

Using Assigned Protection Factors (APFs) for Respirator Selection

Use with Chapter 296-842 WAC, Respirators



How to use this tool:

Follow guidance in this tool if you need help using the APFs in Table 5 of Chapter 296-842 WAC, Respirators. **When you finish using this guidance, return to WAC 296-842-13005 to complete the respirator selection process.**

This tool is designed to compare hazard ratios (these are values that rate the level of employee protection **needed**, based on workplace exposure evaluation results) to APFs (these are values that rate the **expected** level of protection **provided** by different types of respirators under ideal conditions) as part of the respirator selection process specified in WAC 296-842-13005.

You can use this guidance conservatively by selecting a single hazard ratio that applies to all exposures that require respirator use. It can also be used to determine a single hazard ratio for exposures during a particular task or operation.

The steps below address exposures to a single contaminant and multiple contaminants with **separate** or **additive health effects**. The steps don't address circumstances where multiple contaminants interact to boost the toxicity of the mixture beyond the level expected from additive interactions. To find out more about this possibility, contact your local DOSH consultant.

- See www.lni.wa.gov/wisha/consultation for a list of consultants to assist you or
- Go to the Resources section of Chapter 296-800 WAC, Safety and Health Core Rules, for a list of service locations in your area.

Step 1: Start by having this information available for *each* contaminant and exposure duration of concern:

- Those *exposure evaluation results* that indicate employee exposure above a WISHA Permissible Exposure Limit (PEL) value.



Reference:

If you haven't completed an exposure evaluation, see **requirements** in Chapter 296-841 WAC, Airborne Contaminants.



Using Assigned Protection Factors (APFs) for Respirator Selection

Use with Chapter 296-842 WAC, Respirators

- The WISHA PEL values relevant to your exposure evaluation results. These values are found in Table 3 of WAC 296-841-20020.
 - When no WISHA PEL values have been established for an airborne contaminant, use relevant available information and informed professional judgment to determine an acceptable exposure limit value to use for calculating hazard ratios. For example, you may use exposure limit values established by the American Conference of Governmental Industrial Hygienists (ACGIH).

Step 2: Substitute the values from Step 1 into the following formula and calculate separate hazard ratios for **each** airborne **contaminant** and exposure **duration** of concern.

$$\text{Hazard ratio} = \frac{\text{Exposure evaluation result}^*}{\text{PEL}^*}$$

Using Assigned Protection Factors (APFs) for Respirator Selection

Use with Chapter 296-842 WAC, Respirators



Use this key to understand the terms used in the formula.

Table HT-1 Key to Formula symbols	
The term	Is the
Exposure evaluation result	Estimated or measured concentration of an airborne contaminant for an 8-hour or other exposure period. This result comes from the exposure evaluation required by another chapter in WAC 296-841-20005.
PEL	<p>WISHA Permissible Exposure Limit (PEL) established for the airborne contaminant. Use the PEL value (such as TWA₈, STEL, or Ceiling limit) applicable to your exposure evaluation result.</p> <p>PELs are found in another chapter in WAC 296-841-20020.</p>
*	<p>Measurement unit, such as parts per million (ppm), associated with the exposure evaluation result and PEL values. The measurement units for both values must match.</p> <p>Ppm is the measurement unit commonly used to express concentrations of gases or vapor.</p> <p>Other measurement units may be used. For example, milligrams per cubic meter (mg/ m³) is commonly used to express particle contaminant concentrations.</p> <p>Contact your laboratory or your DOSH consultant if you need assistance with converting measurement units.</p>

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Using Assigned Protection Factors (APFs) for Respirator Selection

Use with Chapter 296-842 WAC, Respirators

- If you are uncertain about this step, review Example 1:

Example 1: Calculating Hazard Ratios

You receive exposure evaluation results from the laboratory that indicate employees are exposed to a **single airborne contaminant** as follows:

300 mg/m³ averaged over an 8-hour exposure period

600 mg/m³ averaged over a 15-minute (short-term) exposure period

You look up the 8-hour and 15-minute WISHA PEL values for the contaminant and durations of concern. They are:

50 mg/m³ = TWA₈ (an 8-hour limit)

150 mg/m³ = STEL (a 15 minute limit)

Substitute the appropriate values into the formula to calculate **separate** hazard ratios for the 8-hour and 15-minute exposure. Then proceed to Step 3.

