



## CHEMICAL UPDATE WORKSHEET

<b>Chemical Name:</b>	<b>Chloroform</b>
<b>CAS #:</b>	<b>67-66-3</b>
<b>Revised By:</b>	RRD Toxicology Unit
<b>Revision Date:</b>	August 14, 2015

### (A) Chemical-Physical Properties

	<b>Part 201 Value</b>	<b>Updated Value</b>	<b>Reference Source</b>	<b>Comments</b>
<b>Molecular Weight (g/mol)</b>	119.38	119.38	EPI	EXP
<b>Physical State at ambient temp</b>	Liquid	Liquid	MDEQ	
<b>Melting Point (°C)</b>	---	-63.60	EPI	EXP
<b>Boiling Point (°C)</b>	61.1	61.10	EPI	EXP
<b>Solubility (ug/L)</b>	7.92E+6	7.950E+06	EPI	EXP
<b>Vapor Pressure (mmHg at 25°C)</b>	205.2	1.97E+02	EPI	EXP
<b>HLC (atm-m<sup>3</sup>/mol at 25°C)</b>	3.67E-3	3.67E-03	EPI	EXP
<b>Log Kow (log P; octanol-water)</b>	1.92	1.97	EPI	EXP
<b>Koc (organic carbon; L/Kg)</b>	39.7	31.82	EPI	EST
<b>Ionizing Koc (L/kg)</b>		NR	NA	NA
<b>Diffusivity in Air (Di; cm<sup>2</sup>/s)</b>	0.104	7.69E-02	W9	EST
<b>Diffusivity in Water (Dw; cm<sup>2</sup>/s)</b>	1.0E-5	1.0891E-05	W9	EST
<b>Soil Water Partition Coefficient (Kd; inorganics)</b>	NR	NR	NA	NA

	Part 201 Value	Updated Value	Reference Source	Comments
Flash Point (°C)	NA	NA	NA	NA
Lower Explosivity Level (LEL; unit less)	NA	NA	NA	NA
Critical Temperature (K)		536.40	EPA2001	EXP
Enthalpy of Vaporization (cal/mol)		6.99E+03	EPA2001	EXP
Density (g/mL, g/cm3)		1.4788	CRC	EXP
EMSOFT Flux Residential 2 m (mg/day/cm <sup>2</sup> )	2.63E-05	2.77E-05	EMSOFT	EST
EMSOFT Flux Residential 5 m (mg/day/cm <sup>2</sup> )	6.18E-05	6.66E-05	EMSOFT	EST
EMSOFT Flux Nonresidential 2 m (mg/day/cm <sup>2</sup> )	3.73E-05	4.40E-05	EMSOFT	EST
EMSOFT Flux Nonresidential 5 m (mg/day/cm <sup>2</sup> )	8.64E-05	1.05E-04	EMSOFT	EST

