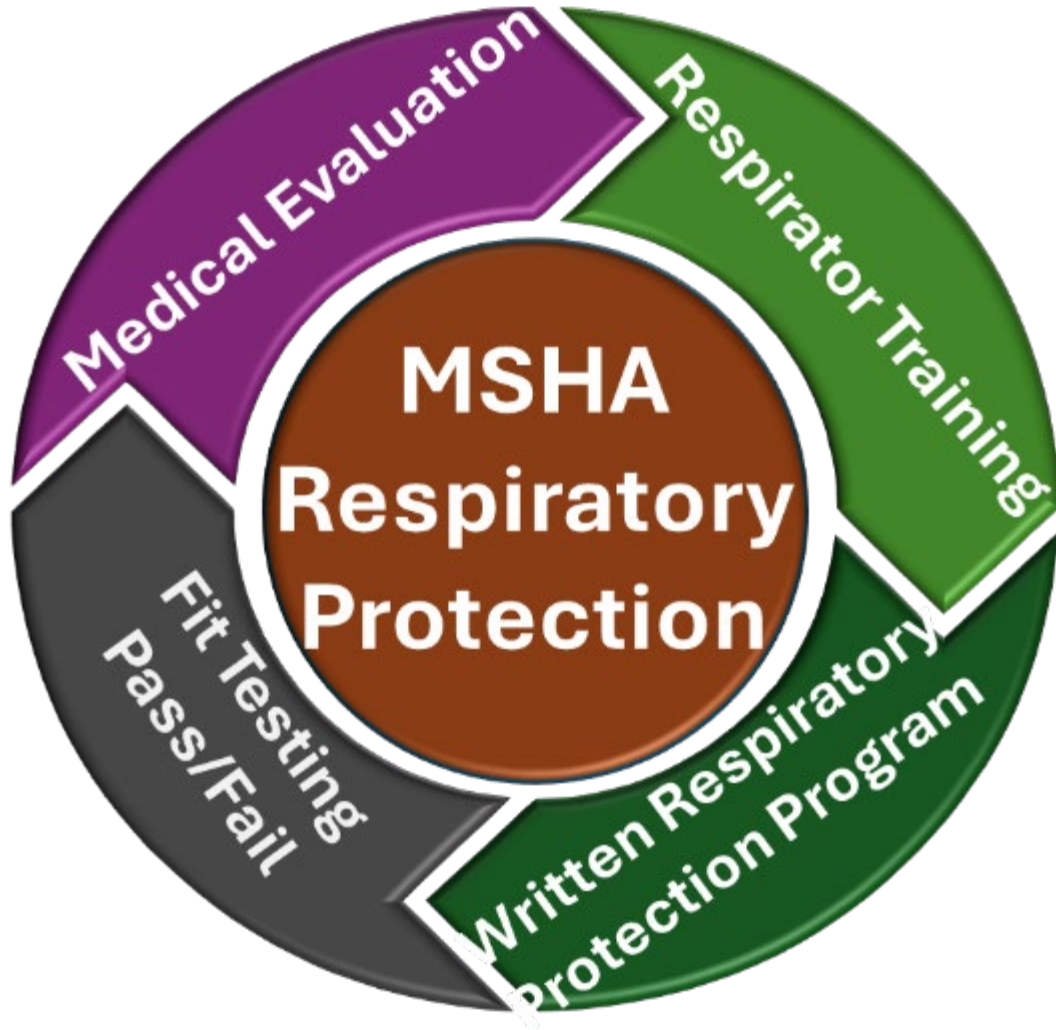
- Understand MSHA regulations for respiratory protection.
- Learn to select, use, inspect, clean, and maintain respirators.
- Learn about medical evaluations and annual fit testing.
- Present a free template for written respiratory protection program.

MSHA Silica Rule: Respiratory Protection

30 CFR Part 60.14

- Use respiratory protection as a **temporary measure** when miners must work in concentrations of respirable crystalline silica (RCS) above the permissible exposure limit (PEL) while:
 - Engineering control measures are being developed or implemented;
 - It is necessary by the nature of work involved.
- Transfer affected miners who cannot wear a respirator to another area or occupation at the same mine, where respiratory protection is not required.
- Respirators must be NIOSH-approved and classified as **100 series or high efficiency (HE) filters** ($\geq 99.97\%$).
- Establish a **written respiratory protection program** referencing to **ASTM F3387-19**.

Requirements for Wearing A Respirator



Every mine or contractor that requires miners to wear respiratory protection must complete the following:

