CHEMICAL UPDATE WORKSHEET

Chemical Name:	**Tetrahydrofuran (DD)**
CAS #:	**109-99-9**
Revised By:	RRD Toxicology Unit
Revision Date:	August 19, 2015

(A) Chemical-Physical Properties

	Part 201 Value	Updated Value	Reference Source	Comments
Molecular Weight (g/mol)	72.12	72.11	EPI	EXP
Physical State at ambient temp	Liquid	Liquid	MDEQ	
Melting Point (˚C)	---	-108.44	EPI	EXP
Boiling Point (˚C)	65	65.00	EPI	EXP
Solubility (ug/L)	1.0E+9	1000000000	EPI	EXP
Vapor Pressure (mmHg at 25˚C)	162.3	1.62E+02	EPI	EXP
HLC (atm-m^3/mol at 25˚C)	9.63E-3	7.05E-05	EPI	EXP
Log Kow (log P; octanol-water)	0.46	0.46	EPI	EXP
Koc (organic carbon; L/Kg)	2.83	10.75	EPI	EST
Ionizing Koc (L/kg)		NR	NA	NA
Diffusivity in Air (Di; cm^2/s)	0.08	9.54E-02	W9	EST
Diffusivity in Water (Dw; cm^2/s)	8.0E-6	1.08E-05	W9	EST
Soil Water Partition Coefficient (Kd; inorganics)	NR	NR	NA	NA

	Part 201 Value	Updated Value	Reference Source	Comments
Flash Point (˚C)	6.0 F	-14	CRC	EXP
Lower Explosivity Level (LEL; unitless)	0.02	0.02	CRC	EXP
Critical Temperature (K)		540	CRC	EXP
Enthalpy of Vaporization (cal/mol)		7.12E+03	CRC	EXP
Density (g/mL, g/cm^3)		0.8833	CRC	EXP
EMSOFT Flux Residential 2 m (mg/day/cm^2)	2.69E-05	2.52E-05	EMSOFT	EST
EMSOFT Flux Residential 5 m (mg/day/cm^2)	6.55E-05	5.17E-05	EMSOFT	EST
EMSOFT Flux Nonresidential 2 m (mg/day/cm^2)	3.83E-05	3.90E-05	EMSOFT	EST
EMSOFT Flux Nonresidential 5 m (mg/day/cm^2)	9.28E-05	7.55E-05	EMSOFT	EST

(B) Toxicity Values/Benchmarks

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
Reference Dose (RfD) (mg/kg/day)	1.3E-2	9.0E-1	IRIS, 2012	
RfD details	Per RD: RfD derived by GLEAS/SWQD 2/26/98; Administered to rats in DW for 4 weeks at 1, 10, 100 or 1000 ppm. LOAEL = 1000 mg/l - histopathology not performed at 10 or 100 ppm; UF = 10,000 (10x each for interspecies, intra-species, and sub-chronic to chronic; 3x each for substantially less than chronic and LOAEL to NOAEL. CRITICAL EFFECTS = mild changes in liver, thyroid, and kidney (Komsta, et al., 1988). RD calculation date:	**Tier 1 Source:** **IRIS:** **Basis:** Tetrahydrofuran IRIS, 2012, RfD= 9.0E-1 mg/kg/day is a Tier 1 source and more recent than the DEQ review. **Critical Study**: • Hellwig, J; Gembardt, C; Jasti, S. (2002) Tetrahydrofuran: two-generation reproduction toxicity in Wistar rats by continuous administration in the drinking water. Food Chem Toxicol 40(10):1515–1523. • BASF. (1996) Tetrahydrofuran: two-generation reproduction toxicity study in Wistar rats, continuous administration in the drinking water, with cover letter dated 8/30/96. Study No. 71R0144/93038. Submitted under TSCA Section 8D. EPA Document No. 86960000573. NTIS No. OTS558774. **Methods**: Rat two-generation reproductive study **Critical effect**: decreased pup body weight gain in F1 and F2 pups **End point or Point of Departure (POD):** $BMDL_{1SD}$ = 928 mg/kg-day **Uncertainty Factors**: UF = 1,000 (10 each for intraspecies variability, interspecies extrapolation, and database deficiencies; 1 for subchronic to chronic; 1 for LOAEL to NOAEL) **Source and date:** IRIS, Last revision date – 2/21/2012. **Tier 2 Sources:** **PPRTV:** No PPRTV record is available at this time. **MRL:** No MRL record is available at this time. **Tier 3 Source:** **MDEQ:** Per DEQ-CCD/RRD (2/26/1998), RfD = 1.3E-2 mg/kg-day. See Part 201 Value RfD details.		Complete

