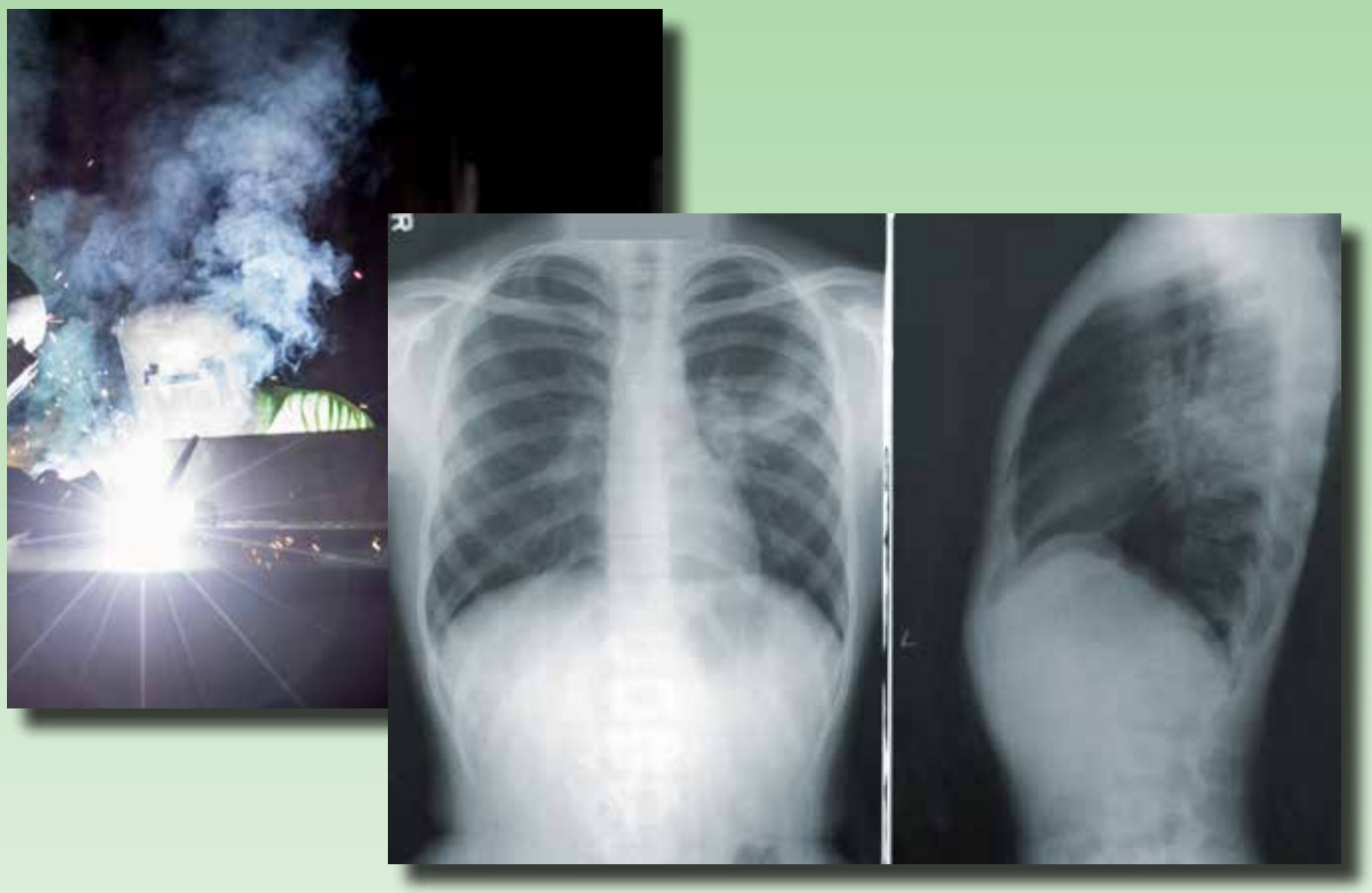
Respiratory Protection in the Workplace

– *A Guide for Employers*



Department of Industrial Relations
Division of Occupational Safety and Health

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STATE OF CALIFORNIA CAL OSHA DEPARTMENT OF INDUSTRIAL RELATIONS

Contents

About This Guide

This guide is not meant to be a substitute for, or a legal interpretation of, the occupational safety and health standards. Please see the California Labor Code and Title 8 of the **California Code of Regulations** for detailed and exact information, specifications, and exceptions.

Section 5144, **Respiratory Protection** is the primary respiratory protection standard that all employers with employees using respirators must effectively comply with. However, note that there are other regulations covering certain airborne, substance-specific hazards that also include additional respirator use requirements, such as:

- **General Industry Safety Orders**
  - **Section 5141**, Control of Harmful Exposures to Employees
  - **Section 5141.1**, Protection from Wildfire Smoke
  - **Section 5150**, Ventilation and Personal Protective Equipment Requirements for Welding, Brazing and Cutting
  - **Section 5151**, Ventilation and Personal Protective Equipment Requirements for Abrasive Blasting Operations
  - **Section 5153**, Ventilation and Personal Protective Equipment Requirements for Spray Coating Operations
  - **Section 5190**, Cotton Dust
  - **Section 5192**, Hazardous Waste Operations and Emergency Response
  - **Section 5197**, Food Flavorings Containing Diacetyl
  - **Section 5198**, Lead
  - **Section 5199**, Aerosol Transmissible Diseases
  - **Section 5199.1**, Aerosol Transmissible Diseases–Zoonotic
  - **Article 110**, Regulated Carcinogens

- **Construction Safety Orders**
  - **Article 4**, Dusts, Fumes, Mists, Vapors, and Gases

T8CCR, section 5194, **Hazard Communication** requires every employer to develop, implement, and maintain at the workplace a written hazard communication program for their employees. This includes gathering information on the hazardous chemicals your employees are exposed to, such as:

- A list of the hazardous chemicals known to be present.
- The Safety Data Sheets that correspond to the listed chemicals, which will be an important source of information when determining when respiratory protection will be required, and what types should be used.

This guide is intended to provide an overview of respiratory protection – not comprehensively address all possible aspects and types of respirators.

When Do Respirators Have To Be Used?

Respirators are protective devices used to reduce workers' harmful exposures to airborne hazards, including oxygen-deficient atmospheres.

What is a Harmful Exposure?

Airborne harmful exposures to your employees can be in the form of:

- Dusts, fumes, mists, smoke, vapors or gases that are:
  - In excess of any permissible limit prescribed by T8CCR, section 5155.
  - Of such a nature by inhalation as to result in, or have a probability to result in, injury, illness, disease, impairment or loss of function.
- Oxygen-deficient atmospheres that occur when there is less than 19.5% oxygen present.

How to Identify Harmful Exposures

There can be a number of things to consider when trying to accurately determine what your employees' airborne hazardous contaminant exposures are. The following is a brief overview.

Factors in Assessing Respiratory Hazards

- Identify the respiratory hazards your employees are exposed to and determine what the corresponding Cal/OSHA allowable exposure levels are. A good place to start is the Safety Data Sheet (SDS) for each of the materials your employees work with.

