

2012 Manganese Update

Background

The year 2012 brought changes to the manganese occupational exposure limits, which had an effect on various industries and industrial processes. Manganese is a grey-white metal resembling iron. Manganese is used extensively to produce a variety of important alloys and to desulfurize and deoxidize steel. Manganese is also in many welding rods and filler metals to promote hardness. Manganese oxide fume is formed when manganese metal is heated and reacts with oxygen in the air such as occurs during welding. One of the more recent ailments identified by the National Institutes of Health (www.nih.gov) that can afflict welders is manganism, also known as welder's disease. Overexposure to manganese fume has been associated with other symptoms, such as weakness/lethargy, speech issues, and other negative health factors.

Occupational Exposure Limits

To help reduce the risk of adverse health effects caused by exposures to airborne materials such as manganese, the United States Occupational Safety and Health Administration (OSHA) has established permissible exposure limits (PELs) which are law. In addition, the American Conference of Governmental Industrial Hygienists (ACGIH) sets threshold limit values (TLVs) which are airborne exposure limit guidelines. Industrial hygienists use these occupational exposure limits (OEL) to evaluate and manage worker exposures. While the PEL must be complied with, TLVs are often used by industrial hygienists where they are lower than the OSHA PELs.

The current Federal OSHA PEL for manganese compounds, including manganese fume, is 5 milligrams per cubic meter of air (5 mg/m^3)¹. This PEL is a ceiling limit which means the exposure shall at no time exceed the exposure limit given for that substance. Note, "state plan" states are required to have standards, policies and procedures at least as effective as those of Federal OSHA. If you are in an area under the jurisdiction of a state OSHA plan, consult local standards for current OSHA exposure limits. The ACGIH Board of Directors in December 2012 adopted two 8 hr -Time Weighted Average (TWA) TLVs for manganese, elemental and inorganic compounds². This action changed the TLV from a TWA limit of 0.2 mg/m^3 to 0.02 mg/m^3 for respirable manganese. In addition, a TLV-TWA limit of 0.1 mg/m^3 was added for inhalable manganese. The respirable fraction is the smallest size fraction typically sampled. Respirable samples consist of particles mostly less than $4 \mu\text{m}$ mass median aerodynamic diameter (MMAD) (includes welding fume). This would most likely be the limit used for evaluating welding exposures. Because some occupational exposures include particles greater than $4 \mu\text{m}$ MMAD, the supplementary inhalable TLV was set. The inhalable limit would most likely apply to non-welding exposures such as grinding.

This change to the TLV limits comes after manganese had been on the ACGIH Notice of Intended Changes list for 3 years. This time period provided an opportunity for comment on this change, allowing for substantive data and information to be presented for evaluating the revised TLV. Documentation is available from ACGIH for manganese and its revised TLV's³.

1. "Air Contaminants," Code of Federal Regulations Title 29, Part 1910.1000, Table Z-1. 2011 pp 7-14.

2. American Conference of Governmental Industrial Hygienists, Annual Reports for the Year 2012: Committees on Threshold Limit Values (TLVs®) and Biological Exposure Indices (BEIs®), ACGIH: Cincinnati, OH, 2013.

3. American Conference of Governmental Industrial Hygienists, Cincinnati, OH, www.acgih.org

Respiratory Protection for Manganese Exposure

In many cases, changes in manufacturing processes and engineering controls alone can not reduce exposure levels to below the OELs. In such cases, it may be appropriate to use respiratory protection. For any particular application, an array of respirator types that provide an appropriate level of protection is available. The cost of these respirators may vary from around \$1 for a basic negative-pressure, disposable, filtering facepiece to \$1,000 or more for a powered air purifying or supplied-air system. Respirators should be selected based on results from air sampling and the necessary assigned protection factor (APF) as established within OSHA 29 CFR 1910.134. OSHA requires employers to implement a written respiratory protection program when respiratory protection is used. Elements of the written program include respirator selection, use, care and maintenance, medical evaluation, training, and fit testing for tight fitting respirators.

Respirator Selection for Manganese Oxide Fume Exposures

The table below shows suggested respiratory protection for manganese up to the maximum use concentrations based on the OSHA respirator APFs and ACGIH TLV of 0.02 mg/m³ for respirable fraction.

Exposure	Respiratory Protection
≤ 0.2 mg/m ³	<ul style="list-style-type: none"> • Half Facepiece with N, R, or P class particulate filter (includes filtering facepiece respirator) • Any other respirator with an APF ≥ 10
≤ 0.5 mg/m ³	<ul style="list-style-type: none"> • Full Facepiece with N, R, or P class particulate filter^a • PAPR with HE Filter and Full Facepiece, Hood/Helmet, or Loose Fitting • Facepiece • Continuous flow supplied-air system with Full Facepiece, Hood/Helmet or Loose Fitting Facepiece • Any other respirator with an APF ≥ 25
≤ 1 mg/m ³	<ul style="list-style-type: none"> • Full Facepiece with N, R, or P class particulate filter^a • PAPR with HE Filter and Full Facepiece or Hood/Helmet • Continuous flow supplied-air system with Full Facepiece or Hood/Helmet • Any other respirator with an APF ≥ 50
≤ 20 mg/m ³	<ul style="list-style-type: none"> • PAPR with HE Filter and Full Facepiece or Hood/Helmet • Continuous flow supplied-air system with Full Facepiece or Hood/Helmet^b. • Any other respirator with an APF ≥ 1000

a. When quantitatively fit tested

b. Manufacturer must provide evidence that hood/helmet respirator systems meet APF of 1,000

Summary

Manganese is found in many manufacturing processes. The 2012 change to manganese exposure limits had an effect on various industries and industrial processes. As a precaution, review Safety Data Sheets (SDS) for materials containing these substances in manufacturing processes. If there are questions regarding the air quality, it may be a good idea to discuss the option of air sampling with an industrial hygienist to better determine the levels of contaminants within a given process. If the air sampling results indicate exposure levels above the occupational exposure limit (either PEL or TLV, whichever the employer is using), changes to manufacturing processes, use of other engineering controls or PPE may be suitable choices to reduce employee exposures to acceptable levels.

Further questions regarding selection of respiratory protection for manganese may be directed to 3M Personal Safety Division Technical Service at 1 (800) 243-4630.

Personal Safety Division

3M Center, Building 235-2W-70
St. Paul, MN 55144-1000

3M PSD products are occupational use only.

In United States of America

Technical Service: 1-800-243-4630

Customer Service: 1-800-328-1667

3M.com/workersafety

In Canada

Technical Service: 1-800-267-4414

Customer Service: 1-800-364-3577

3M.ca/Safety

© 3M 2019. All rights reserved.

3M is a trademark of 3M Company and its affiliates.

Used under license in Canada. All other trademarks are property of their respective owners.

If printed, please recycle. May 2019