1. Written Respiratory Protection Program (RPP)
2. Training
3. Medical Evaluation
4. Fit Testing

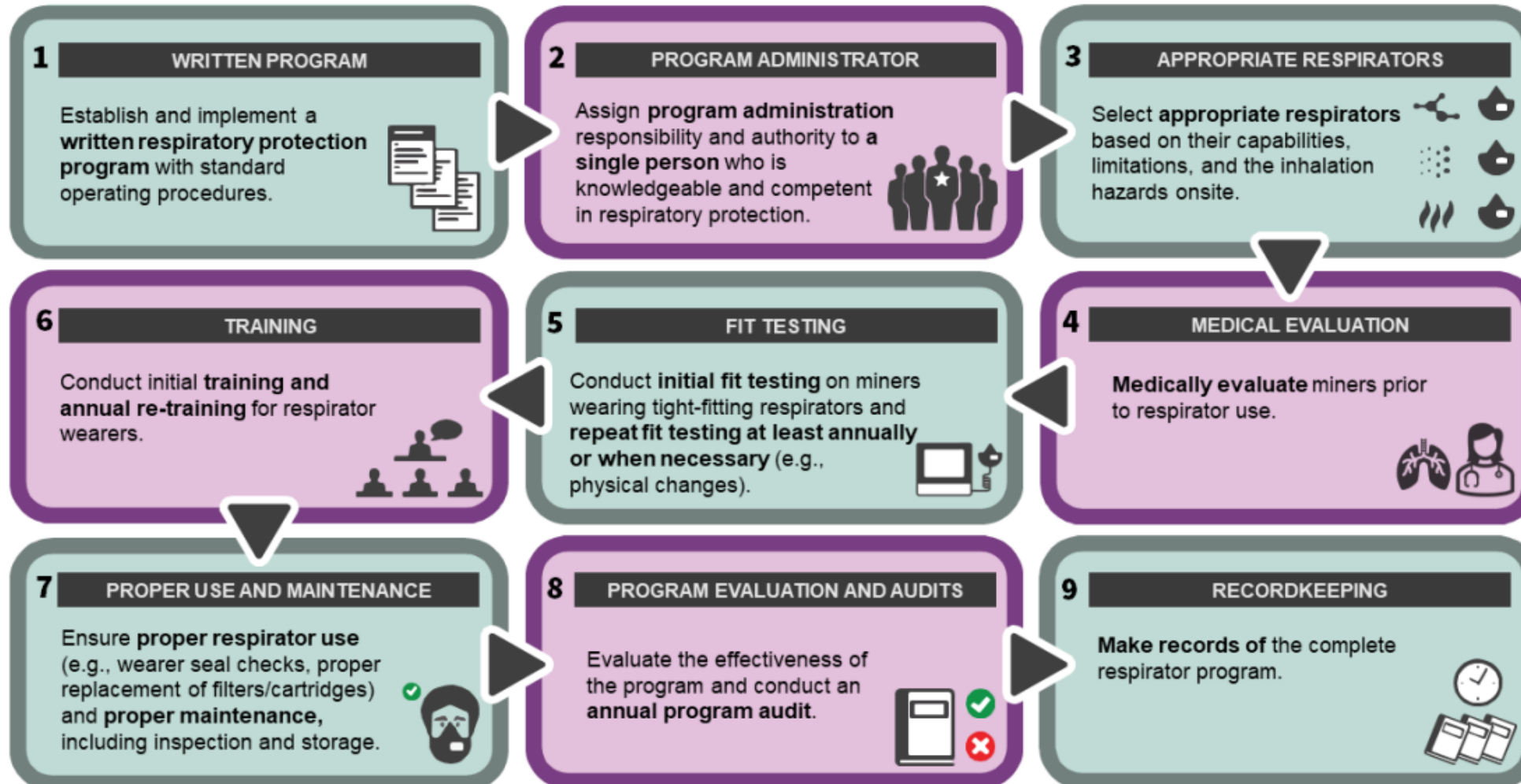
Medical Evaluation for Respiratory Protection vs. Medical Surveillance under Silica Rule

Items	Medial Evaluation (Respirator)	Medical Surveillance (Silica Rule)
Who	<ul style="list-style-type: none">• All miners required to wear a respirator	<ul style="list-style-type: none">• New miners: mandatory• Existing miners: voluntary
When	<ul style="list-style-type: none">• Before respirator use and fit testing	<ul style="list-style-type: none">• New miners: with 60 days after hire; follow-up exam within 3 years.• Existing miners: within initial 12-month, and every 5 years
How	<ul style="list-style-type: none">• Medical questionnaire• Workplace information• Follow-up exam as needed	<ul style="list-style-type: none">• A review of medical and work history• A physical examination with emphasis on the respiratory system;• A chest X-ray classified by a NIOSH-certified B Reader• Pulmonary function testing
What	Decisions about respirator use: <ul style="list-style-type: none">• Full clearance• With limitation/restriction• Not approved	<ul style="list-style-type: none">• Provide results to the miner or designees• Provide chest X-ray results to NIOSH

MSHA's Silica Rule Requires a Respiratory Protection Program (RPP) that

- Establishes standard practices for the selection, use, and maintenance of respirators.
- Complies with Standard Practice for Respiratory Protection (ASTM F3387-19).
- Applies to all miners required to wear respiratory protection during routine, non-routine, and emergency operations.