Some important points to take from section 5155, Airborne Contaminants

- These are assigned concentration limits to airborne contaminants that **nearly all** workers may be exposed to daily during a 40-hour workweek for a working lifetime without adverse effect. Also, because of some variation in **individual susceptibility**, an occasional worker may suffer discomfort, aggravation of a preexisting condition or occupational disease upon exposure to concentrations even below the assigned exposure levels.
- Harmful exposure to any substance not listed must be controlled in accordance with T8CCR, **section 5141**, which may include use of respiratory protection.
- Some of the listed chemicals have an "S" (skin) notation, which means they can be absorbed into the bloodstream through the skin, the mucous membranes, or the eye. They can contribute to the overall exposure and may require other forms of protection besides respiratory.
- There are three types of exposure limits (some of the listed chemicals can have more than one type of assigned exposure limit):
  1. C (ceiling): maximum concentration of an airborne contaminant that an employee may be exposed to at any time.
  2. PEL (permissible exposure level): The maximum permitted 8-hour time-weighted average concentration of an airborne contaminant.
  3. STEL (short term exposure level): A 15-minute (or sometimes other than 15 minutes, as indicated) time-weighted average exposure which is not to be exceeded at any time during a workday, even if the 8-hour time-weighted average is below the PEL.

- There may be instances where there are no assigned Cal/OSHA exposure limits, in which case there may be other occupational exposure limits, such as NIOSH RELs (recommended exposure levels) and ACGIH TLVs (threshold limit values), or other toxicological or industrial hygiene publications that can be used.
- Determine the state and the physical form of the chemicals. For instance, are they solids, liquids, gases, or a mixture of these forms? What are the particle sizes (where applicable)? Do the liquids and solids give off vapors or do they form dusts or mists? Does an oxygen-deficient atmosphere exist in your workplace? Are any combination of these hazards present?
- Evaluate the extent of the hazards posed by the chemicals that may be present. For instance, are employees working in conditions that exceed or fall below acceptable exposure limits? How many employees are exposed?
- The person supervising, directing or evaluating the monitoring and exposure control methods must be competent in industrial hygiene practices.
- Determine if there are routes of exposure other than the lungs, such as the skin, that are of concern.
- Address additive effects where there are mixtures of chemicals as some of them may affect the same target organ. In this circumstance, additive exposure levels need to be determined as described in the Appendix to section 5155.

Reference section 5155(e), **Workplace Monitoring**.

Methods for Assessing Employees' Exposures

Air Monitoring is used to assess the concentration of air contaminants that your employees may be breathing. Measurements can be made by using instruments that directly measure exposure levels or collect air samples that require lab analysis. Measuring your workers' exposures to respiratory hazards can be complex. It involves knowing how to use and calibrate sampling equipment. It also involves understanding the effects of numerous workplace environmental factors, such as ambient temperatures and humidity, process temperatures, general facility conditions (e.g., general and local ventilation) and chemical interferences and interactions.

The following are some questions that need to be answered when assessing the concentration of air contaminants:

- What are the exposure levels under normal conditions of use?
- Are short-term peak and full-shift average exposures—where applicable—being assessed?
- Are the respirable dust fractions being determined for substances that have respirable dust PELs?
- What are the exposure levels in a reasonably foreseeable emergency?
- When are you going to perform air monitoring and for how long?
- Are exposures constant throughout a shift, or are there processes that create high concentrations for short periods?
- Will you monitor all employees or a representative number of exposed employees?
- Did you assume worst-case conditions to evaluate the highest foreseeable employee exposure levels?
- How much air monitoring is needed to make a reliable evaluation?
- Are the employees' exposure assessments taking into consideration Ceiling, STEL and PEL exposure limits, where applicable? Employees may not be overexposed to the PEL, but they might be at the Ceiling or STEL.

"**Respirable dust fraction."** With some airborne substances, the smaller particles that can be inhaled into the deeper parts of the lungs—"respirable"—can be significantly more hazardous. Reference **section 5155, Table AC-1 Footnote "n"** for the definition of what a respirable dust fraction is.

Breathing zone air monitoring is the best and most reliable method for assessing employees' exposures to air contaminants. Typically, an employee wears a personal air pump that draws air through sampling media in the breathing zone of the employee. The breathing zone is the area around the employee's head and shoulders where the contaminants collected represent what the worker is inhaling.

In some instances, it may also be useful to collect **area air samples** at fixed locations in and around the work area. This method of air monitoring is used more for: screening; establishing boundaries of high exposure areas; evaluating the effectiveness of control measures; supplementing breathing zone air monitoring and obtaining background airborne concentrations.

Objective Data is specific and reliable information that indicates whether the use or handling of a product or material will release concentrations of a respiratory hazard that exceed a level that would trigger the need for respirator use. For example, you can use data:

- On the physical and chemical properties of air contaminants in combination with information on room dimensions, air exchange rates and contaminant release rates to estimate the maximum exposure that could be anticipated in the workplace.
- Obtained from other exposure assessments done on similar work operations involving the same contaminants under similar conditions.

You may need outside help with all this. Expert assistance is available from safety and health professionals employed by:

- Workers' compensation insurance carriers
- Cal/OSHA Consultation Service
- Private consulting firms
- Respirator product vendors
- Industry associations

Safety and health professionals can also help you determine: how to reduce employees' exposures so they don't have to wear respirators; what kind of respirator and filters should be used and how to fit test the respirators.

The information you collect on what your employees are exposed to, and how much, will be important when it comes to selecting the right respirator and determining how often cartridges need to be changed out. Keep in mind that this information also becomes subject to section 3204, **Access to Employee Exposure and Medical Records**.

How to Control Harmful Exposures

Ideally, substitute with less toxic materials. If that is not an option, then you must reduce those exposures by one, or a combination, of the following control measures:

1. Engineering control measures, such as enclosing or isolating the process, or using dilution or local exhaust ventilation, whenever feasible.
2. Applicable administrative controls, such as limiting exposure by adjustment of the work schedule and using work practice controls (e.g. prohibiting use of dry sweeping or compressed air to clean off surfaces and wetting dusty materials before they are disturbed), when engineering controls are not feasible or do not achieve sufficient hazard reduction.
3. Using appropriate respirators as a last resort:
   - When the controls listed above are not feasible.

- While the controls are being instituted.
- When the controls are not sufficient to reduce respiratory hazards to a level below established exposure limits.
- During reasonably foreseeable emergencies.

Refer to T8CCR sections 5141, **Control of Harmful Exposure to Employees**, and 5144(a)(1) **Respiratory Protection** for details.

Also refer to the substance-specific regulations in articles **109** and **110** of the General Industry Safety Orders, and **article 4** of the Construction Safety Orders for additional requirements, such as:

- Selection of the proper type of respirators to be used for particular hazardous substances (including filtering facepiece respirators).
- Limitations on using administrative controls.

Voluntary Use of Respirators

Voluntary use of a respirator is allowed when all of the following conditions have been met:

1. An employee requests a respirator even though the use of one is not required by you (the employer).
2. A Cal/OSHA standard does not require one and you have determined that its use is not necessary to protect the health of the employee.
3. It will not in itself create a hazard.

When used voluntarily, only the following written respiratory protection program elements must be met:

1. Employee medical evaluation and approval to wear a respirator.
2. Procedures for cleaning, storing and maintaining respirators.
3. Training – provide employees with the information contained in **Appendix D** of T8CCR section 5144, Information for Employees Using Respirators When Not Required Under the Standard. Employees must understand the limitations of the respirators and how to use and maintain them.