**(B) Toxicity Values/Benchmarks**

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
<b>Reference Dose (RfD) (mg/kg/day)</b>	1.3E-2	1.0E-2	IRIS, 2001	
<b>RfD details</b>	<p>Chronic (7.5 years) oral (capsule) bioassay (Heywood et al., 1979)                      NOAEL=none;                      LOAEL=12.9 mg/kg/day;                      UF=1000. Critical effect = fatty cyst formation in liver.                      SUBCHRONIC RfD: The chronic oral RfD was adopted as the sub chronic oral RfD.                      Source: IRIS                      CCD date: 12/02/1985</p>	<p><b>Tier 1 Source:</b>  <b>IRIS:</b>  <b>Basis:</b> IRIS is a Tier 1 source.  <b>Critical Study:</b> Heywood, R; Sortwell, RJ; Noel, PRB; et al. (1979) Safety evaluation of toothpaste containing chloroform: III. Long-term study in beagle dogs. J Environ Pathol Toxicol 2:835-851  <b>Methods:</b> Beagle dogs (8/sex/dose) were exposed to 15 or 30 mg chloroform/kg/day orally in a toothpaste base in gelatin capsules, 6 days/week for 7.5 years. The treatment was followed by a 20- to 24-week recovery period. Critical effect: increased serum glutamate-pyruvate transaminase (SGPT) levels and increased incidence and severity of fatty cysts in the liver  <b>End point or Point of Departure (POD):</b> LOAEL = 15 mg/kg/day (adjusted to 12.9 mg/kg/day); BMDL10 = 1.2 mg/kg/day.  <b>Uncertainty Factors:</b> UF = 1,000 (10 each for interspecies variability, interspecies extrapolation, and LOAEL to NOAEL extrapolation)  <b>Source and date:</b> IRIS, Last revision date - 10/19/2001. A Toxicological Review is available.</p> <p><b>Tier 2 Sources:</b>  <b>PPRTV:</b> No PPRTV record available at this time.  <b>MRL:</b> Per ATSDR (9/1997), chronic oral MRL = 0.01 mg/kg-day. An intermediate MRL = 0.1 mg/kg-day is available based on the Heywood et al. (1979) study.  <b>Critical Study:</b> Heywood, R; Sortwell, RJ; Noel, PRB; et al. (1979) Safety evaluation of toothpaste containing chloroform: III. Long-term study in beagle dogs. J Environ Pathol Toxicol 2:835-851  <b>Method(s):</b> Beagle dogs (8/sex/dose) were exposed to 15 or 30 mg chloroform/kg/day orally in a toothpaste base in gelatin capsules, 6 days/week for 7.5 years. The treatment was followed by a 20- to 24-week recovery period.  <b>Critical effect:</b> increased serum glutamate-pyruvate transaminase (SGPT)</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<p><u>End point or Point of Departure (POD):</u> LOAEL = 15 mg/kg/day  <u>Uncertainty Factors:</u> UF = 1,000 (10 each for interspecies variability, interspecies extrapolation, and LOAEL to NOAEL extrapolation)  <u>Source and date:</u> ATSDR, 9/1997</p> <p><b>Tier 3 Source:</b>  <b>MDEQ:</b> Per DEQ-CCD/RRD, RfD = 1.3E-2 mg/kg-day. See Part 201 Value RfD details.</p>		
<b>Oral Cancer Slope Factor (CSF) (mg/kg-day<sup>-1</sup>)</b>	4.4E-3	NA	MDEQ, 2001	
<b>CSF details</b>	<p>Kidney tumors were seen in male Osborne-Mendel rats exposed via the drinking water for 104 weeks (Jorgenson, 1985). Revised species scaling factor of (BWh/BWa) to the 0.25 power used for q* calculation. CCD/WRD date: 1/11/2000</p>	<p><b>Carcinogen Weight-of-Evidence (WOE) Class:</b> likely to be carcinogenic to humans by all routes of exposure under high-exposure conditions that lead to cytotoxicity and regenerative hyperplasia in susceptible tissues  <b>IRIS WOE Basis:</b> based on: 1) observations in animals exposed by both oral and inhalation pathways which indicate that sustained or repeated cytotoxicity with secondary regenerative hyperplasia precedes, and is probably required for, hepatic and renal neoplasia; 2) there are no epidemiological data specific to chloroform and, at most, equivocal epidemiological data related to drinking water exposures that cannot necessarily be attributed to chloroform amongst multiple other disinfection byproducts; and 3) genotoxicity data on chloroform are essentially negative.                      Additional Information: Per IRIS (10/19/2001), no value is estimated. The RfD is considered protective against cancer risk as the chloroform-induced carcinogenicity is secondary to cytotoxicity and regenerative hyperplasia and the mode of action indicates that cytotoxicity is the critical effect.  <b>Source and Date:</b> IRIS, Last revision date - 10/19/2001</p> <p><b>Tier 1 and 2 Sources:</b>  <b>IRIS:</b> See above.  <b>PPRTV:</b> No PPRTV record available at this time.  <b>MRL:</b> NA; MRLs are for non-cancer effects only.</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<b>Tier 3 Source:</b> <b>MDEQ:</b> Per DEQ-CCD/WRD, CSF = 4.4E-3 mg/kg-day) <sup>-1</sup> . See Part 201 Value CSF details.		
<b>Reference Concentration (RfC) or Initial Threshold Screening Level (ITSL) (µg/m³)</b>	--	9.8E+1	ATSDR, 1997	
<b>RfC/ITSL details</b>	NA	<b>Tier 2 Source:</b> <b>ATSDR:</b> <b>Basis:</b> ATSDR is a Tier 2 source, no Tier 1 available. Inhalation chronic MRL = 0.02 ppm or 9.8E-2mg/m <sup>3</sup> (at 25°C and 1 atm). An intermediate-duration inhalation MRL = 0.05 ppm (2.4E-1 mg/m <sup>3</sup> ) is available based on a LOAEL of 14 ppm for toxic hepatitis in workers exposed to up to 400 ppm for less than 6 months (Phoon et al. 1983). Chronic MRL derivation: <b>Critical Study (ies):</b> Bomski H, Sobolewska A, Strakowski A. 1967. Toxic damage of the liver by chloroform in chemical industry workers. Int Arch F Gewerbepathologie u. Gewerbehygiene 24: 127- 134 (German) <b>Methods:</b> A group of 68 workers were occupationally exposed to chloroform for 1-4 years. Doses ranged from 2 to 205 ppm and air concentrations ranged from 0.01 to 1.0 mg/L. <b>Critical effect:</b> hepatomegaly <b>End point or Point of Departure (POD):</b> LOAEL = 2 ppm <b>Uncertainty Factors:</b> UF = 100 (for interspecies variability and LOAEL to NOAEL extrapolation) <b>Source and date:</b> ATSDR, 9/1997. A Toxicological Profile is available.		Complete
		<b>Tier 1 and 2 Sources:</b> <b>IRIS:</b> Per IRIS (10/19/2001), no value at this time. <b>PPRTV:</b> No PPRTV record available at this time.		

