**Occupational Health and Safety Administration (OHSA)**

**Manganese Fume (as Mn)**

**General Description**

**Synonyms:** Mn; Manganese metal; Colloidal manganese; Manganese-55

**OSHA IMIS Code Number:** 1620  (IMIS Name History: Manganese prior to 9/1/89)

**Chemical Abstracts Service (CAS) Registry Number:** 7439-96-5

**NIOSH Registry of Toxic Effects of Chemical Substances (RTECS) Identification Number:** [OO9275000](http://www.cdc.gov/niosh-rtecs/oo8d8678.html)

**NIOSH Pocket Guide to Chemical Hazards -** [**Manganese Compounds and Fume (as Mn)**](http://www.cdc.gov/niosh/npg/npgd0379.html): Physical description, chemical properties, potentially hazardous incompatibilities, and more

**U.S. Environmental Protection Agency (EPA) Hazard Summary -** [**Manganese**](http://www.epa.gov/ttn/atw/hlthef/manganes.html)**:** Uses, sources and potential exposure, acute and chronic health hazard information, and more

**Exposure Limits and Health Effects**

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| --- | --- | --- | --- |
| **Exposure Limit** | **Limit Values** | **HE Codes** | **Health Factors and Target Organs** |
| **OSHA Permissible Exposure Limit (PEL) - General Industry**  See [29 CFR 1910.1000 Table Z-1](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992&p_text_version=FALSE) | 5 mg/m3 Ceiling | HE7 | Manganism\* Target organs: Brain, central nervous system |
| **OSHA PEL - Construction Industry**  See [29 CFR 1926.55 Appendix A](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10629) | 5 mg/m3 Ceiling | HE7 | Manganism\* Target organs: Brain, central nervous system |
| **OSHA PEL - Shipyard Employment**  See [29 CFR 1915.1000 Table Z-Shipyards](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10286&p_text_version=FALSE) | 5 mg/m3 Ceiling | HE7 | Manganism\* Target organs: Brain, central nervous system |
| **National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL)** | 1 mg/m3 TWA3 mg/m3 STEL | HE4 | Metal fume fever\*\* |
| HE7 | Poor coordination, memory/judgment trouble, emotional instability, shaking/tremor in hands and/or legs, difficulty speaking properly, hallucinations |
| HE11 | Manganese pneumonia |
| **American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV)** (2013) | 0.02 mg/m3  (respirable fraction) TWA  0.1 mg/m3 (inhalable fraction) TWAA4 | HE7     | Neurophysiological and neuropsychological effects, including impaired visual time, eye-hand coordination, and hand steadiness, decreased motor function, decreased behavioral tests, tremor |
| [**CAL/OSHA PELs**](http://www.dir.ca.gov/title8/5155table_ac1.html)  | 0.2 mg/m3(respirable fraction)  TWA3 mg/m3  STEL | HE7 | Neurobehavioral dysfunction, decreased eye-hand coordination |

\*Manganism is a condition that occurs when someone has been exposed to toxic levels of manganese. Symptoms tend to mimic Parkinson's Disease and include gait disturbances, clumsiness, tremors, speech disturbances, and psychological disturbances. \*\*Metal fume fever is a temporary condition caused by inhaling manganese fumes. Symptoms typically include chills, fever, upset stomach, vomiting, and dryness of the throat, cough, weakness, and achiness.

**National Toxicology Program (NTP) carcinogenic classification:** Not listed

**International Agency for Research on Cancer (IARC) carcinogenic classification:** Not listed

**EPA carcinogenic classification:** [Not classifiable as to human carcinogenicity](http://www.epa.gov/iris/subst/0373.htm#woe)

**EPA Inhalation Reference Concentration (RfC):** [5x10-5 mg/m3](http://www.epa.gov/iris/subst/0373.htm#inhalrfc)

**Agency for Toxic Substances and Disease Registry (ATSDR) Inhalation Minimal Risk Level (MRL):** [0.04 μg/m3 (chronic)](http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=23)

**NIOSH Immediately Dangerous to Life or Health (IDLH) concentration:** [500 mg/m3 (as Mn)](http://www.cdc.gov/niosh/idlh/7439965.html)   **Notes on Other Potential Health Effects and Hazards**