Filtering facepiece respirators (disposable "dust masks"). When it comes to voluntary use of these types of respirators:

- A written respiratory protection program is not required.
- Employers must still provide employees with the information in section 5144, Appendix D, Information for Employees Using Respirators When Not Required Under the Standard.

Refer to **Types of Respirators (page 9)**, below, for more information on what is considered a filtering facepiece respirator.

Wildfires

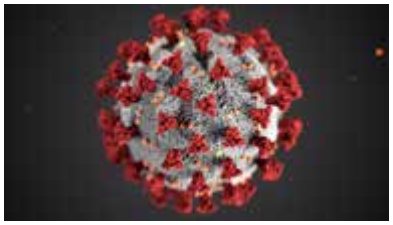
Employers should reasonably anticipate that employees may be exposed to wildfire smoke. Smoke from wildfires contains chemicals, gases and fine particles that can harm health. T8CCR, **section 5141.1** establishes required safety and health protection measures for employees—including the use of respirator protection—when the current Air Quality Index (AQI) for PM2.5 is 151 or greater.

Employers are required to provide employees with NIOSH-approved respiratory protection in accordance with T8CCR, section 5144 as follows for:

- **Voluntary** use when the current AQI for PM2.5 (solid particles and liquid droplets suspended in air, known as particulate matter, with an aerodynamic diameter of 2.5 micrometers or smaller) is 151 or greater but less than 500. Employees must be trained on the information in **Appendix B** of T8CCR, section 5141.1.

- **Mandatory** use when the current AQI for PM2.5 exceeds 500.

Aerosol Transmissible Diseases



- T8CCR, **section 5199** establishes employee protection requirements that address occupational exposure to aerosol transmissible diseases (ATD).

  ATDs are defined as diseases for which droplet or airborne precautions are required, as listed in **Appendix A** of section 5199. These diseases can be transmitted by infectious particles or droplets through inhalation or direct contact with the mucous membranes of the eyes or respiratory tract. The disease-causing aerosols covered by this regulation are pathogens, such as bacteria and viruses.

- T8CCR, **section 5199.1** establishes employee protection requirements that address occupational exposure to zoonotic ATDs.

Sections 5199 and 5199.1 can require use of respiratory protection and are applicable to specific types of workplaces and conditions, so be sure to review the scope and application of these two standards to see if and how they affect your employees.

Immediately Dangerous to Life or Health (IDLH) Environments

Paragraphs (d) and (g) of section 5144 establish protection requirements for employees that must work in an IDLH condition – an atmosphere that: poses an immediate threat to life; would cause irreversible adverse health effects or would impair an individual's ability to escape from a dangerous atmosphere. The control measures include the use of specific types of atmosphere-supplying respirators or respirators certified by NIOSH for escape.

Confined spaces

If the IDLH environment is within a confined space, then other Cal/OSHA T8CCR regulations can come into play, such as:

- Construction: **article 37**
- General Industry: **section 5157**
- Grain handling facilities: **section 5178**
- Telecommunication vaults: **section 8616**
- Ship building, repairing, breaking: **section 8355**
- Electrical utility operations within underground vaults: **sections 2700, 2943 and 2943.1**

Section 5158 confined space requirements apply to:

- Construction activities defined in **section 1502**
- Agricultural operations defined in **section 3437**
- Marine terminal operations defined in **section 3460**
- Telecommunication manholes and unvented vaults regulated by **section 8616**
- Grain handling facilities regulated by **section 5178**
- Natural gas utility operations within distribution and transmission facility vaults defined in Title 49 Code of Federal Regulations Parts 191, 192 and 193

Also refer to Section 5192(q), **Emergency Response to Hazardous Substance Releases**, should it be applicable to your workplace.

Types of Respirators

This guide provides a brief overview. Please review the following for more detailed information:

- **OSHA**
- **NIOSH**

There are a variety of different types of respirators that are typically categorized as either air-purifying or atmosphere-supplying, with some being further sub-categorized as:

- Positive or negative-pressure
- Tight or loose-fitting
- Continuous-supply, demand or pressure-demand
- Half or full-face

What is important is to make sure the appropriate one is being used given the:

- Type and concentration of airborne contaminants in question.
- Comfort of the user. The more uncomfortable it is, the less likely it will be used, or used properly. Be sure to also consider heat-stress issues associated with the type of respirator selected for use.

Air-purifying Respirators (APR)

APRs work by removing gas, vapor and particulate contaminants from the air through the use of filters, cartridges or canisters. There is no one filter or cartridge/canister that removes all contaminants, so it is important to use the right one for the air contaminants of concern.

For example: in an organic solvent-based paint spray operation you would probably need a combination of a particulate/aerosol pre-filter and an organic vapor cartridge.

All filters/cartridges have a NIOSH approval label and are color-coded.

Examples of air-purifying respirators include:

- Disposable filtering facepiece respirators (dust masks) used for airborne particulates.

- Tight-fitting elastomeric respirators with half or full-face masks that have disposable filters/cartridges/canisters.
- Powered air-purifying respirators (PAPRs) that have a loose-fitting hood, helmet or tight-fitting facepiece. A battery-powered fan pulls air through filters, cartridges or canisters instead of the lungs having to do the work.

There are nine classes of **particulate filters,** consisting of three levels of filter efficiency, each with three categories of resistance to filter efficiency degradation.

The three levels of filter efficiency are 95%, 99%, and 99.97% (referred to as “100”).

The three categories of resistance to filter efficiency degradation are labeled N, R, and P.

N = not resistant to oil
R = somewhat resistant to oil
P = strongly resistant to oil

The class of filter will be clearly marked on the filter, filter package or respirator box. For example, a filter marked N95 would mean an N-series filter that is at least 95% efficient.

Chemical cartridges that include particulate filter elements will carry a similar marking that pertains only to the particulate filter element.

Filtering facepiece respirator (dust mask) means a negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium. Those that are NIOSH-approved will have two head straps and be identified with the N, R or P and a 95, 99 or 100 designation. Some models have an exhalation valve.

Atmosphere-Supplying

Atmosphere-supplying respirators work by using breathing air that meets specified quality standards and consist of a loose-fitting hood, helmet or a tight-fitting half or full-facepiece. The breathing air is supplied by a compressor or compressed air cylinders.

Examples of atmosphere-supplying respirators include:

- Airline respirators where the breathing air is supplied through an airline from a source outside the contaminated work area, and typically consist of a loose-fitting hood, helmet or tight-fitting facepiece.

- Self-contained breathing apparatus (SCBA) that allow the user to carry a compressed breathing air cylinder with them, and always used with a tight-fitting facepiece.

- Combination respirators that use an airline to an outside source, along with an auxiliary SCBA that can be used to escape from a hazardous environment should the airline fail, and always a tight-fitting facepiece.
- Escape-only respirators that are intended for use only during an emergency exit. Escape-only respirators cannot be used to enter an area that has a hazardous atmosphere.

Atmosphere-supplying respirators can also be categorized as continuous-flow, demand, or pressure-demand.

Continuous-flow means air is supplied to the users (typically via an airline) at set air pressures and flow rates, regardless of whether they "demand" it – i.e., they don't have to inhale to activate a regulator to trigger in-flow of air. This type of respirator is typically under positive pressure and often does not rely on a tight-fitting facepiece-to-face seal.