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<b>Tier 3 Source:</b> <b>MDEQ:</b> Per DEQ-CCD, no value at this time.		
<b>Inhalation Unit Risk Factor (IURF) ((<math>\mu\text{g}/\text{m}^3</math>)<sup>-1</sup>)</b>	2.4E-6	2.3E-5	IRIS, 2001	
<b>IURF details</b>	<p>The potency is based on the geometric mean of oral studies conducted by Jorgenson et al (1985) and NCI (1976). In the NCI study male rat kidney tumors result in potency of 2.6 E-2 (mg/kg)-1. The potency from rat kidney tumors in Jorgenson et al is 6.1 E-3 (mg/kg)-1. Geometric mean of oral potency = 1.3E-2 (mg/kg)-1. Potency was converted to air potency of 2.4E-6 (<math>\mu\text{g}/\text{m}^3</math>)-1, using 20m<sup>3</sup>, 70kg, and 65% absorption. CCD/AQD date: 3/27/1991</p>	<p><b>Tier 1 Source:</b> <b>IRIS:</b> <b>Basis:</b> IRIS is s Tier 1 source. <b>Critical Study:</b> National Cancer Institute (NCI). (1976) Report on carcinogenesis bioassay of chloroform. Bethesda, MD: National Cancer Institute. <b>Methods:</b> This IURF is based on data from a gavage study. The incidence data for both male and female mice were used to derive slope factors of 3.3E-2 and 2.0E-1 per (mg/kg)/day, respectively.</p> <ol style="list-style-type: none"> <li>1) <i>Dose response data: Tumor Type</i> - — hepatocellular carcinoma; <i>Test Species</i> - mouse, B6C3F1, female; <i>Route</i> - oral, gavage</li> <li>2) <i>Extrapolation method:</i> linearized multistage procedure, extra risk.</li> </ol> <p><b>Carcinogen Weight-of-Evidence (WOE) Class:</b> chloroform is likely to be carcinogenic to humans by all routes of exposure under high-exposure conditions that lead to cytotoxicity and regenerative hyperplasia in susceptible tissues (U.S. EPA, 1998a, b). Chloroform is not likely to be carcinogenic to humans by any route of exposure under exposure conditions that do not cause cytotoxicity and cell regeneration. <b>IRIS WOE Basis:</b> based on: 1) observations in animals exposed by both oral and inhalation pathways which indicate that sustained or repeated cytotoxicity with secondary regenerative hyperplasia precedes, and is probably required for, hepatic and renal neoplasia; 2) there are no epidemiological data specific to chloroform and, at most, equivocal epidemiological data related to drinking water exposures that cannot necessarily be attributed to chloroform amongst multiple other disinfection byproducts; and 3) genotoxicity data on chloroform are essentially negative. <b>Source and Date:</b> IRIS, Last revision date - 10/19/2001</p> <p><b>Tier 2 Sources:</b></p>		Complete