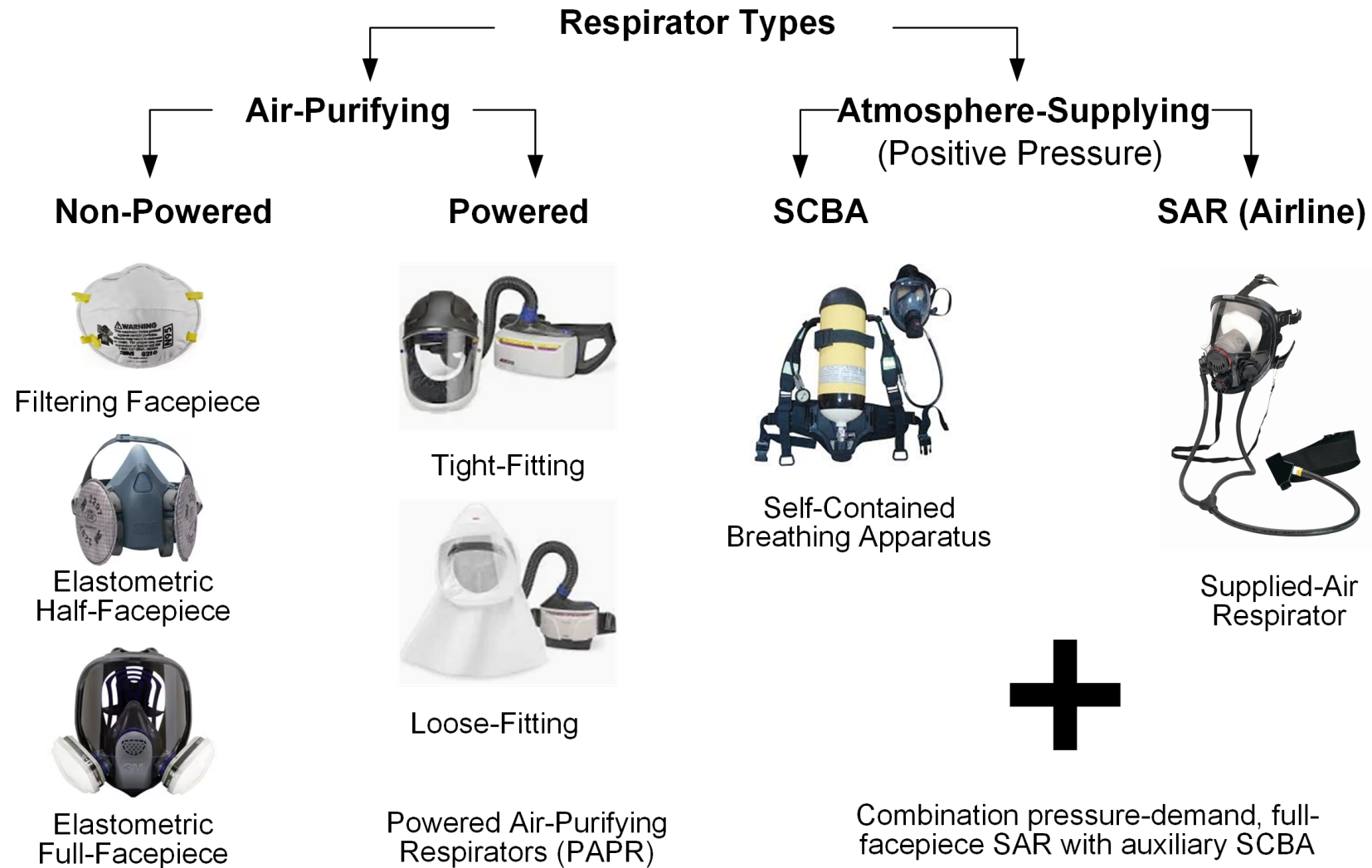
Key Requirements of ASTM F3387-19 Respiratory Protection Standard Practices



Standard Operating Procedures (SOP) for Respirator Use

1. Hazard assessment;
2. Respirator selection;
3. Medical evaluation;
4. Training;
5. Fit testing;
6. Issuance;
7. Maintenance, inspection, and storage;
8. Air-purifying element change schedule;
9. Breathing air quality;
10. Monitoring respirator use;
11. Hazard re-evaluation;
12. Mine Operator policies;
13. Program evaluation and auditing.

What Types of Respirators Are Available?



Air-Purifying Respirator Styles



Filtering Facepiece Respirators (FFRs)

- Cover nose and mouth; disposable
- Remove particles, but not gases or vapors
- APF: 10



Elastomeric Half-Facepiece Respirators (EHFRs)

- Cover nose and mouth; reusable
- Remove particles, gases, and vapors when equipped with appropriate filter, cartridge, or canister
- APF: 10



Elastomeric Full-Facepiece Respirators (EFFRs)

- Cover the whole face and provide eye protection; reusable
- Remove particles, gases, and vapors when equipped with appropriate filter, cartridge, or canister
- APF: 50 (with quantitative fit testing)



Powered Air-Purifying Respirators (PAPRs)

- Less air resistance
- Loose-fitting facepiece: APF = 25
- Half-facepiece tight fitting: APF = 50
- Full-facepiece tight fitting: APF = 1000
- Helmet/hood: APF = 25 or 1000

Assigned Protection Factor (APF): the level of respiratory protection that a respirator or class of respirators is expected to provide when a continuing, effective respiratory protection program is implemented.

Fit Testing Best Practices & Discussion on Respirators

Diane Hale, ASP, CEHSP, CHMM



Fit Testing Is Required Prior To (Tight-Fitting) Respirator Use

- A respirator fit test verifies that a respirator is both **comfortable** and provides the miner with the expected **protection**.
- Depending on head shape and size, one may need to try several different respirator styles to determine which **provides the best seal**.
- A mine operator may offer different respirator styles, but it's crucial to only use the specific respirator model, size, and style for which the miner has passed a fit test.



Quantitative Fit Test (QNFT)

- Measures the amount of inward leakage around the face seal
- Generates a numerical fit factor (ratio of outside to inside test agent particle concentration) that must be 10X the respirator's APF
- **Higher fit factor indicates a better fit**
- Tight-fitting negative pressure respirator fit factors: 100 half-facepiece/500 full-facepiece
- A passing QNFT must be achieved to apply an APF of 50 or greater to a full-face air-purifying respirator
- Equipment Examples: Occupational Health Dynamics (OHD) Quantifit/QuantiFit2™ and TSI PortaCount™



<https://safetysourcefire.ca/product/quantifit2/>



<https://www.oemupdate.com/blog/brand-update/respirator-fit-testing-for-every-industry/>

Qualitative Fit Test (QLFT)



- Subjective pass/fail test that relies on person's response to a test agent (e.g., taste, smell).
- "Pass" result is equivalent to QNFT fit factor of 100 (i.e., leakage into respirator is 100 times less than outside test agent concentration).
- For tight-fitting negative pressure air-purifying respirators, the maximum respirator APF that can be applied is 10 when QLFT is performed (e.g., fit factor of 100 for both half- and full-facepiece).