The **pressure-demand** feature provides the highest protection factor and admits breathing air to the facepiece when the positive pressure inside the facepiece is reduced by inhalation – i.e., the user "demands" it. A positive pressure is maintained at all times so if there is any leakage, it will be to the outside of the facepiece, not in.

There are also **demand** supplied-air respirators that are similar to pressure-demand, except they are not designed to maintain a positive pressure within the face mask at all times – i.e., the user must inhale, creating a negative pressure within the mask, before the regulator activates and provides air.

Certain types of atmosphere-supplying respirators are mandated for use in IDLH atmospheres, such as:

- A full facepiece pressure-demand SCBA.
- A combination full facepiece pressure-demand airline respirator with an auxiliary SCBA.

Other types of atmosphere-supplying respirators must be used in situations such as:

- In atmospheres for which there are no approved air-purifying filters.
- During certain welding, brazing, or cutting operations that involve toxic metals. Reference T8CCR, **section 5150**.
- During procedures that involve higher concentrations of airborne contaminants, including abrasive blasting, where a higher protection factor is warranted.
- Emergency escape from a hazardous environment (e.g., escape-only respirators).

Reference **Breathing Air Quality and Supply - Airline Systems (page 21)** for additional guidance on some of the various issues that must be addressed in order to ensure a safe airline respirator system.

Negative and Positive-pressure Respirators

Air-purifying and atmosphere-supplying respirators may also be classified on the basis of their functioning as either negative or positive-pressure respirators.

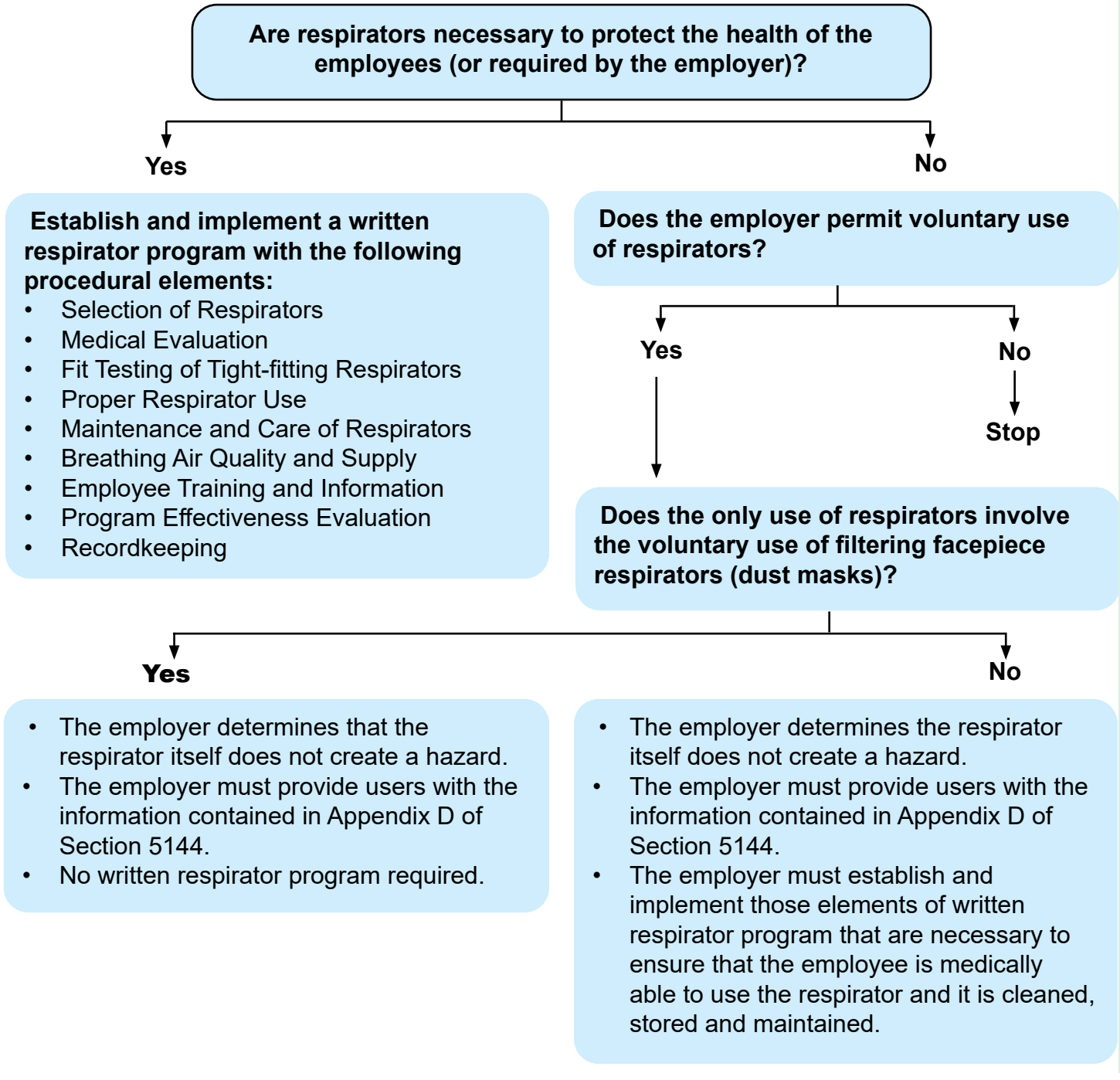
Negative-pressure respirators are tight-fitting respirators that work by creating pressure differences between the air inside and outside the respirator. With APRs, when the user breathes in, the pressure inside the facepiece becomes negative, which pulls air into the facepiece through filters/cartridges. Examples typically include filtering facepiece respirators (“dust masks”) as well as elastomeric half and full-facepiece respirators. With air-supply respirators, the creation of a negative pressure when the user breathes in activates a regulator that supplies air. Proper fit testing becomes important given any leakage that may occur between the face and facepiece.

Positive-pressure respirators are designed to maintain a positive pressure within the facepiece even when the user inhales. Examples include loose-fitting powered air purifying respirators (PAPR), pressure-demand self-contained breathing apparatus (SCBA) with a tight-fitting facepiece, and continuous-flow, loose or tight-fitting airline respirators.

Written Respiratory Protection Program

Invest the time to have in-house knowledge about respirators and how they should be used in your workplace. The person you designate to run your respirator program will be the Respiratory Protection Program Administrator, and they will have specific duties and responsibilities that are detailed in T8CCR, section 5144, **Respiratory Protection**. Make sure they have the training and necessary knowledge to carry this out.

Establish, in writing, how all of the required elements and site-specific procedures will be effectively implemented in your workplace, as summarized in the following flow chart:



Be sure the manufacturers' instructions are always available to the users, since that will be a critical source of information when ensuring respirators are properly used and maintained. Consider incorporating the manufacturers' instructions for all of the respirators your employees use into your written respiratory protection program.

The Fed OSHA **Small Entity Compliance Guide for the Respiratory Protection Standard** has checklists for each of the required respirator program elements that you may find helpful.

Selection of Respirators

Once you know what your employees are exposed to, how much of an exposure there is, and the conditions in which respirators must be used, you are now ready to start selecting which respirators employees will be using. The following are some important considerations when developing your written respirator program selection procedures:

NIOSH certification

Only select a NIOSH-certified respirator and only use it in compliance with the conditions of its certification. Those conditions will include the specific contaminants in question, the maximum exposure concentrations allowed, as well as the acceptable respirator components.