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		<p><b>PPRTV:</b> No PPRTV record available at this time.  <b>MRL:</b> NA; MRLs are for non-cancer effects only.</p> <p><b>Tier 3 Source:</b>  <b>MDEQ:</b> Per DEQ-CCD/AQD (3/27/1991), IURF = <math>2.4E-5</math> mg/kg-day<sup>-1</sup>. See Part 201 Value IURF details.</p>		
Mutagenic Mode of Action (MMOA)? (Y/N)	--	NO	USEPA, 2014	
MMOA Details	--	NA Not listed as a carcinogen with mutagenic MOA in the USEPA OSWER List.		
Developmental or Reproductive Effector? (Y/N)	No	No, the RfD or RfC/ITSL is not based on a reproductive-developmental effect.	MDEQ, 2014	
Developmental or Reproductive Toxicity Details	NA	NA		
State Drinking Water Standard (SDWS) (ug/L)	SDWA, 1976	80 <sup>l</sup>	SDWA, 1976	
SDWS details	NA	MI Safe Drinking Water Act (SDWA) 1976 PA 399. <sup>l</sup> 1998 Final Rule for Disinfectants and Disinfection By-products: The total for trihalomethanes (THM) is 0.08 mg/L.		
Secondary Maximum Contaminant Level (SMCL) (ug/L)	80	80	SDWA, 1976 and USEPA SMCL List, 2015	
SMCL details	NA	SDWA, 1976 and USEPA SMCL List, 2015		
Is there an aesthetic value for drinking water? (Y/N)	NO	Not evaluated.	NA	
Aesthetic value (ug/L)	NA	NA	NA	

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
<b>Aesthetic Value details</b>	NA	NA		
<b>Phytotoxicity Value? (Y/N)</b>	NO	Not evaluated.	NA	
<b>Phytotoxicity details</b>	NA	NA	NA	
<b>Others</b>				

**(C) Chemical-specific Absorption Factors**

	Part 201 Value	Update	Source/Reference/ Dates	Comments/Notes /Issues
Gastrointestinal absorption efficiency value (ABS <sub>gi</sub> )	---	1.0	MDEQ, 2015/USEPA RAGS-E, 2004	
ABS <sub>gi</sub> details		RAGS E (USEPA, 2004) Default Value		
Skin absorption efficiency value (AE <sub>d</sub> )	---	0.1	MDEQ, 2015	
AE <sub>d</sub> details				
Ingestion Absorption Efficiency (AE <sub>i</sub> )		1.0	MDEQ, 2015	
AE <sub>i</sub> Details				
Relative Source Contribution for Water (RSC <sub>w</sub> )		0.2	MDEQ, 2015	
Relative Source Contribution for Soil (RSC <sub>s</sub> )		1.0	MDEQ, 2015	
Relative Source Contribution for Air (RSC <sub>A</sub> )		1.0	MDEQ, 2015	
Others				

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

<b>Current GSI value (µg/L)</b>	350
<b>Updated GSI value (µg/L)</b>	350
<b>Rule 57 Drinking Water Value (µg/L)</b>	350

	<b>Rule 57 Value (µg/L)</b>	<b>Verification Date</b>
<b>Human Non-cancer Values- Drinking water source (HNV-drink)</b>	350	9/2010
<b>Human Non-Cancer Values- Non-drinking water sources (HNV-Non-drink)</b>	11,000	9/2010
<b>Wildlife Value (WV)</b>	NA	NA
<b>Human Cancer Values for Drinking Water Source (HCV-drink)</b>	* (350)	9/2010
<b>Human Cancer values for non-drinking water source (HCV-Non-drink)</b>	* (350)	9/2010
<b>Final Chronic Value (FCV)</b>	630	1/2010
<b>Aquatic maximum value (AMV)</b>	5,700	1/2010
<b>Final Acute Value (FAV)</b>	11,000	1/2010

Sources:

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

**(E) Target Detection Limits (TDL)**

	<b>Value</b>	<b>Source</b>
<b>Target Detection Limit – Soil (<math>\mu\text{g}/\text{kg}</math>)</b>	50	MDEQ, 2015
<b>Target Detection Limit – Water (<math>\mu\text{g}/\text{L}</math>)</b>	1	MDEQ, 2015
<b>Target Detection Limit – Air (ppbv)</b>	2.20E+00	MDEQ, 2015
<b>Target Detection Limit – Soil Gas (ppbv)</b>	7.30E+01	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 OEHHA	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