**Examples: Bitrex (bitter), saccharin (sweet),
banana oil, irritant smoke.**

Respirator Fit Test Requirements

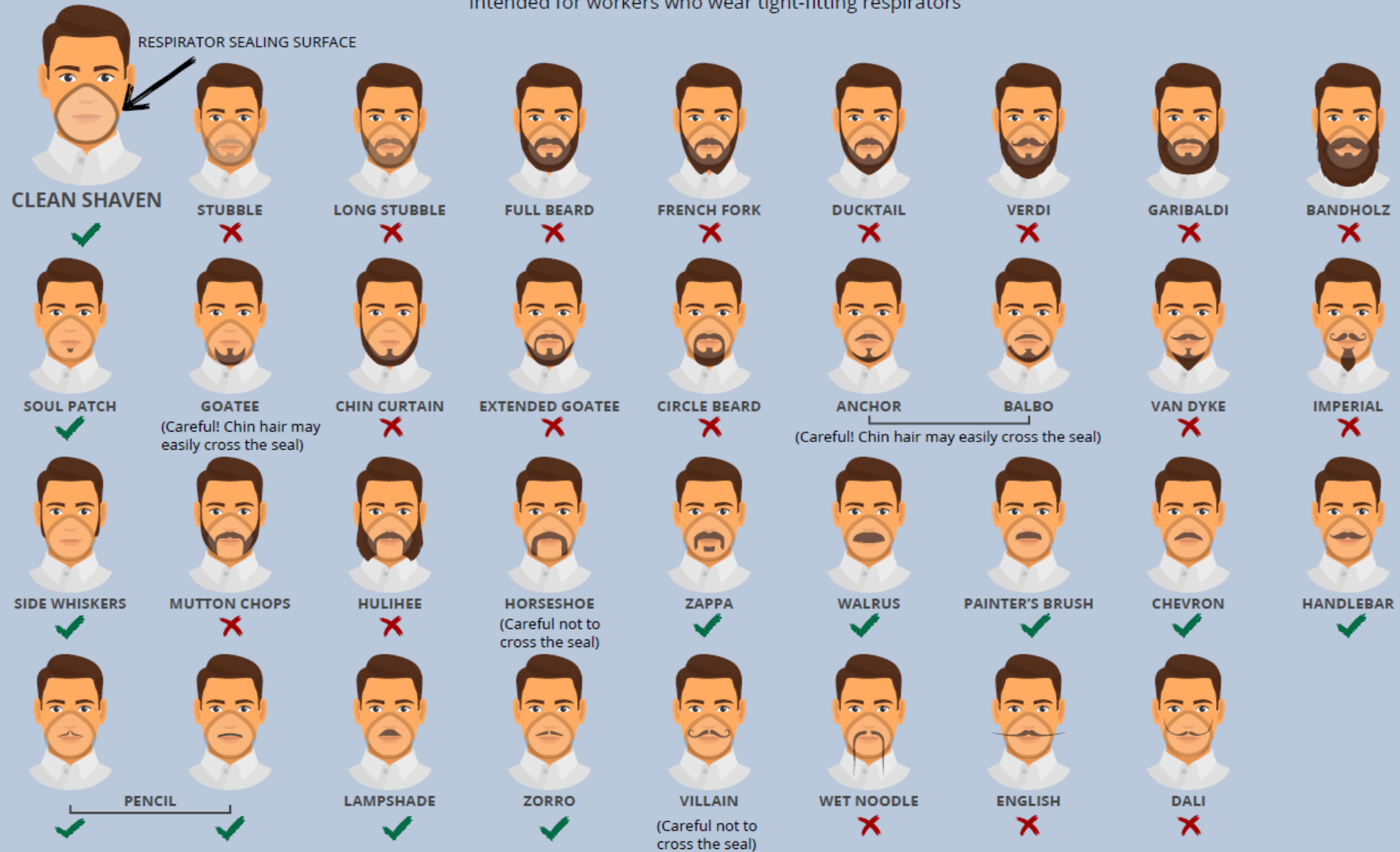


- NO BEARDS, scruff, or 5 o'clock shadows
- No other types of facial hair (e.g., mustaches, long sideburns)
- Men must be clean shaven - NO EXCEPTIONS
- Clean face free of heavy make up
- No facial piercings

Even minimal facial hair may cause respirators to LEAK.

Facial Hairstyles and Filtering Facepiece Respirators

Intended for workers who wear tight-fitting respirators



Original image vector by fredrisher/Shutterstock.com

Comfort Is an Important Factor in Wearer Acceptance of the Respirator



- No one size or model of respirator will fit all types of faces.
- A variety of sizes, models, and styles from which to choose shall be provided for the wearer.
- Consider breathing resistance, vision, communications, and weight.

Tight Sealing on Respirators



One size normally does not fit all!

Have available multiple sizes and sizes so that you are prepared.