Look for the NIOSH approval label, which includes:

- The approval number
- Protection level
- Component with part number
- Caution and limitation statements in the form of a table or matrix of information

The NIOSH **Approval Label Fact Sheet** provides additional information.

Some filtering facepiece respirators are NIOSH-certified while others are not. Refer to the **NIOSH Respirator Trusted-Source Information Web page** to help you make sure you only use NIOSH-certified filtering facepiece respirators.

Respirator cartridge change out

A cartridge change-out schedule will be necessary for air purifying respirators used for protection against gases and vapors if an end-of-service-life indicator (ESLI) is not available. An atmosphere-supplying respirator may be more practical if the change-out schedule is short. Refer to **Proper Respirator Use (page 17)** for more information on ESLI and change-out schedules.

Assigned protection factors (APF) and maximum use concentration (MUC)

Will the type of respirator you are considering provide sufficient protection given the expected exposure levels?

The **APF** means the workplace level of respiratory protection that a respirator is expected to provide to employees when the employer implements a continuing, effective respiratory protection program. For example, a respirator with an APF of 10 means that it is expected to reduce the user's exposure to the specific airborne contaminant of concern by a factor of 10, assuming that the user has passed a fit test to that model respirator and is wearing it properly.

The **MUC** means the maximum atmospheric concentration of a hazardous substance from which an employee can be expected to be protected when wearing a respirator, and is determined by the assigned protection factor of the

respirator and the exposure limit of the hazardous substance. For example, if the PEL for a contaminant is 50 PPM (parts per million) and the respirator has an APF of 10, then the MUC is 10 x 50 = 500 PPM.

Respirator selection example. Let's assume:

- Your employees are working with a solvent that has a PEL of 35 PPM averaged over an 8-hour period, as well as a STEL of 70 PPM averaged over a 15-minute period.
- You have determined that employees' 8-hour average exposures range from 225 to 335 PPM, depending on the work employees are engaged in.
- It was also determined that there are certain steps in the work process where some employees can experience exposures ranging from 550 to 850 PPM for short periods of time.
- The respirator being considered has an APF of 10.

Is this respirator adequate?

The 8-hour average exposure tops out at 335 PPM, which is less than the MUC of 350 PPM (PELx10) – so yes, it is adequate relative to the PEL. But...the short-term exposures top out at 850 PPM and the corresponding MUC is 700 PPM (STELx10), which means a respirator with a higher protection factor will be needed.

Note that each of the airborne contaminant sampling methods have assigned sampling and analytical errors (SAE). Be sure to keep this in mind when determining if your employees' exposures exceed an assigned PEL, STEL, or Ceiling. For instance, in the example above, the 8-hour exposures were determined to top out at 335 PPM, which is only 15 PPM less than the MUC of 350 PPM. Assuming the method used to determine employee exposures has an SAE of 12%, then the actual employee exposures are plus or minus 12% of 335 PPM, which means actual employee exposure is somewhere between 295 PPM and 375 PPM. You may want to consider selecting a respirator with an APF higher than 10 for that reason.

Reference Table 1 of T8CCR, section 5144(d)(3) for a listing of the APFs corresponding to the different types of respirators.

Full-face air-purifying respirators (non-PAPR) have an APF of 50, but that APF is only applicable if a passing quantitative fit test is performed. An APF of 10 must be used instead if the user undergoes a passing qualitative fit test. See **Fit testing of Tight-fitting Respirators (page 15)** for more information.

Comfort, visibility, and communication

- Certain models or types of respirators (e.g., half-face vs. full-face) may be more uncomfortable to wear or cumbersome to use than others.
- Respirators must not create a hazard by impairing the worker's vision, hearing, or communication. Some models or types of respirators impair visibility more than others, and some allow for better verbal communication. Certain PAPRs and atmosphere-supplying respirators can introduce air noise that may make it more difficult for the user to hear.

Heat and physical stress

- The physical stress of wearing a respirator may aggravate underlying acute or chronic diseases, particularly diseases related to the heart and lungs.
- Use of atmosphere-supplying respirators in lieu of air-purifying respirators can

result in less heat load, and in some cases the cooling of the air being supplied to the user.

Comfort, visibility, communication, heat and physical stress are some of the reasons section 5144(d)(1)(D) requires employers to select respirators from a sufficient number of respirator models and sizes so that the respirator is acceptable to and correctly fits the user.

PAPRs

- If the physician or other licensed health care professional (PLHCP) conducting the employee's medical evaluation finds a medical condition that may place the employee's health at increased risk if a negative pressure respirator is used, the employer must provide a PAPR if the PLHCP's medical evaluation finds that the employee can use such a respirator.
- Several of the substance-specific standards—such as asbestos (sections 1529 or 5208), cadmium (section 1532 or 5207), and lead (section 1532.1 or 5198)—require the provision of PAPRs over regular APRs if an employee prefers to use a PAPR and it will provide sufficient protection.

Other Cal/OSHA hazardous substance-specific regulations that can influence your respirator selection:

- Section 5150, **Ventilation and Personal Protective Equipment Requirements for Welding, Brazing and Cutting**
- Section 5152, **Ventilation and Personal Protective Equipment Requirements for Grinding, Polishing, and Buffing Operations**
- Section 5197, **Occupational Exposure to Food Flavorings Containing Diacetyl**
- Section 5198, **Lead**
- Some of the hazardous substances listed in article 110, **Regulated Carcinogens**
- Some of the hazardous substances listed in article 4, **Dusts, Fumes, Mists, Vapors, and Gases**

The manufacturer of the respirator you are considering should be able to assist you with proper selection. Be sure to also always refer to the respirator instructions provided by the manufacturer. Other resources for proper respirator selection are:

- NIOSH **Guide to the Selection and Use of Particulate Respirators**
- NIOSH **Respirator Selection Logic**

Medical Evaluations

Using a respirator may place a physiological burden on employees that varies with the:

- Type of respirator worn (certain types of respirators impose a greater physiological burden than others).
- Job and workplace conditions in which the respirator is used (e.g., heat load, level of physical activity).
- Medical status of the employee (e.g., preexisting lung or heart disorders, claustrophobia).

This is why all employees required to use respirators must be medically evaluated to make sure they are able to wear them.

Medical approval is also required for employees voluntarily using reusable elastomeric respirators. Voluntary use of filtering facepiece respirators is the only time medical approval is not required.

What needs to be done when setting up respirator medical evaluations for your employees:

- Identify a physician or other licensed health

care professional (PLHCP) to perform the medical evaluations.
- Ensure that a medical questionnaire, or an initial medical examination that obtains the same information as required by section 5144, **Appendix C - Part A, sections 1 and 2**, is used. The questions in Part B, or other questions not listed, can be included at the discretion of the PLHCP who will review the questionnaire.
- Ensure that the medical evaluations are administered confidentially during the employee's normal working hours or at a time and a place convenient to the employee.
- Ensure medical evaluations are performed before the employee is fit tested or required to use the respirator in the workplace for the first time.
- Provide the employee with an opportunity to discuss the questionnaire and the evaluation results with the PLHCP.
- Obtain a written recommendation from the PLHCP regarding an employee's ability to use a respirator that is limited to the following information:
  - Any limitations on respirator use related to the medical condition of the employee or related to the workplace conditions in which the respirator will be used and whether the employee is medically able to use the respirator.
  - The need, if any, for follow-up medical evaluations.
  - A statement that the PLHCP has provided the employee with a copy of the PLHCP's written recommendation.

