



CHEMICAL UPDATE WORKSHEET

Chemical Name:	Lead (DD)
CAS #:	7439-92-1
Revised By:	RRD Toxicology Unit
Revision Date:	January 6, 2016

(A) Chemical-Physical Properties

	Part 201 Value	Updated Value	Reference Source	Comments
Molecular Weight (g/mol)	207.2	207.20	EPI	EXP
Physical State at ambient temp	Inorganic	Inorganic	MDEQ	
Melting Point (°C)	---	327.462	CRC	EXP
Boiling Point (°C)	1740	1749.00	CRC	EXP
Solubility (ug/L)	NA	NA	NA	NA
Vapor Pressure (mmHg at 25°C)	NA	NR	NA	NA
HLC (atm-m³/mol at 25°C)	NR	NR	NA	NA
Log Kow (log P; octanol-water)	NR	NR	NA	NA
Koc (organic carbon; L/Kg)	NR	NR	NA	NA
Ionizing Koc (L/kg)		NR	NA	NA
Diffusivity in Air (Di; cm²/s)	NR	NR	NA	NA
Diffusivity in Water (Dw; cm²/s)	NR	NR	NA	NA
Soil Water Partition Coefficient (Kd; inorganics)	11000	1.1E+04	MDEQ	EST

	Part 201 Value	Updated Value	Reference Source	Comments
Flash Point (°C)	NA	NA	NA	NA
Lower Explosivity Level (LEL; unitless)	NA	NA	NA	NA
Critical Temperature (K)		NR	NA	NA
Enthalpy of Vaporization (cal/mol)		NR	NA	NA
Density (g/mL, g/cm ³)		NR	NA	NA
EMSOFT Flux Residential 2 m (mg/day/cm ²)	NA	NR	EMSOFT	NA
EMSOFT Flux Residential 5 m (mg/day/cm ²)	NA	NR	EMSOFT	NA
EMSOFT Flux Nonresidential 2 m (mg/day/cm ²)	NA	NR	EMSOFT	NA
EMSOFT Flux Nonresidential 5 m (mg/day/cm ²)	NA	NR	EMSOFT	NA