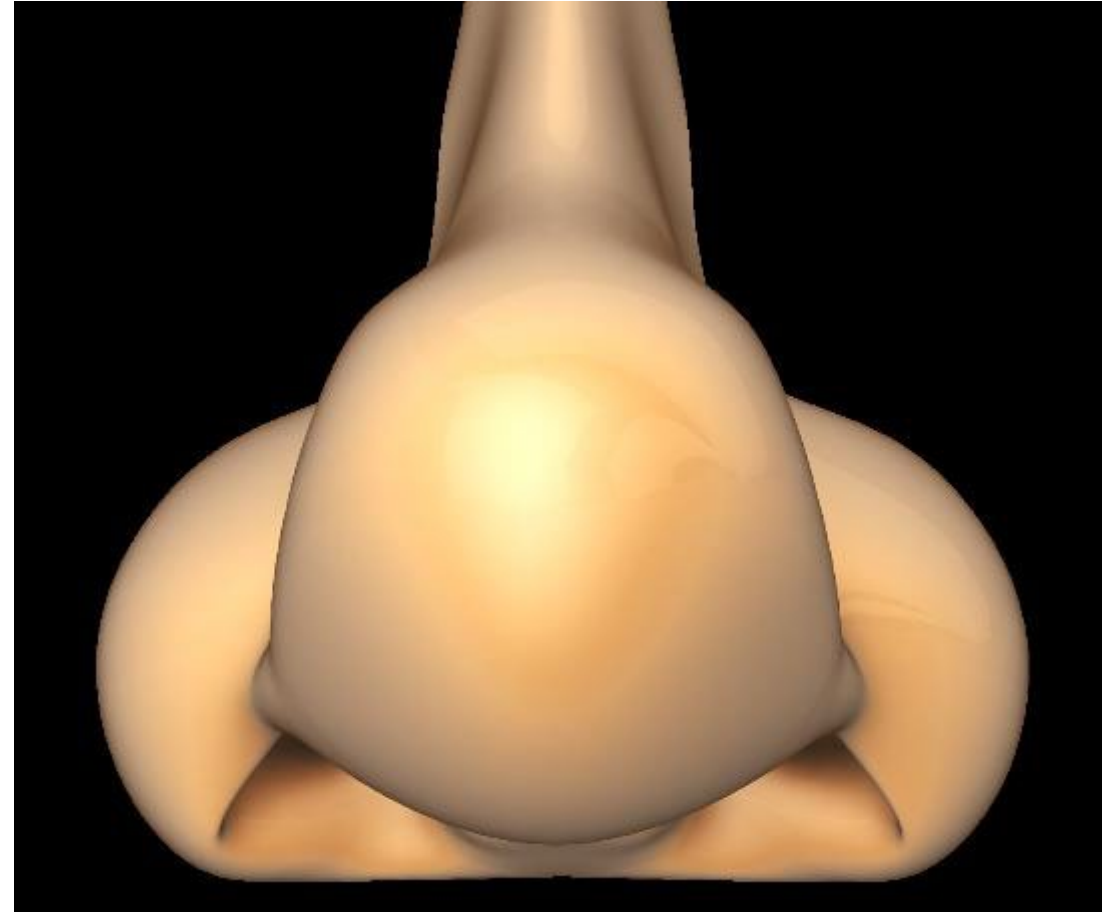
Many Factors Affect the Selection of Elastomeric or Silicone Respirators



- **Chemical compatibility**
- **Comfort**
- **Head size**
- **Facial features**
- **Distance between nose and lower lip (N95)**

Fitting the Respirator to the Miner

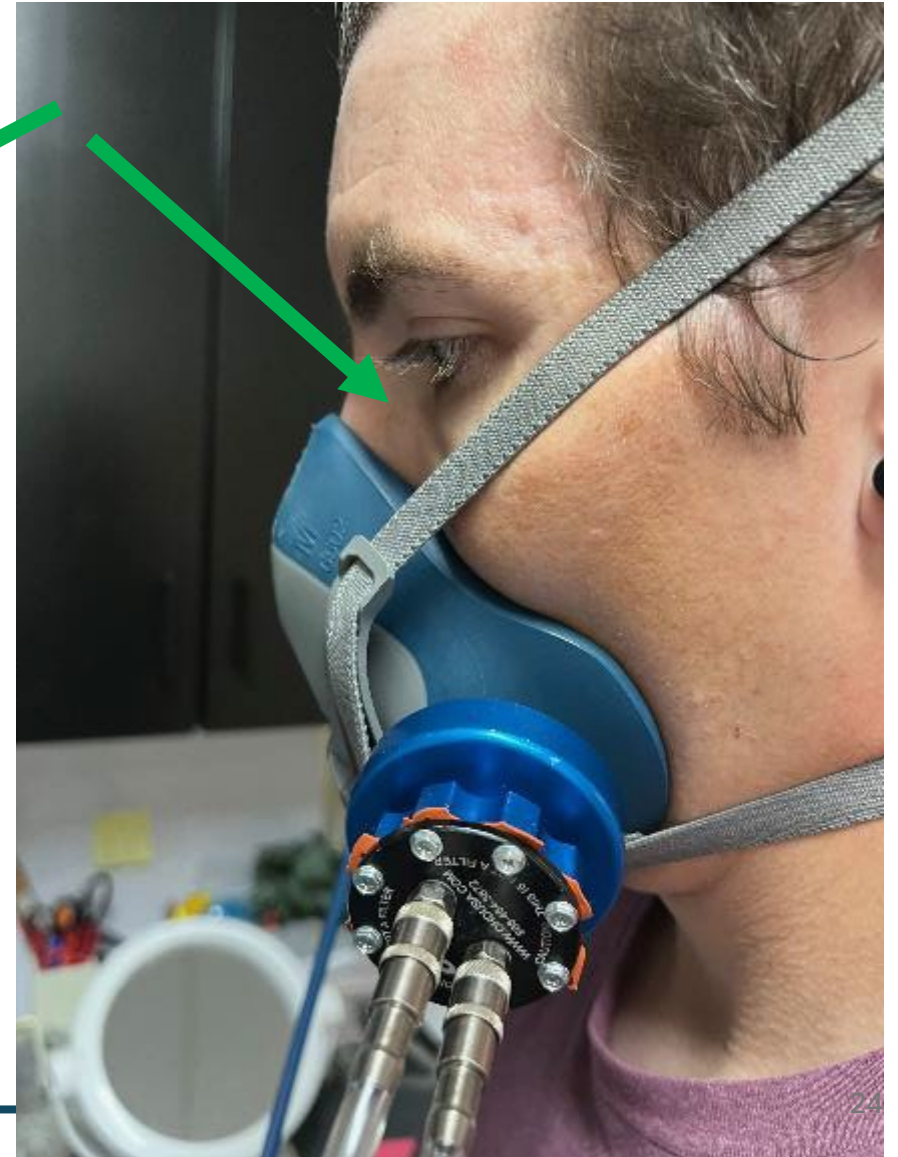
- Many styles and sizes
- Evaluate facial features
- Large head, big nose, angular nose, flat nose...
- Petite miner, small mouth and nose
- Specific features unique to style