You must provide your employees with instructions on delivering or sending the completed questionnaire directly to the PLHCP who will review it in order to ensure that employees' medical evaluations remain confidential.

Information that must be given to the PLHCP includes:

- The type and weight of the respirator.
- The duration and frequency of the respirator's use (including its use for rescue and escape).
- The expected physical work effort.
- The additional protective clothing and equipment to be worn.
- The temperature and humidity extremes that may be encountered.
- A copy of the written respiratory protection program.
- A copy of T8CCR, section 5144.

Additional medical evaluations are required when:

- An employee reports medical signs or symptoms that are related to their ability to use a respirator.
- A PLHCP, supervisor, or the respirator program administrator indicates an employee needs to be reevaluated.
- Information from the respiratory protection program, including observations made during fit testing and program evaluation, indicates a need for employee reevaluation.
- A change occurs in workplace conditions (e.g., physical work effort, protective clothing, temperature) that may result in a substantial increase in the physiological burden placed on an employee.

Fit Testing of Tight-fitting Respirators

Why do tight-fitting respirators have to be fit tested?

Faces come in a wide variety of shapes and sizes. When it comes to tight-fitting respirators, this means a particular respirator make, model and size may fit one person, but not another. Any leakage between the user's face and respirator facepiece seal means the user may not be properly protected.

The purpose of fit testing is to identify the specific make, model, style and size of the tight-fitting respirator that is best suited for each employee. In addition, fit testing provides an opportunity to check for

problems with respirator use and reinforces respirator training by giving employees an opportunity to review the proper methods for putting on and wearing the respirator.

The following are some issues you need to consider when developing your fit testing procedures

Fit testing is required:

- Before the initial use of a respirator in the workplace.
- Whenever a different respirator facepiece is used.
- At least annually.
- Whenever the employee reports changes or whenever the employer, respirator program administrator or PLHCP observes changes in the employee's physical condition that could affect respirator fit (e.g., facial scarring, dental changes, cosmetic surgery or an obvious change in body weight).

  - The employee must be given a reasonable opportunity to select a different respirator facepiece and to be retested, if the employee subsequently indicates that the fit of the respirator is unacceptable.
  - Employees cannot have facial hair that interferes with the face-to-facepiece seal during the fit testing procedures, or at any time they are required to wear respirators.

How are respirators fit tested?

Employees using a negative or a positive-pressure, tight-fitting facepiece respirator must be provided with either a qualitative or a quantitative fit test administered using one of the protocols detailed in section 5144, **Appendix A, Fit Testing Procedures**.

Qualitative fit test (QLFT) is a subjective pass/fail test that is used to assess the adequacy of a respirator's fit by relying on a person's response to a test agent that they can taste, smell or perceive due to lung/nasal irritation.

Tight-fitting, negative pressure APRs. Whether half or full-face, the maximum APF that can be applied is 10 when a **qualitative** fit test is performed. A passing **quantitative** fit test would have to be achieved for a full-face respirator in order to apply an APF of 50, or greater.

Quantitative fit test (QNFT) is more objective and assesses the adequacy of a respirator's fit by measuring the amount of leakage into the respirator. The result produced by a QNFT is expressed as a fit factor, which is a quantitative estimate of the fit of a particular respirator to a specific individual.

Minimum passing average fit factor

- 100 for half-face tight-fitting, negative pressure respirators.
- 500 for full-face tight-fitting respirators.

Reference **Table 1** of section 5144 for a breakdown of the different types of respirators and their APF.

Tight-fitting atmosphere-supplying and powered air-purifying respirators.

Fit testing is accomplished by performing QNFT or QLFT only in the negative pressure mode – regardless of the mode of operation (positive or negative-pressure) actually used in the workplace. This can be done in a couple of ways:

1. **QLFT:** Temporarily convert the respirator user's actual facepiece into a negative pressure respirator with appropriate filters, or by using an

identical negative-pressure air-purifying respirator facepiece with the same sealing surfaces as a surrogate for the atmosphere-supplying or powered air-purifying respirator facepiece.

2. **QNFT:** Modify the facepiece to allow sampling inside the facepiece, midway between the nose and mouth. This must be accomplished by installing a permanent sampling probe onto a surrogate facepiece, or by using a sampling adapter designed to temporarily provide a means of sampling air from inside the facepiece.

Prescription eyeglasses and personal protective equipment, such as ear muffs, safety glasses or face shields, can interfere with the fit and function of a respirator (and vice versa), so be sure to have employees wear the eyeglasses and personal protective equipment they'll be using along with the respirator being fit tested.

Proper Respirator Use

You need to be aware of, and develop procedures designed to prevent situations that can compromise the effective use of respirators and jeopardize workers' protection, such as:

- The person wearing the respirator fails to properly perform seal checks.
- The person wearing the respirator is also using personal protective equipment, prescription eyeglasses or other equipment that interferes with the face-to-facepiece seal.
- The respirator is not properly repaired, and its defective parts are not replaced.
- Modifications are made to the respirator, or non-approved replacement parts are used.
- Filters/cartridges are not being changed out as required.
- The person has facial hair or there are other conditions that interfere with the face-to-facepiece seal or valve function.

Positive and negative-pressure seal checks

Employees must perform a positive-pressure and/or a negative-pressure seal check each time they put on a tight-fitting respirator by using either one of the following:

- The procedures provided in T8 CCR, Section 5144, Appendix B-1, **User Seal Check Procedures**.
- The manufacturer's procedures that the employer demonstrates are as effective.

End-of-life service indicators (ESLI) and cartridge/canister change-out schedules

The service life of a cartridge/canister depends on many factors, including environmental conditions (e.g., high humidity), breathing rate, cartridge capacity, the amount of contaminant in the air and how many hours the cartridge is used each day. Not changing out cartridges/canisters as needed can mean employees may be over-exposed to the contaminants of concern. You cannot always rely upon your senses to detect cartridge/canister saturation and breakthrough.

ESLI: Some cartridges and canisters are equipped with an ESLI that warns the user of the end of adequate respiratory protection. The indicator is usually a sorbent material that changes color when the cartridge/canister approaches saturation or is no longer effective. However, few cartridges/canisters are currently equipped with an ESLI.

Cartridge change-out schedules: Most employers will have to develop a cartridge or canister change schedule or provide employees with atmosphere-supplying respirators. A change schedule is the part of your respiratory protection program that

determines how often cartridges/canisters must be replaced, and which information was relied on to make this determination.

You must base your change schedule on:

- The results of exposure assessments relevant to your specific workplace.
- The respirator manufacturer's cartridge capacity data, or other reliable data.
- The workplace environmental conditions (e.g., temperature, humidity).

How to create a cartridge/canister change-out schedule:

- Use a math model, such as what's provided on the **Fed OSHA Respirator Etool** or the **NIOSH MultiVapor Application**.
- Use the manufacturer's recommendations. Most of the respirator manufacturers have produced their own mathematical models that can be used for their own respirators.

Be sure to take notice of the instructions and limitations for each of the models. You should use a conservative estimate when establishing the change schedule.

For particulate filters, it's important employees understand that they need to change out filters when they start to notice increased difficulty breathing through the filters.