(B) Toxicity Values/Benchmarks

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
Reference Dose (RfD) (mg/kg/day)	NA	NA	MDEQ, 2015	
RfD details	--	<p>Tier 1 Source: IRIS: Per IRIS 07/08/2004, RfD is not available. A great deal of information on the health effects of lead has been obtained through decades of medical observation and scientific research. This information has been assessed in the development of air and water quality criteria by the Agency's Office of Health and Environmental Assessment (OHEA) in support of regulatory decision-making by the Office of Air Quality Planning and Standards (OAQPS) and by the Office of Drinking Water (ODW). By comparison to most other environmental toxicants, the degree of uncertainty about the health effects of lead is quite low. It appears that some of these effects, particularly changes in the levels of certain blood enzymes and in aspects of children's neurobehavioral development, may occur at blood lead levels so low as to be essentially without a threshold. The Agency's RfD Work Group discussed inorganic lead (and lead compounds) at two meetings (07/08/1985 and 07/22/1985) and considered it inappropriate to develop an RfD for inorganic lead. IRIS also notes Centers for Disease Control and Prevention's (CDC) ongoing effort to re-evaluate the blood lead level of concern. See Tier 3 info from the CDC.</p> <p>EPA/Regional Screening Levels (RSLs): EPA has no consensus RfD or cancer slope factor for lead, so it is not possible to calculate RSLs. EPA considers lead to be a special case because of the difficulty in identifying the classic "threshold" needed to develop an RfD. EPA therefore evaluates lead exposure by using blood-lead modeling such as the IEUBK model. The EPA OSW has released a detailed directive on risk assessment and cleanup of residential soil lead. However, this directive was written in 1994 and uses the outdated acceptable blood lead level of 10 µg/dl. EPA uses the Adult Lead Model to estimate SLs for an industrial setting (i.e., to protect a fetus carried by a pregnant female worker).</p> <p>Tier 2 Sources: PPRTV: No PPRTV record available for lead at this time.</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		<p>MRL: Per ATSDR (08/2007): MRLs were not derived for lead because a clear threshold for some of the more sensitive effects in humans has not been identified. In addition, deriving an MRL would overlook the significant body of blood lead literature. These data suggest that certain subtle neurobehavioral effects in children may occur at very low blood lead levels. In lieu of MRLs, ATSDR has developed a framework to guide decisions at lead sites. This approach utilizes site-specific exposure data to estimate internal doses as measured by blood lead levels.</p> <p>Tier 3 Sources:</p> <p>MDEQ/WRD: Per DEQ-CCD: RfD = 0.00043 mg/kg/d based on the lead action level of 15 µg/L reported by EPA, 1991. Calculation date = 09/30/2007. No other DEQ division has generated an RfD or other toxicity endpoint.</p> <p>Centers for Disease Control and Prevention (CDC), January 4, 2012: Based on a growing body of studies concluding that blood lead levels (BLLs) <10 µg/dL harm children, the CDC Advisory Committee on Childhood Lead Poisoning Prevention (ACCLPP) recommends elimination of the use of the term “blood lead level of concern”. This recommendation is based on the weight of evidence that includes studies with a large number and diverse group of children with low BLLs and associated IQ deficits. Effects at BLLs < 10 µg/dL are also reported for other behavioral domains, particularly attention-related behaviors and academic achievement. New findings suggest that the adverse health effects of BLLs less than 10 µg/dL in children extend beyond cognitive function to include cardiovascular, immunological, and endocrine effects. Additionally, such effects do not appear to be confined to lower socioeconomic status populations. Therefore, the absence of an identified BLL without deleterious effects combined with the evidence that these effects, in the absence of other interventions, appear to be irreversible, underscores the critical importance of primary prevention. This report recommends that a reference value based on the 97.5th percentile of the (the National Health and Nutrition Examination Survey (NHANES) generated BLL distribution in children 1-5 years old (currently 5</p>		