The Nose Impacts the Seal!



Respirator Seal Placement



Antifog Wipers in Draeger Full Face



- **Filters**
- **Supplied air line**
- **SCBA**
- **Panorama Nova ONE SIZE fits all**

When to Clean Respirators?



- Clean as often as necessary when issued for the exclusive use of one miner. **EACH USE!**
- Clean and disinfect before being worn by different miners.
- Clean and disinfect emergency or rescue use respirators after each use.
- Clean after each fit testing and training.

Cleaning and Disinfection Instructions

- **Use neutral detergent:**
liquid dish soap works well
- **Not to exceed 120 degrees F**
- **Do not use solvents**
- **Disinfect with quaternary ammonia or Na Hypochlorite (bleach)**

Disinfectant wipes for quick cleaning but not for everyday!

replace exhalation valve cover.
6. Inspect lens for any damage that may impair respirator performance or vision.
Cleaning and Storage
Cleaning is recommended after each use.

WARNING

Do not clean respirator with solvents. Cleaning with solvents may degrade some respirator components and reduce effectiveness. Inspect all respirator components before each use to ensure proper operating condition. **Failure to do so result in sickness or death.**

1. Remove cartridges, filters and/or breathing tubes. The center adapter, lens and facepiece can also be removed if necessary.
2. Clean facepiece (excluding filters and cartridges), by immersing in warm cleaning solution, water temperature not 120°F (49°C), and scrub with soft brush until clean. Add neutral detergent if necessary. Do not use cleaners containing oils.
3. Disinfect facepiece by soaking in a solution of quaternary ammonia disinfectant or sodium hypochlorite (1oz. [30] bleach in 2 gallons [7.5L] of water), or other disinfectant.
4. Rinse in fresh, warm water and air dry in non-contaminated atmosphere.
5. Respirator components must be inspected prior to each use. A respirator with any damaged or deteriorated components be repaired or discarded.
6. The cleaned respirator should be stored away from contaminated areas when not in use.

REPLACEMENT PART INSTRUCTIONS

3M™ Facepiece Assemblies for 6700/6800/6900

The facepiece consists of the head harness assembly, nose cup assembly, center adapter assembly, lens assembly, facepiece (medium or large), and frame assembly (top, bottom, nuts and screws).

To disassemble lens assembly from facepiece, remove the two Phillips screws from top frame. Then, pull the frame top bottom away from the facepiece. The frame top, frame bottom, facepiece and the lens assembly have vertical line markings indicate their positions relative to one another. Make certain these markings are aligned for reassembly.

3M™ Center Adapter Assembly 6864 Replacement

The center adapter assembly consists of center adapter base, cover, exhalation valve, and adapter gasket. It is secured to the lens with a bayonet style twist lock connection, which compresses the sealing gasket.

To remove the center adapter from the facepiece:

Read Instructions for Use Limitations

Limitations on Use

contaminated area. Immediately and repair or replace respirator, or contact supervisor.

- Store respirator away from contaminated areas when not in use.
- Dispose of used product in accordance with applicable regulations.

In Brazil, breathing air systems must be supplied with air which meets ANSI Z86.1-1989/CGA G-7.1, Grade D breathing air.

Use Limitations

- This respirator does not supply oxygen when used in air-purifying mode. Do not use in atmospheres containing less than 19.5% oxygen.
- Do not use when concentrations of contaminants are immediately dangerous to life or health, are unknown or when concentrations exceed 10 times the permissible exposure limit (PEL) in air-purifying mode when qualitatively fit tested, 50 times the PEL in air-purifying mode when quantitatively fit tested, 1000 times PEL in supplied air or powered air purifying modes, or according to specific OSHA standards or applicable government regulations, whichever is lower.
- Do not alter, abuse or misuse this respirator.
- Do not use with beards or other facial hair or other conditions that prevent a good seal between the face and the face seal of the respirator.

In Brazil, according to the Respiratory Protection Program of the Ministry of Labor, do not use quantitatively fit tested full facepiece respirators when concentrations of contaminants are greater than 100 times the permissible exposure limit in air-purifying mode.

