

Airborne Exposure Limit for Manganese and How to Protect Welders



Most fumes generated during welding contain a small percentage of manganese – a brittle metal that, when inhaled, can damage the lungs, liver, kidneys, and central nervous system. When manganese is inhaled, it bypasses the body's normal defense mechanisms for detoxification and can bioaccumulate in vital organs, such as the brain. Even at relatively low exposure levels, chronic manganese inhalation can cause serious health effects. Exposures can vary considerably, however, depending on the amount of manganese in the welding wire, rod, flux, and the base metal that is being welded upon, as well as welder body position while welding and local exhaust ventilation.

OREGON OSHA'S AIRBORNE LIMIT FOR MANGANESE COMPOUNDS AND FUME

To protect workers from overexposure to manganese while performing welding-related tasks, Oregon OSHA set the maximum concentration of manganese compounds and fume that a worker may be exposed to at 0.1 milligram per cubic meter of air (0.1 mg/m³) measured as an eight-hour time-weighted average. This permissible exposure limit (PEL) for manganese compounds and fume is listed in Table Z-1 of *Oregon's Rules for Air Contaminants*: OAR [437-002-0382](#) (general industry); OAR [437-003-1000](#) (construction); and OAR [437-004-9000](#) (agriculture).

TABLE OR Q-2 AND OPTIONS FOR PROTECTING WELDERS

Oregon OSHA's manganese rule, OAR 437-002-0281, gives employers the option to use two different levels of respiratory protection – based on assigned protective factors (APF) – during common welding and welding-related tasks such as grinding.

An APF is a number between 10 and 10,000 that designates the level of protection a respirator can be expected to provide the wearer when properly fitted, maintained, and worn correctly. Essentially, the higher the APF number, the greater the level of protection the respirator will provide for a particular contaminant.



Table OR Q-2 sets an APF of 10 or 25 for each eligible task. The appropriate APF is determined by the time necessary for an employee to complete a task during a single work shift. To control employee exposures to manganese compounds and fume, employers must:

1. Identify the type of welding tasks employees are performing.
2. Estimate the time required to perform each of those welding tasks if they correspond with Table OR Q-2 during each shift.
3. Provide appropriate respiratory protection based on the most hazardous welding task.

Employers who choose to use Table OR Q-2 are not required to do air monitoring to ensure that manganese exposures remain at or below the PEL. However, employees must still wear respirators and use them in accordance with 29 CFR [1910.134 – Respiratory Protection](#).

Employers also need to be aware of two additional requirements in the manganese rule:

1. If an employee cannot complete a task listed in Table OR Q-2 within the time limit established for a respirator with APF of 10, then the employee must end the task for that work shift or use a respirator that has an APF of 25 or higher.
2. If an employee performs multiple tasks listed in Table OR Q-2 during a single work shift, then the employer must add the time for all welding tasks and assume

that the total time was spent performing the most hazardous activity.

Two examples help explain these additional requirements.

Example 1: An employer anticipates that an employee will perform 60 minutes of grinding tasks directly related to the welding process and 90 minutes of flux core arc welding during the same work shift.

1. The time necessary to complete grinding tasks related to welding (60 minutes) and flux core arc welding (90 minutes) is 150 minutes total.
2. In Table OR Q-2, flux core arc welding has an APF of 25 for tasks that take longer than 120 minutes.
3. Therefore, a respirator with an APF of 25 or higher is required for the employee to do 60 minutes of grinding tasks directly related to the welding process **and** 90 minutes of flux core arc welding during the same shift.

Example 2: An employer anticipates an employee will perform 10 minutes of grinding tasks directly related to the welding process and 30 minutes of handheld torch cutting during an employee's work shift.

1. The time necessary to complete grinding tasks directly related to the welding process (10 minutes) and handheld torch cutting (30 minutes) is 40 minutes total.
2. In Table OR Q-2, grinding tasks directly related to the welding process that take 15 to 180 minutes have an APF of 10 and handheld torch cutting tasks that take 15 to 150 minutes have an APF of 10.
3. Therefore, a respirator with an APF of 10 or higher is required to do 10 minutes of grinding tasks directly related to the welding process and 30 minutes of handheld torch cutting during the same shift.



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WORKERS

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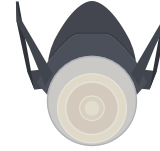
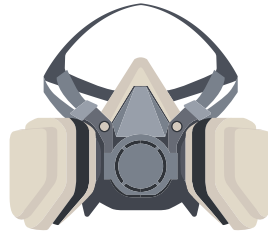


TABLE OR Q-2 for Manganese

Welding, cutting, or grinding task	Assigned Protective Factor (APF) for respiratory protection for tasks during a single work shift within the range of times shown	
	APF 10	APF 25
Carbon arcing	5 to 60 minutes	More than 60 minutes
Flux core arc welding or MIG-flux core welding	15 to 120 minutes	More than 120 minutes
Gas metal arc welding or MIG-solid wire welding	30 to 270 minutes	More than 270 minutes
Gas tungsten arc welding or TIG-welding	150 minutes or more	Not applicable
Grinding tasks directly related to welding	15 to 180 minutes	More than 180 minutes
Handheld torch cutting	15 to 150 minutes	More than 150 minutes
Handheld plasma cutting	30 to 300 minutes	More than 300 minutes
Shielded metal arc welding	10 to 90 minutes	More than 90 minutes

Notes:

- See descriptions of the tasks in OAR 437-002-0299 - Definitions.
- Assigned Protective Factor (APF) is defined in 29 CFR 1910.134 - Respiratory Protection.
- Estimated exposures to Manganese within these guidelines were calculated using a more protective exposure target of 0.02 mg/m³.
- Welding, cutting, and grinding tasks listed in Table OR Q-2 are defined in OAR 437-002-0299 - Definitions.