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<p>µg/dL) be used to identify children with elevated BLL. No specific guidance has been provided on how acceptable soil and drinking water concentrations should be derived.</p> <p>California Department of Toxic Substances Control (DTSC) (CALEPA): DTSC uses a benchmark for a source-specific incremental increase in blood lead of up to 1 µg/dL as the basis for deriving the associated soil lead concentrations. This benchmark is used for the protection of school children and fetuses (OEHHA, 2007). The DTSC’s Leadsread model (DTSC, 2007) was used to estimate PbB in children. The Leadsread model considers exposure to lead in soil by three pathways: ingestion, re-suspension and inhalation, and dermal contact. The Leadsread model was queried for the soil lead concentrations that would give rise to a 90th percentile estimate of increase in blood lead of 1 µg/dL using the “goal seek” function in Excel™. The resulting residential soil screening level for lead (CHHSL) is 80 mg/kg (from 150 mg/kg).</p> <p>Massachusetts DEP: Action Level = 0.015 mg/kg/day.</p> <p>RIVM: Maximum permissible risk = 3.6E-3 mg/kg/day This value was derived in 1991 based on children being most sensitive to lead. In 1991 the background exposure to Pb was estimated to be 1.2 µg/kg bw/day (32-34 µg/kg via food and water, 2 µg/day via air for adults and .08 µg/day via air for children) (Vermeire et al. 1991).</p>		
Oral Cancer Slope Factor (CSF) (mg/kg-day)⁻¹	NA	NA	MDEQ, 2015	
CSF details	--	<p>Tier 1 Source: IRIS: Per IRIS (05/04/1988), classification B2 – probable human carcinogen based on sufficient animal evidence. Current data are not adequate to derive a quantitative estimate of carcinogenic risk following oral exposure to lead. The National Toxicology Program's Report on Carcinogens Review Committee has recommended that lead and lead compounds be considered "reasonably anticipated to be human carcinogens". Also, the International Agency for</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<p>Research on Cancer (IARC) has undertaken a reevaluation of lead's carcinogenicity.</p> <p>Tier 2 Sources: PPRTV: No PPRTV record for lead is available at this time. MRL: NA; MRLs are for non-cancer effects only.</p> <p>Tier 3 Source: MDEQ: Per DEQ-CCD, no oral cancer slope factor value is available at this time.</p>		
Reference Concentration (RfC) or Initial Threshold Screening Level (ITSL) ($\mu\text{g}/\text{m}^3$)	1.5E+0	1.5E-1	USEPA, 2008	
RfC/ITSL details	Rolling 3-month average. AIR: NAAQS value.	<p>Tier 1 Source: USEPA: Basis: USEPA is the only available value. National Ambient Air Quality Standard (NAAQS) = $0.15 \mu\text{g}/\text{m}^3$ as rolling 3-month average not to exceed value. See <i>Federal Register</i>, Vol. 73, No. 219, Wednesday, November 12, 2008, Rules and Regulations, Page 66,964 for details. Source: USEPA NAAQS, 10/15/2008:</p> <p>Tier 1 and 2 Sources: IRIS: Per IRIS, 07/08/2004, an RfC is not available. PPRTV: No PPRTV record for lead is available at this time. MRL: Per ATSDR (08/2007): MRLs were not derived for lead because a clear threshold for some of the more sensitive effects in humans has not been identified. In addition, deriving an MRL would overlook the significant body of blood lead literature. These data suggest that certain subtle neurobehavioral effects in children may occur at very low blood lead levels. In lieu of MRLs, ATSDR has developed a framework to guide decisions at lead sites. This approach utilizes site-specific exposure data to estimate internal doses as measured by blood lead</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		levels. Tier 3 Source: MDEQ/AQD: Per DEQ-CCD; an RfC for lead is not available.		
Inhalation Unit Risk Factor (IURF) (($\mu\text{g}/\text{m}^3$)⁻¹)	NA	NA	MDEQ, 2015	
IURF details	--	Per IRIS (05/04/1988), classification B2 – probably human carcinogen based on sufficient animal evidence. Current data are not adequate to derive a quantitative estimate of carcinogenic risk following inhalation exposure to lead. The National Toxicology Program's Report on Carcinogens Review Committee has recommended that lead and lead compounds be considered "reasonably anticipated to be human carcinogens". Also, the International Agency for Research on Cancer (IARC) has undertaken a reevaluation of lead's carcinogenicity. Tier 1 and 2 Sources: IRIS: Per IRIS (5/04/1988), an IURF is not available. PPRTV: No PPRTV record for lead is available at this time. MRL: NA; MRLs are for non-cancer effects only. Tier 3 Source: MDEQ/AQD: Per DEQ-CCD, an IURF value for lead is not available.		Complete
Mutagenic Mode of Action (MMOA)? (Y/N)	--	No	USEPA, 2015	
MMOA Details	--	Not listed as a carcinogen with mutagenic MOA in the USEPA OSWER List		
Developmental or Reproductive Effector? (Y/N)	No	Yes- for both oral and inhalation Oral Exposure Pathways- Full Term Exposure Inhalation Exposure Pathways- Full Term Exposure	MDEQ, 2015	
Developmental or Reproductive Toxicity Details	NA	The IEUBK Model addresses the effects of lead in children i.e., IQ deficits, attention-related behaviors, and academic achievement. New findings suggest		