Time Use Limitations

- Cartridges and filters must be used before expiration date on packaging.
- Particle filters must be replaced if they become damaged, soiled or if an increase in breathing resistance occurs. N-series filters should not be used in environments containing oils. R-series filters may be limited to 8 hours of continuous or intermittent use if oil aerosols are present. In environments containing only oil aerosols, R-series filters should be replaced after 40 hours of use or 30 days, whichever is first.
- Service life of gas/vapor cartridges will depend upon activity of wearer (breathing rate); specific contaminant and concentration; and environmental conditions such as humidity, pressure, and temperature. Cartridges must be replaced in accordance with an end of service life indicator, established change schedule or earlier if smell, taste or irritation from contaminants is detected. Please see 3M Service Life Software at www.3M.com/sls.
- The 6007 and 60927 mercury vapor cartridges must be discarded within 50 hours of use against mercury vapor; or according to organic vapor, chlorine, hydrogen sulfide or sulfur dioxide service life, or when odors of vapors or gases become noticeable, whichever occurs first. Mercury vapor has no odor.

NIOSH Cautions and Limitations

The following restrictions may apply. See NIOSH Approval Label.

A - Not for use in atmospheres containing less than 19.5 percent oxygen.

NIOSH Limitations

in accordance with an end of service life indicator, established change schedule or earlier if smell, taste or irritation from contaminants is detected. Please see 3M Service Life Software at www.3M.com/sls.

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NIOSH Cautions and Limitations

The following restrictions may apply. See NIOSH Approval Label.

A - Not for use in atmospheres containing less than 19.5 percent oxygen.

B - Not for use in atmospheres immediately dangerous to life or health.

C - Do not exceed maximum use concentrations established by regulatory standards.

D - Air-line respirators can be used only when the respirators are supplied with respirable air meeting the requirements of CGA G-7.1 Grade D or higher quality.

E - Use only the pressure ranges and hose lengths specified in the User's Instructions.

F - Do not use powered air-purifying respirators if airflow is less than four cfm (115 lpm) for tight fitting facepieces or six cfm (170 lpm) for hoods and/or helmets.

G - If airflow is cut off, switch to filter and/or cartridge or canister and immediately exit to clean air.

H - Follow established cartridge and canister change schedules or observe ESL to ensure that cartridges and canisters are replaced before breakthrough occurs.

J - Failure to properly use and maintain this product could result in injury or death.

L - Follow the manufacturer's User's Instructions for changing cartridges, canister and/or filters.

M - All approved respirators shall be selected, fitted, used, and maintained in accordance with MSHA, OSHA, and other applicable regulations.

N - Never substitute, modify, add, or omit parts. Use only exact replacement parts in the configuration as specified by the manufacturer.

O - Refer to User's Instructions, and/or maintenance manuals for information on use and maintenance of these respirators.

S - Special or critical User's Instructions and/or specific use limitations apply. Refer to User's Instructions before donning.

S - Special or Critical User's Instructions

3M™ Organic Vapor Service Life Indicator Cartridges (60011 and 609211) are equipped with a passive 3M™ End of Service Life Indicator (ESLI). The indicator must be readily seen when wearing the respirator. If you cannot readily see the ESLI, use a mirror to observe the ESLI; rely on a co-worker who can see the ESLI; or go to a clean area, remove the respirator and view the ESLI. Do not rely solely on the organic vapor ESLI unless your employer has determined that it is appropriate for your workplace. See 60011 or 609211 User Instructions for more information, including Special Instructions regarding the ESLI.

Respirator Storage

- Individual storage bags or bins preferred.
- Protect from damage, contamination, dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals.
- Store in airtight bags (Ziplock Bags) away from contaminated environments.
- Prevent deformation of the facepiece and exhalation valve.
- Hanging for a long time may distort the facepieces and cause straps to lose elasticity.
- Dry thoroughly if stored in a plastic sealable bag.



Respirator Replacement

- Follow the change schedule established by the mine operator.
- Replace particulate filter when it's soiled, damaged, or breathing becomes difficult.
- Replace chemical cartridge according to established change schedule or earlier if odor, taste, or irritation is detected.



Do N95 Respirators Expire?

- N95 respirators DO have a shelf life of 5 years (typically) if:
 - Sealed in original package
 - Stored in specific climate conditions
 - Humidity: <80%
 - Storage temperatures: <86°F
- Refer to manufacturer's recommendations





Inspections of PPE Equipment

- **Always before use**
- **Stored SCBA units**
- **Problematic without expiration dates**
 - Workers may never inspect
 - Parts may be failing and not known
 - How long sitting on the shelf?

What we find without Supervisor Oversight



- **Workers only wipe cleaning**
- **Not inspecting**
- **Poor condition of respirators**

Why Shelf Life Matters in our Arid Southwest

Polymers Dry Out



Dirt and Bugs



Recordkeeping



- 1. Respiratory protection program**
- 2. Medical evaluation**
- 3. Hazard assessment**
- 4. Respirator (PPE) assessment and selection**
- 5. Emergency respirator inspection**
- 6. Breathing-air system inspection and maintenance**
- 7. Training**
- 8. Fit testing**
- 9. Program evaluation**

Other Items to Be Considered by Mine Operators

- **Miner Operator Pays:** Any expense related to respiratory protection program.
- The person doing the fit testing does not need to be a healthcare provider; facility staff can learn to conduct fit tests.
- Find an occupational medicine clinic for professional licensed healthcare provider provider for medical evaluation.
- **Do not send miners to their primary care doctor.**
 - Their healthcare insurance will be billed; the mine operator is required by law to cover the cost of this expense.
 - Their doctor may not know or understand the risks of using the respirator.