$$\frac{\text{Concentration}}{\text{PEL(TWA}_8\text{)}} = \frac{300 \text{ mg/M}^3}{50 \text{ mg/M}^3} = \text{A hazard ratio of } \mathbf{6} \text{ for the 8-hour exposure period}$$

$$\frac{\text{Concentration}}{\text{PEL(STEL)}} = \frac{600 \text{ mg/M}^3}{150 \text{ mg/M}^3} = \text{A hazard ratio of } \mathbf{4} \text{ for the 15-minute exposure period}$$



Note:

If your exposures of concern involve an airborne **mixture** of contaminants, **repeat this step** for each contaminant in the mixture.

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Using Assigned Protection Factors (APFs) for Respirator Selection

Use with Chapter 296-842 WAC, Respirators



Step 3: Decide which of the following applies to the exposure of concern and proceed as instructed.

- Exposure is to a **single** contaminant and you have calculated **one** hazard ratio. Skip to Step 5.
- Exposure is to a **single** contaminant and you have calculated **two or more** hazard ratios. Select the higher hazard ratio value and skip to Step 5.
- Exposure is to a **mixture** of airborne contaminants and you have determined health effects are additive. Follow Step 4.
- Exposure is to a **mixture** of airborne contaminants and you have determined health effects are **not additive**. Select the highest hazard ratio value and skip to Step 5.



Reference:

If you **haven't evaluated** the contaminants in the airborne mixture to find out if they have additive health effects, **follow the guidance** in a separate Helpful Tool, Mixtures of Airborne Contaminants, found in the Resources section of Chapter 296-841 WAC, Airborne Contaminants.

Step 4: When the contaminants of an airborne mixture have additive health effects:

- Add the hazard ratios of all additive contaminants to get a total for **each exposure duration**.
 - When you have one total, use this to represent the overall hazard ratio when completing Step 5.
 - When you have **more than one total**, select the **highest total** and use this to represent the overall hazard ratio for the exposures of concern.

Using Assigned Protection Factors (APFs) for Respirator Selection

Use with Chapter 296-842 WAC, Respirators

If you are uncertain about this step, review Example 2.

Example 2: Determining Hazard Ratios For Exposures to Mixtures of Contaminants with Additive Health Effects	
<p>Your employees are exposed to 2 contaminants at the same time (a mixture).</p> <p>You have followed Step 2 to calculate all hazard ratios needed and have determined that both contaminants have additive health effects as mentioned in Step 3.</p> <p>Add up hazard ratios as follows and select the highest total to represent the overall hazard ratio. Then proceed to Step 5.</p>	
Hazard Ratios for the 8- hour exposure duration	Hazard ratios for a 15-minute exposure duration
$\begin{array}{r} 6 \text{ (Contaminants)} \\ +9 \text{ (Contaminants)} \\ \hline 15 \text{ (total)} \end{array}$ <p>Select 15 to represent the overall hazard ratio</p>	$\begin{array}{r} 4 \text{ (Contaminants)} \\ +1 \text{ (Contaminants)} \\ \hline 5 \text{ (total)} \end{array}$

Step 5: Compare your hazard ratio (or overall hazard ratio) to the Assigned Protection Factors (APFs) in Table 5 of WAC 296-842-13005.

- Identify any respirator types in with an APF **at least as high** as your hazard ratio. These respirator types are capable of providing a sufficient protection level for your workplace exposures, **pending further respirator selection restrictions**.
- Continue to **follow other selection requirements** found in WAC 296-842-13005 of this chapter to determine your **final** respirator selection outcome.

If you are uncertain about this step, review Example 3.

Using Assigned Protection Factors (APFs) for Respirator Selection

Use with Chapter 296-842 WAC, Respirators

Example 3: Using Hazard Ratios to Select Appropriate APFs

An overall hazard ratio of 15 has been determined.

Compare this hazard ratio to the APF values shown in Table 5 of WAC 296-842-13005.

- Exclude respirator types with an APF of 5 or 10, since these values are lower than your hazard ratio of 15.
- Note respirator types with an APF of 25 or more, since their APF are higher than your hazard ratio of 15. These are acceptable for further selection consideration.
- Proceed with this information to Step 8 of WAC 296-842-13005, to continue the selection process.

