

4. CHEMICAL AND PHYSICAL INFORMATION

4.1 CHEMICAL IDENTITY

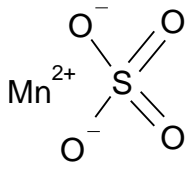
Table 4-1 lists common synonyms, trade names, and other relevant information regarding the chemical identity of manganese and several of its most important compounds.

4.2 PHYSICAL AND CHEMICAL PROPERTIES

Information regarding the physical and chemical properties of manganese is located in Table 4-2.

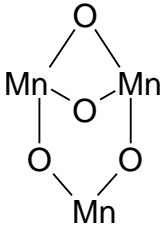

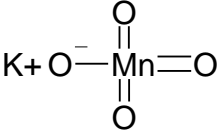
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Table 4-1. Chemical Identity of Manganese and Compounds^a

Characteristic	Information		
Chemical name	Manganese	Mn(II) chloride	Manganese sulfate
Synonym(s)	Elemental manganese ^b ; colloidal manganese ^b ; cutaval ^b	Manganese chloride ^b ; manganese dichloride	Manganese sulfate
Registered trade name(s)	Cutaval ^b ; Mangan ^b	No data	Sorba-spray manganese ^b
Chemical formula	Mn	MnCl ₂	MnSO ₄
Chemical structure	Mn	$\begin{array}{c} \text{Cl}^- \\ \\ \text{Mn}^{2+} \\ \\ \text{Cl}^- \end{array}$	
Identification numbers:			
CAS registry	7439-96-5	7773-01-5	7785-87-7
NIOSH RTECS	009275000 ^b	009625000 ^b	OP1050000 ^b
EPA hazardous waste	No data	No data	No data
OHM/TADS	No data	No data	No data
DOT/UN/NA/IMDG shipping	No data	No data	No data
HSDB	00550 ^b	02154 ^b	02187 ^b
NCI	No data	No data	No data

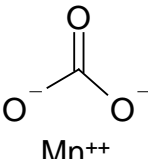
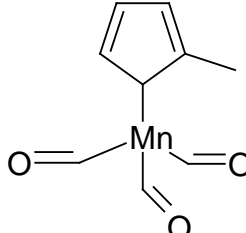
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Table 4-1. Chemical Identity of Manganese and Compounds^a

Characteristic	Information		
Chemical name	Manganese (II, III) oxide	Manganese dioxide	Potassium permanganate
Synonym(s)	Manganese tetroxide; manganomanganic oxide ^c	Manganese peroxide; manganese binoxide; manganese black; battery manganese	Permanganic acid; potassium salt; chameleon mineral ^c
Registered trade name(s)	No data	No data	No data
Chemical formula	Mn ₃ O ₄	MnO ₂	KMnO ₄
Chemical structure			
Identification numbers:			
CAS registry	1317-35-7	1313-13-9	7722-64-7
NIOSH RTECS	OP0900000 ^b	No data	SD6475000 ^b
EPA hazardous waste	No data	No data	No data
OHM/TADS	No data	No data	No data
DOT/UN/NA/IMDG shipping	No data	No data	UN1490 ^b , IMDG 5.1 ^b
HSDB	No data	No data	01218 ^b
NCI	No data	No data	No data

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Table 4-1. Chemical Identity of Manganese and Compounds^a

Characteristic	Information		
Chemical name	Mn(II) carbonate	Mangafodipir	Methylcyclopentadienyl manganese tricarbonyl (MMT)
Synonym(s)	Carbonic acid; manganese (2+) salt; manganous carbonate ^b ; natural rhodochrosite ^b	Mangafodipir trisodium ^d ; MnDPDP ^d	MMT; manganese, tricarbonyl ([1,2,3,4,5-eta]-1-methyl-2,4-cyclopentadien-1yl)-; methylcymantrene; tricarbonyl (2-methylcyclopentadienyl) manganese ^b
Registered trade name(s)	No data	Teslascan ^d ; Win 59010 ^d	AK-33X; Antiknock-33; CI-2; Combustion Improver-2 ^b
Chemical formula	MnCO ₃	C ₂₂ H ₂₄ MnN ₄ O ₁₄ P ₂ H ₃ Na ₃	C ₉ H ₇ MnO ₃
Chemical structure		No data	
Identification numbers:			
CAS registry	598-62-9	140678-14-4	12108-13-3
NIOSH RTECS	No data	OO9163250	48184
EPA hazardous waste	No data	No data	No data
OHM/TADS	No data	No data	No data
DOT/UN/NA/IMDG shipping	No data	No data	No data
HSDB	00790 ^b	No data	2014
NCI	No data	No data	No data

^aAll information obtained from Sax and Lewis 1987, except where noted.