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		that the adverse health effects of BLLs less than 10 µg/dL in children extend beyond cognitive function to include cardiovascular, immunological and endocrine effects. By comparison to most other environmental toxicants, the degree of uncertainty about the health effects of lead is quite low. It appears that some of these effects, particularly changes in the levels of certain blood enzymes and in aspects of children's neurobehavioral development, may occur at blood lead levels so low as to be essentially without a threshold.		
State Drinking Water Standard (SDWS) (µg/L)	--	TT ⁶	SDWA, 1976	
SDWS details	NA	MI Safe Drinking Water Act (SDWA) 1976 PA 399. TT stands for treatment technique and the footnote to the "MCL" states the following: ⁶ Copper action level 1.3 mg/L; lead action level 0.015 mg/L.		
Secondary Maximum Contaminant Level (SMCL) (µg/L)	--	NO	SDWA, 1976 and USEPA SMCL List	
SMCL details	NA	MI Safe Drinking Water Act (SDWA) 1976 PA 399 and USEPA SMCL List, 2015		
Is there an Aesthetic Value? (Y/N)	NO	Not evaluated.	NA	
Aesthetic value details	NA	NA		
Is there a Phytotoxicity Value? (Y/N)	NO	Not evaluated.	NA	
Phytotoxicity details	NA	NA		
Others:				

(C) Chemical-specific Absorption Factors

	Part 201 Value	Update	Source/Reference/ Dates	Comments/Notes /Issues
Gastrointestinal absorption efficiency value (ABS _{gi})	---	1.0	MDEQ, 2015/USEPA RAGS-E, 2004	
ABS _{gi} details		RAGS E (USEPA, 2004) Default Value		
Skin absorption efficiency value (AE _d)	---	0.01	MDEQ, 2015	
AE _d details				
Ingestion Absorption Efficiency (AE _i)		0.5	MDEQ, 2015	
AE _i Details				
Relative Source Contribution for Water (RSC _w)		0.2	MDEQ, 2015	
Relative Source Contribution for Soil (RSC _s)		1.0	MDEQ, 2015	
Relative Source Contribution for Air (RSC _A)		1.0	MDEQ, 2015	
Others				

(D) Rule 57 Water Quality Values and GSI Criteria

Current GSI value (µg/L)	(G,X)
Updated GSI value (µg/L)	(G,X)
Rule 57 Drinking Water Value (µg/L)	14

	Rule 57 Value (µg/L)	Verification Date
Human Non-cancer Values- Drinking water source (HNV-drink)	14	9/2007
Human Non-Cancer Values- Non-drinking water sources (HNV-Non-drink)	190	9/2007
Wildlife Value (WV)	NA	NA
Human Cancer Values for Drinking Water Source (HCV-drink)	NA	NA
Human Cancer values for non-drinking water source (HCV-Non-drink)	NA	NA
Final Chronic Value (FCV)	$(EXP(0.9859*(LnH)-1.270))*CFc^D$ $CFc = 1.46203-[(LnH)(0.14571)]$ D = value is expressed as dissolved	11/2010
Aquatic maximum value (AMV)	$(EXP(0.9859*(LnH)-0.2972))*CFc^D$ $CFc = 1.46203-[(LnH)(0.14571)]$ D = value is expressed as dissolved	11/2010
Final Acute Value (FAV)	$(EXP(0.9859*(LnH)-0.9904))*CFc*2^D$ $CFc = 1.46203-[(LnH)(0.14571)]$ D = value is expressed as dissolved	11/2010

Sources:

1. MDEQ Surface Water Assessment Section Rule 57 [website](#)
2. MDEQ Rule 57 [table](#)

(E) Target Detection Limits (TDL)

	Value	Source
Target Detection Limit – Soil ($\mu\text{g}/\text{kg}$)	10,000	MDEQ, 2015
Target Detection Limit – Water ($\mu\text{g}/\text{L}$)	3	MDEQ, 2015
Target Detection Limit – Air (ppbv)	NA	MDEQ, 2015
Target Detection Limit – Soil Gas (ppbv)	NA	MDEQ, 2015

CHEMICAL UPDATE WORKSHEET ABBREVIATIONS:

CAS # - Chemical Abstract Service Number.