1. Manganese is combustible, and finely dispersed particles can form explosive mixtures in air (NIOSH/IPCS 2003).
2. Data indicate that manganese exposure is associated with a range of neurobehavioral and neuropsychiatric changes, some of which may persist for long periods after occupational exposure ceases (ACGIH 2013).
3. Even at lower levels of manganese exposure (about 0.0129 mg/m3), investigators found neuropsychological changes with respect to attention, mood, and fine motor control (Laohaudomchok et al. 2011).
4. One study found that six deaths from pneumonia in a Norwegian ferroalloy plant could be attributed to occupational exposures to manganese (Hobbesland et al. 1997). Another study looking at welders found three fatalities due to pneumonia that could be traced back to manganese exposure (Wergeland and Iversen 2001).
5. A study examining welders found that the only difference between welding-related Parkinsonism and idiopathic Parkinsonism is the age of onset. As a result, the authors concluded that welding could be a risk factor for developing Parkinson's Disease (Racette et al. 2001).
6. Based on the findings of neurobehavioral impairment by Roels et al. (1987, 1992), the LOAEL for derivation of the EPA RfC is 0.15 mg/m3, and the LOAEL(HEC) is 0.05 mg/m3.

**Date Last Revised:** 4/5/2013  **Literature Basis**

* ACGIH: Documentation of the Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs) - Manganese, Elemental and Inorganic Compounds. 2013.
* ATSDR: [Toxicological Profile for Manganese](http://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=102&tid=23). 2012.
* California Occupational Safety & Health Standards Board: [Initial](http://www.dir.ca.gov/oshsb/aircontaminantsISOR.pdf) [88 KB PDF, 16 pages] and [Final](http://www.dir.ca.gov/oshsb/aircontaminantsFSOR.pdf) [63 KB PDF, 9 pages] Statement of Reasons. February 3, 2001.
* EPA: [Integrated Risk Information System for Manganese](http://www.epa.gov/iris/subst/0373.htm#inhalrfc) (CASRN 7439-96-5). 1988.
* Hobbesland, A., Kjuus, H. and Thelle, D.S.: Mortality from nonmalignant respiratory diseases among male workers in Norwegian ferroalloy plants. Scand. J. Work Environ. Health 23(5): 342-350, 1997.
* Laohaudomchok, W. et al. Neuropsychological effects of low-level manganese exposure in welders. Neurotoxicology. 32(2): 171-179, 2011.
* NIOSH: Occupational Health Guideline for Manganese. 1978.
* NIOSH/IPCS: International Chemical Safety Cards - [Manganese](http://www.cdc.gov/niosh/ipcsneng/neng0174.html). November 27, 2003.
* Racette, B.A., McGee-Minnich, L, Moerlein, S.M., Mink, J.W., Videen, T.O. and Perlmutter, J.S.: Welding-related parkinsonism: clinical features, treatment, and pathophysiology. Neurology 56(1): 8-13, 2001.
* Roels, H., R. Lauwerys, J.P. Buchet et al.: Epidemiological survey among workers exposed to manganese: Effects on lung, central nervous system, and some biological indices. Am. J. Ind. Med. 11: 307-327, 1987.
* Roels, H.A., P. Ghyselen, J.P. Buchet, E. Ceulemans, and R.R. Lauwerys: Assessment of the permissible exposure level to manganese in workers exposed to manganese dioxide dust. Br. J. Ind. Med. 49: 25-34, 1992.
* Wergeland, E. and Iversen, B.G.: Deaths from pneumonia after welding. Scand. J. Work Environ. Health 27(5): 353, 2001.

**Monitoring Methods used by OSHA**

**Laboratory Sampling/Analytical Method:**

* **sampling media:** Mixed Cellulose Ester Filter (MCEF) 0.8 microns  **maximum volume:** 960 Liters  **minimum volume:** 480 Liters  **maximum flow rate:** 2.0 L/min (TWA)  **maximum volume:** 30 Liters  **maximum flow rate:** 2.0 L/min (STEL)  **maximum volume:** 10 Liters  **minimum time:** 5 Minutes  **maximum flow rate:** 2.0 L/min (Ceiling)  **current analytical method:** Atomic Absorption Spectroscopy; AAS  **method reference:** OSHA Analytical Method ([OSHA 121](http://www.osha.gov/dts/sltc/methods/inorganic/id121/id121.html))  **method classification:** Fully Validated
* **alternative analytical method:** Inductively Coupled Argon Plasma; ICP/DCP-AES  **method reference:** OSHA Analytical Method ([OSHA 125G](http://www.osha.gov/dts/sltc/methods/inorganic/id125g/id125g.html))  **method classification:** Fully Validated  **note:** Samples may be collected up to an 8 hour period, if the filter is not overloaded. Analytical method does not distinguish between dust & fume.

\*\* All Trademarks are the property of their respective owners.

<http://www.osha.gov/dts/chemicalsampling/data/CH_250200.html>