^bHSDB 2008

^cO'Neil et al. 2006

^dRTECS 2007

CAS = Chemical Abstracts Service; DOT/UN/NA/IMDG = Department of Transportation/United Nations/North America/International Maritime Dangerous Goods Code; EPA = Environmental Protection Agency; HSDB = Hazardous Substances Data Bank; NCI = National Cancer Institute; NIOSH = National Institute for Occupational Safety and Health; OHM/TADS = Oil and Hazardous Material Technical Assistance Data System; RTECS = Registry of Toxic Effects of Chemical Substances

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Table 4-2. Physical and Chemical Properties of Manganese and Compounds^a

Property	Manganese	Mn(II) chloride	Manganese sulfate
Molecular weight	54.94 ^b	125.85 ^b	151.00 ^b
Color	Steel-gray ^b	Pink	Pale rose-red
Physical state	Solid	Solid	Solid
Melting point	1,244 °C ^c	650 °C	700 °C
Boiling point	2,095 °C ^b	1,412 °C ^b	850 °C (decomposes)
Density at 20 °C	7.26 g/cm ³ ^b at 20 °C	2.325 g/cm ³ at 25 °C ^b	3.25 g/cm ³ ^d
Odor	No data	No data	Odorless
Odor threshold:			
Water	No data	No data	No data
Air	No data	No data	No data
Solubility:			
Water at 20 °C	Decomposes	No data	No data
Acids	Reacts with diluted mineral acids with evolution of hydrogen and formation of divalent manganous salts ^b	No data	No data
Organic solvents	No data	Soluble in alcohol, insoluble in ether	Soluble in alcohol, insoluble in ether
Partition coefficients:			
Log K _{ow}	No data	No data	Not applicable
Log K _{oc}	No data	No data	Not applicable
Vapor pressure at 20 °C	1 Pa at 955 °C ^c	1,000 Pa at 760 °C ^c	No data
Henry's law constant at 25 °C	No data	Not applicable	Not applicable
Autoignition temperature	No data	Noncombustible	No data
Flashpoint	No data	No data	No data
Flammability limits	Flammable and moderately explosive in dust form when exposed to flame ^d	No data	No data
Conversion factors	Not applicable	Not applicable	Not applicable
Explosive limits	Mixture of aluminum and manganese dust may explode in air. Mixtures with ammonium nitrate may explode when heated ^d	No data	No data
Reactivity	Hydrogen ^d ; when heated above 200 °C in presence of nitrogen, forms nitrode; violent reaction with NO ₂ and oxidants; incandescent reaction with phosphorous, nitryl fluoride, nitric acid ^d	No data	No data

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Table 4-2. Physical and Chemical Properties of Manganese and Compounds^a

Property	Manganese (II, III) oxide	Manganese dioxide	Potassium permanganate
Molecular weight	228.81 ^b	86.94 ^b	158.03 ^b
Color	Brownish-black ^b	Black	Purple
Physical state	Solid	Solid	Solid
Melting point	1,564 °C	Loses oxygen at 535 °C ^d	<240 °C (decomposes)
Boiling point	No data	No data	No data
Density at 20 °C	No data	5.0 g/cm ³ ^d	2.703 g/cm ³
Odor	No data	No data	Odorless
Odor threshold:			
Water	No data	No data	No data
Air	No data	No data	No data
Solubility:			
Water at 20 °C	Insoluble	Insoluble	No data
Acids	Soluble in hydrochloric acid	Soluble in hydrochloric acid	Soluble in sulfuric acid
Organic solvents	No data	No data	Soluble in acetone
Partition coefficients:			
Log K _{ow}	Not applicable	No data	No data
Log K _{oc}	Not applicable	No data	No data
Vapor pressure at 20 °C	No data	No data	No data
Henry's law constant at 25 °C	Not applicable	No data	No data
Autoignition temperature	No data	No data	No data
Flashpoint	No data	No data	No data
Flammability limits	No data	No data	No data
Conversion factors	Not applicable	Not applicable	Not applicable
Explosive limits	No data	No data	No data
Reactivity	No data	No data	Spontaneously flammable on contact with ethylene glycol

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Table 4-2. Physical and Chemical Properties of Manganese and Compounds^a

Property	Mn(II) carbonate	Mangafodipir trisodium	Methylcyclopentadienyl manganese tricarbonyl (MMT) ^f
Molecular weight	114.95	757.4 ^e	218.1
Color	Pink ^c	No data	Yellow to dark orange
Physical state	hexagonal, crystals ^c	Liquid (solution for infusion)	Liquid, solid below 2 °C
Melting point	Decomposes	No data	1.5 °C ^d
Boiling point	No data	No data	232 °C
Density at 20 °C	3.70 g/cm ³ ^c	1.537 g/cm ³ ^b	1.39 g/cm ³
Odor	No data	No data	Faint, pleasant
Odor threshold:			
Water	No data	No data	No data
Air	No data	No data	No data
Solubility:			
Water at 20 °C	Insoluble	459.6 g/L ^b	Insoluble
Acids	Soluble in dilute acid ^c	No data	No data
Organic solvents	No data	23 g/L (methanol); 0.8 g/L (ethanol); 0.6 g/L (acetone); 1.1 g/L (chloroform) ^b	Readily soluble in hydrocarbons and the usual organic solvents including hexane, alcohols, ethers, acetone, ethylene glycol, lubricating oils, gasoline and diesel fuel ^b
Partition coefficients:			
Log K _{ow}	No data	-5.62 ^b	No data
Log K _{oc}	No data	No data	No data
Vapor pressure at 20 °C	No data	No data	Ranges from 8 mm Hg at 100 °C to 360.6 mm Hg at 200 °C ^b
Henry's law constant at 25 °C	No data	No data	No data
Autoignition temperature	No data	No data	No data
Flashpoint	No data	No data	110 °C
Flammability limits	No data	No data	No data
Conversion factors	Not applicable	No data	No data
Explosive limits	No data	No data	No data
Reactivity	No data	No data	Light (decomposes)

^aAll information obtained from Sax and Lewis 1987, except where noted.

^bO'Neil et al. 2006

^cLide 2000

^dLewis 2000

^eRTECS 2007

^fData for MMT from NIOSH 2005 unless otherwise noted