Section (A) Chemical-Physical Properties**Reference Source(s):**

CRC	Chemical Rubber Company Handbook of Chemistry and Physics, 95th edition, 2014-2015
EMSOFT	USEPA Exposure Model for Soil-Organic Fate and Transport (EMSOFT) (EPA, 2002)
EPA2001	USEPA (2001) Fact Sheet, Correcting the Henry's Law Constant for Soil Temperature. Office of Solid Waste and Emergency Response, Washington, D.C.
EPA4	USEPA (2004) User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings. February 22, 2004.
EPI	USEPA's Estimation Programs Interface SUITE 4.1, Copyright 2000-2012
HSDB	Hazardous Substances Data Bank
MDEQ	Michigan Department of Environmental Quality
NPG	National Institute for Occupational Safety and Health Pocket Guide to Chemical Hazards
PC	National Center for Biotechnology Information's PubChem database
PP	Syracuse Research Corporation's PhysProp database
SCDM	USEPA's Superfund Chemical Data Matrix
SSG	USEPA's Soil Screening Guidance: Technical Background Document, Second Edition, 1996
USEPA/EPA	United States environmental protection agency's Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). July, 2004.

W9 USEPA's User Guide for Water9 Software, Version 2.0.0, 2001

Basis/Comments:

EST	estimated
EXP	experimental
EXT	extrapolated
NA	not available or not applicable
NR	not relevant

Section (B) Toxicity Values/Benchmarks**Sources/References:**

ATSDR	Agency for Toxic Substances and Disease Registry
CALEPA	California Environmental Protection Agency
CAL DTSC	California Department of Toxic Substances Control
CAL OEHHHA	CAEPA Office of Environmental Health Hazard Assessment
CCD	MDEQ Chemical Criteria Database
ECHA	European Chemicals Agency (REACH)
OECD HPV	Organization for Economic Cooperation and Development HPV Database
HEAST	USEPA's Health Effects Assessment Summary Tables
IRIS	USEPA's Integrated Risk Information System
MADEP	Massachusetts Department of Environmental Protection
MDEQ/DEQ	Michigan Department of Environmental Quality
DEQ-CCD/AQD	MDEQ Air Quality Division
DEQ-CCD/RRD	MDEQ Remediation and Redevelopment Division
DEQ-CCD/WRD	MDEQ Water Resources Division
MNDOH	Minnesota Department of Health

NJDEP	New Jersey Department of Environmental Protection
NYDEC	New York State Department of Environmental Conservation
OPP/OPPT	USEPA's Office of Pesticide Programs
PPRTV	USEPA's Provisional Peer Reviewed Toxicity Values
RIVM	The Netherlands National Institute of Public Health and the Environment
TCEQ	Texas Commission on Environmental Quality
USEPA	United States Environmental Protection Agency
USEPA OSWER	USEPA Office of Solid Waste and Emergency Response
USEPA MCL	USEPA Maximum Contaminant Level
WHO	World Health Organization
WHO IPCS	International Programme on Chemical Safety (IPCS/INCHEM)
WHO IARC	International Agency for Research on Cancers
NA	Not Available.
NR	Not Relevant.

Toxicity terms:

BMC	Benchmark concentration
BMCL	Lower bound confidence limit on the BMC
BMD	benchmark dose
BMDL	Lower bound confidence limit on the BMD
CSF	Cancer slope Factor
CNS	Central nervous system
IURF or IUR	Inhalation unit risk factor
LOAEL	Lowest observed adverse effect level
LOEL	Lowest observed effect level
MRL	Minimal risk level (ATSDR)
NOAEL	No observed adverse effect level
NOEL	No observed effect level

RfC	Reference concentration
RfD	Reference dose
p-RfD	Provisional RfD
aRfD	Acute RfD
UF	Uncertainty factor
WOE	Weight of evidence

Section (C) Chemical-specific Absorption Factors

MDEQ	Michigan Department of Environmental Quality
USEPA RAGS-E	United States Environmental Protection Agency's Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). July, 2004.

Section (D) Rule 57 Water Quality Values and GSI Criteria

GSI	Groundwater-surface water interface
NA	A value is not available or not applicable.
ID	Insufficient data to derive value
NLS	No literature search has been conducted