FREE Respiratory Protection Template

1. Free download
<https://www.dri.edu/miner-training-program/>
2. Must update with mine or contractor information
3. In compliance with MSHA's new requirements
4. Reviewed and approved by MSHA for accuracy

Respiratory Protection Program for [Name of Mine]

The Mine Safety and Health Administration's (MSHA) regulations (e.g., [30 CFR 60.14](#), [56.5005](#), [57.5005](#), and [72.710](#)) require mine operators to implement a written respiratory protection program (RPP) that adheres to the requirements of ASTM F3387-19 *Standard Practice for Respiratory Protection*. This RPP has been specifically developed for [Mine name and location]. The Respirator Program Administrator (RPA) has full authority and responsibility for implementing and maintaining this program.

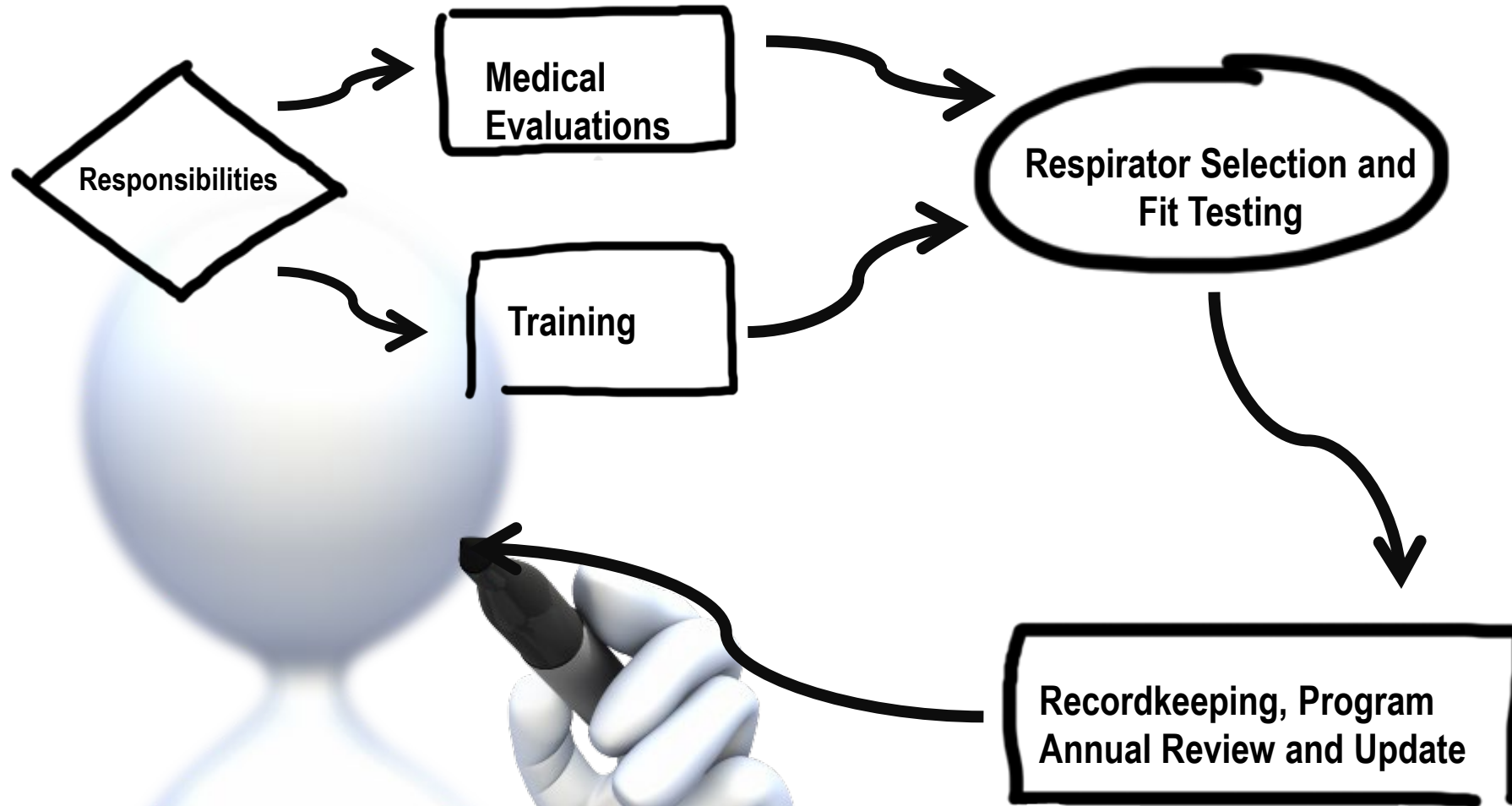
Respirator Program Administrator
Printed Name

Respirator Program Administrator
Signature

Date Created

Date Reviewed





Respiratory Protection Program

Acknowledgements

- Funding by Department of Labor Mine Safety and Health Administration (MSHA) Brookwood-Sago Mine Safety Grant.
- We thank the Nevada Mining Association for assisting in the training implementation.

Disclaimer

- This material was produced under grant number 24R60BS000012-01-01 from the Mine Safety and Health Administration, U.S. Department of Labor. It does not necessarily reflect the views or policies of the U.S. Department of Labor, nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government.
- The use of brand names and/or any mention or listing of specific commercial products or services herein is solely for educational purposes and does not imply endorsement by the trainers, nor discrimination against similar brands, products or services not mentioned.

Help Us by Completing our Training Survey



Follow-up survey (3 months later):

- **How has the training influenced respirator use?**
- **How many people have the trainers trained on this topic?**

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