Other Cal/OSHA hazard-specific regulations that can influence your change-out schedules

- Some of the hazardous substances listed in article 110, **Regulated Carcinogens**.
- Some of the hazardous substances listed in article 4, **Dusts, Fumes, Mists, Vapors, and Gases**.

PAPRs

The battery of a PAPR is a critically important component. Be sure to follow the manufacturer's instructions on proper use, care, maintenance, and charging.

Identification of filters, cartridges, and canisters

Ensure that:

- All filters, cartridges and canisters used in the workplace are labeled and color-coded with the NIOSH approval label.
- The label is not removed and remains legible.

Continuing respirator effectiveness

- Appropriate surveillance must be maintained of work area conditions and degree of employee exposure or stress. You need to reevaluate the continued effectiveness of the respirator program (refer to **Program Effectiveness Evaluation (page 22)** for additional guidance) when there is a change in work area conditions or degree of employee exposure or stress that may affect respirator effectiveness.
- Ensure that employees leave the respirator use area:
  - To wash their faces and respirator facepieces as necessary to prevent eye or skin irritation associated with respirator use.
  - If they detect vapor or gas breakthrough, changes in breathing resistance or leakage of the facepiece.
  - To replace the respirator or the filter, cartridge or canister elements.
- Replace or repair the respirator before allowing an employee to return to the work area if the employee detects vapor or gas breakthrough, changes in breathing resistance or leakage of the facepiece.

Also look at:

- Section 5144 (d) and (g) for more detail on using respirators in routine or reasonably foreseeable emergency situations, interior structural firefighting and IDLH atmospheres.
- Section 5192(q) **Emergency Response to Hazardous Substance Releases** where employees are engaged in emergency response.

Maintenance and Care of Respirators

You are required to provide each respirator user with a respirator that is clean, sanitary and in good working order. This involves establishing procedures and schedules for the cleaning and disinfecting, storage, inspection and repair of respirators. At a minimum, the maintenance program must include policies and procedures on:

- **Cleaning and disinfecting**. Ensure that either of the following are implemented:
  - The procedures for cleaning and disinfecting respirators described in section 5144, **Appendix B-2, Respirator Cleaning Procedures**.
  - The procedures recommended by the respirator manufacturer, provided that such procedures are of equivalent effectiveness.

    Clean and disinfect respirators at the following intervals:

    - Exclusive-use respirators–as often as necessary to maintain a sanitary condition.
    - Shared respirators–before being worn by different persons.
    - Emergency-use respirators–after each use.
    - Respirators used in fit testing and training–after each use.

- **Proper storage**. Respirators must be protected from:
  - Damage and deformation
  - Contamination
  - Dust
  - Sunlight
  - Extreme temperatures
  - Excessive moisture
  - Damaging chemicals

Emergency respirator storage:

- Needs to be readily accessible to the work area.
- Have clearly marked compartments or covers.
- Follow the manufacturer's recommendations.

- **Inspections:**
  - Be sure to include checks for:
    - Respirator function
    - Tightness of connections
    - Condition of parts, including:
      - The facepiece
      - Head straps
      - Valves
      - Connecting tubes
    - Pliability of elastomeric parts and signs of deterioration.
    - Cartridges, canisters or filters.
  - Respirators that are found to be defective must be removed from service and discarded or repaired.
  - SCBAs:
    - Air and oxygen cylinders maintained in a fully charged state, and recharged when pressure falls to 90% of the manufacturer's recommended pressure level.
    - Proper function of the regulator and warning devices.
  - Emergency use respirators:
    - Certify the respirator by documenting the date the inspection was performed, the name (or signature) of the person who made the inspection, the findings, required remedial action

and a serial number or other means of identifying the inspected respirator.
    - Provide this information on a tag or label that is attached to the storage compartment for the respirator, is kept with the respirator or is included in inspection reports stored as paper or electronic files. This information must be maintained until replaced following a subsequent certification.

  Inspect respirators at the following intervals:

    - All respirators used in routine situations - before each use and during cleaning.
    - Emergency use respirators - at least monthly, in accordance with the manufacturer's recommendations, and before and after each use.
    - Emergency escape-only respirators - before being carried into the workplace for use.
    - SCBA - monthly.

- **Repairs:**
    - Only done by persons appropriately trained to perform such operations, and only using the respirator manufacturer's NIOSH-approved parts designed for the respirator.
    - Only according to the manufacturer's recommendations and specifications.
    - Reducing and admission valves, regulators and alarms are only adjusted or repaired by the manufacturer or a technician trained by the manufacturer.

Breathing Air Quality and Supply

Quality

The compressed breathing air provided to airline or self-contained breathing apparatus must meet the requirements for Grade D breathing air (ANSI/ Compressed Gas Association's publication Commodity Specification for Air, G-7.1), which includes:

- Oxygen content of 19.5% to 23.5%.
- Hydrocarbon (condensed) content of 5 milligrams per cubic meter of air or less.
- Carbon monoxide (CO) content of 10 parts per million (ppm) or less.
- Carbon dioxide content of 1,000 ppm or less.
- Lack of noticeable odor.

Refer to section 5144(i) requirements if your workplace uses liquid or compressed oxygen at greater than 23.5%.

Compressed air cylinders

Ensure cylinders used to supply breathing air to respirators:

- Are tested and maintained as prescribed in the Shipping Container Specification Regulations of the Department of Transportation.
- Have a certificate of analysis from the supplier that the breathing air meets the requirements for Grade D breathing air.
- Have a moisture content that does not exceed a dew point of -50 deg. F at 1 atmosphere pressure.
- Are only from the respirator manufacturers that obtained the NIOSH approval, and are marked and maintained in accordance with the NIOSH respirator certification for the SCBA.

Compressors

Ensure that the compressors used to provide breathing air are constructed and situated to:

- Prevent entry of contaminated air into the air-supply system (e.g., vehicular traffic, discharge from other ventilation systems).
- Minimize moisture content so that the

dew point at 1 atmosphere pressure is 10 degrees F below the ambient temperature.

- Have suitable in-line air-purifying sorbent beds and filters to ensure breathing air quality. Sorbent beds and filters are maintained and replaced following the manufacturer's instructions.
  - Have a tag at the compressor containing the most recent change date and the signature of the person authorized by the employer to perform the change.
- Have high-temperature and/or carbon monoxide alarms to monitor carbon monoxide levels on oil-lubricated compressors. The air supply must be monitored at intervals sufficient to prevent carbon monoxide in the breathing air from exceeding 10 ppm if only high-temperature alarms are used.
- Ensure breathing air couplings are incompatible with outlets for non-respirable worksite air or other gas systems.
- Ensure no asphyxiating substance is introduced into breathing air lines.

Airline systems

A typical airline system consists of several components. The following summarizes what some of those components are and some additional issues that need to be addressed in order to ensure that the system will be safe for the users, and comply with section 5144.

The air source, which typically consists of an air compressor or tanks/cylinders of compressed air, and the airlines used to distribute the air to the users.

- **Maintenance and calibration** of air monitoring systems. When a carbon monoxide sensor is required, it is important that it is maintained and calibrated according to the manufacturer's instructions. This will include the alarm system that alerts the users of an air supply failure (e.g., a complete shut-down or reduction below minimal operating parameters, or excessive air contamination), as well as the alarm trigger levels (e.g., greater than 10 PPM of carbon monoxide).
- **Pressure vessel inspections** and permits. Airline respirator compressors may have a receiver large enough to fall under T8CCR, subchapter 1, **Unfired Pressure Vessel Orders** requirements.
- **Sufficient capacity** to accommodate the type of respirator, number of users, lengths of airline hose and any in-line devices that may be used.
  - **The type of airline respirator being used**. For example, a continuous flow respirator may require a higher quantity of air suppled to the facepiece/helmet/hood compared to a demand or pressure demand respirator.
  - **Number of users at one tim**e. The larger the number of users, the higher the capacity requirements of the air source.
  - **Length of airline hose used.** Typically, the longer the length, the higher the required operating pressure (P.S.I.) at the airline connection point. At the same time, never exceed the maximum length of airline or air pressure at the airline connection point, as indicated by the manufacturer.
  - **In-line devices**. Depending on the respirator manufacturer and model, there are devices that can be used to heat or cool (e.g., an air vortex tube) the air being provided from the airline to the facepiece. Use of such devices may require higher air supply capacity.

The respirator assembly.

NIOSH approval is granted to respiratory protection equipment made up of specific combinations of parts or assemblies

that have been successfully tested to the performance standards established by the approval agencies. These parts typically consist of:

- The facepiece, hood, or helmet.
- An air supply valve, orifice, or demand or pressure-demand regulator.
- An air supply hose/line that connects to the air source.
- Detachable couplings.
- A flexible breathing tube that connects the facepiece/hood/helmet to the air supply valve/regulator.
- A respirator harness that holds the components of the respirator against the wearer's body.

Violation of the NIOSH approval may occur if any of the parts used in an airline respirator assembly are:

- Not provided by the respirator manufacturer.
- Provided by the respirator manufacturer, but one or more of the part numbers do not match what is specified by the manufacturer for that particular model of airline respirator.
- Not used and maintained according to the manufacturer's instructions.

Your written respirator program needs to include the procedures that will be implemented to ensure all of the above requirements are effectively addressed. Consider incorporating the manufacturer's instructions.

Training and Information

1. All training must be comprehensive and conducted in a manner that is understandable to the employees, and provided prior to requiring them to use respirators in the workplace.
2. Retraining must be administered annually, and when:
   a. Changes in the workplace or type of respirator render previous training obsolete.
   b. Inadequacies of the employee's knowledge or use of the respirator indicates the need.
   c. Any other situation arises in which retraining appears necessary to ensure safe respirator use.

The goal is to ensure employees can demonstrate knowledge of at least the following:

- Why the respirator is necessary and how improper fit, usage or maintenance can compromise the protective effect of the respirator.
- What the limitations and capabilities of the respirator are.
- How to use the respirator effectively in emergencies, including situations in which the respirator malfunctions.
- How to inspect, put on and remove, use and check the seals of the respirator.
- What the procedures are for maintenance and storage of the respirator.
- How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators.
- The general requirements of section 5144.

HazCom. Ensure that your workplace has effectively implemented a Hazard Communication Program that meets **section 5194** requirements. This will play a critical role in the employee training and awareness of the chemical hazards they may be exposed to.

Voluntary use of respirators. Employees must be provided with the information in **Appendix D of section 5144** in a written or oral format.

Program Effectiveness Evaluation

You must conduct ongoing evaluations of your respiratory protection program to identify deficiencies and to make corrections as needed.

Alternatives to Respirators

Periodically re-verify that there are no feasible alternatives to respirators, such as:

- Substituting with less toxic chemicals.
- Engineering or administrative controls. Even if they are not sufficient to eliminate the need for respirators, you still need to reduce exposure as much as possible.

Workplace Evaluations

Conduct regular workplace evaluations for respiratory hazards. These evaluations will determine whether the correct respirators are being used and worn properly. Such evaluations will also serve to determine whether the training program needs to be changed or updated.

Periodically re-evaluate employee airborne exposures to the airborne hazards to verify the correct type and style of respirator continues to be used, especially if there are changes to the work process that may increase employee exposures.

Employee Involvement

Obtain the active involvement of employees in reviewing and updating the respiratory protection program. Consult regularly with employees to learn their views on program effectiveness and to identify any problems, particularly when it comes to whether respirators are:

- Interfering with effective workplace performance.
- Fitting properly.
- Being correctly selected for the specific hazards that employees encounter.
- Being worn properly and used when necessary.
- Being properly maintained.

Program Adjustments

Make appropriate changes to the respiratory protection program when problems are identified during the assessment process.

Recordkeeping

The following information and records need to be retained:

- Medical evaluations. Records of medical evaluations must be retained and made available in accordance with section 3204, **Access to Employee Exposure and Medical Records**.
- Fit testing. Maintain the employee qualitative and quantitative fit test records, including:
  - The name or identification of the employee.
  - Type of fit test performed.
  - Specific make, model, style, and size of respirator tested.
  - Date of test.
  - The pass/fail results for QLFTs or the fit factor and strip chart recording or other recording of the test results for QNFTs.
- The written respirator program.

An employee's fit test record needs to be retained until their next fit test is administered, and made available upon request to affected employees.

Additional Resources

American Conference of Governmental Industrial Hygienists (**ACGIH**)
- **Publications**
- **Industrial Ventilation: A Manual of Recommended Practice**

American National Standards Institute (ANSI)
- **Selected Standards**

Division of Occupational Safety & Health (**Cal/OSHA**)
- **Publications**
  - **Guide to California Hazard Communication Regulations**
  - **Sample Hazard Communication Program**
  - **Guide to Developing Your Workplace Injury and Illness Prevention Program**
  - **Injury and Illness Prevention Model Program for High Hazard Employers**
  - **Sample Written Respiratory Protection Program**
  - **Respiratory Protection in the Workplace**
- **Title 8, California Code of Regulations**
  - Section 3203, **Injury and Illness Prevention Program**
  - Section 5144, **Respiratory Protection**
  - Section 5194, **Hazard Communication**

Federal Occupational Safety & Health Administration: (**OSHA**)
- **Respiratory Protection - Safety & Health Topics**
- **Respiratory Protection - eTool**
- **Small Entity Compliance Guide for the Respiratory Protection Standard**

National Institute of Occupational Safety and Health: (**NIOSH**)
- **Respirators**
- **Engineering Controls**
- **Protective Clothing**
- **Respirator Trusted-Sources Information**
- **Certified Equipment List**
- **NIOSH-Approved Particulate Filtering Facepiece Respirators**
- **Fact Sheet - NIOSH Approval Labels - Key Information to Protect Yourself**
- **NIOSH Pocket Guide to Chemical Hazards**

Abbreviations and Acronyms

ANSI	American National Standards Institute
APF	Assigned Protection Factor
APR	Air Purifying Respirator
ESLI	End of Service Life Indicator
IDLH	Immediately Dangerous to Life or Health
MUC	Maximum Use Concentration
NIOSH	National Institute of Occupational Safety and Health
PAPR	Powered Air Purifying Respirator
PEL	Permissible Exposure Level
PLHCP	Physician or other Licensed Health Care Professional
PPM	Parts Per Million
QLFT	Qualitative Fit Test
QNFT	Quantitative Fit Test
SAR	Supplied Air Respirator
SCBA	Self-Contained Breathing Apparatus
STEL	Short Term Exposure Level
T8CCR	Title 8 of the California Code of Regulations

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