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
	2/26/98.			
Oral Cancer Slope Factor (CSF) (mg/kg-day)$^{-1}$)	--	NA	MDEQ, 2015	
CSF details	NA	**Carcinogen Weight-of-Evidence (WOE) Class**: "suggestive evidence of carcinogenic potential" following exposure by all routes of exposure **IRIS WOE Basis**: Information is available on the carcinogenic effects of THF via the inhalation route demonstrates that tumors occur in tissues remote from the site of absorption. Information on the carcinogenic effects of THF via the oral and dermal routes in humans or animals is not is available. Based on the observance of systemic tumors following inhalation exposure, and in the absence of information to indicate otherwise, it is assumed that an internal dose will be achieved regardless of the route of exposure. **Source and Date**: IRIS, Last revision date – 2/12/2012 **Tier 1 and 2 Sources:** **IRIS:** Per IRIS (2/12/2012), no value at this time. **PPRTV:** No PPRTV record is available at this time. **MRL:** NA; MRLs are for non-cancer effects only. **Tier 3 Source:** **MDEQ:** Per DEQ-CCD, no value at this time.		Complete
Reference Concentration (RfC) or Initial Threshold Screening Level (ITSL) (µg/m³)	5.9E+3	2.0E+3	IRIS, 2012	
RfC/ITSL details	The TLV based number is being used as an interim value. CCD/AQD date:	**Tier 1 Source:** **IRIS:** **Basis:** Tetrahydrofuran IRIS, 2012, RfC= 2.0E+3 µg/m³ is a Tier 1 source. **Critical Study**: NTP (National Toxicology Program). (1998) Toxicology and carcinogenesis studies of tetrahydrofuran (CAS No. 109-99-9) in F344/N rats and		Complete

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
	1/01/1988.	B6C3F1 mice. Public Health Service, U.S. Department of Health and Human Services; NTP TR- 475. Is available from the National Institute of Environmental Health Services, Research Triangle Park, NC. **Methods**: in F344/N rats and B6C3F1 mice (10/specie/sex/dose) were exposed to 0, 195, 590, 1,770, 5,310, 14,750 mg/m3 for 13 weeks. **Critical effect**: increased liver weight and centrilobular cytomegaly; CNS effects (narcosis) **End point or Point of Departure (POD):** $BMCL_{10}$ = 246 mg/m^3 **Uncertainty Factors**: UF = 100 (10 for intraspecies variability and 3 each for interspecies extrapolation and database deficiencies) **Source and date:** IRIS, Last revision date – 2/21/2012. **Tier 2 Sources:** **PPRTV:** No PPRTV record is available at this time. **MRL:** No MRL record is available at this time. **Tier 3 Source:** **MDEQ:** Per DEQ-CCD/AQD (8/01/2012), RfC/ITSL = 8.0E+3 µg/m³. Annual averaging time. The IRIS RfC value was modified by applying a composite UF of 30 (10 for intraspecies variability and 3 for interspecies extrapolation) to the $BMCL_{10}$ = 246 mg/m3. The EPA database uncertainty factor of 3 was removed.		
Inhalation Unit Risk Factor (IURF) ($(\mu g/m^3)^{-1}$)	--	NA	MDEQ, 2015	
IURF details	NA	**Carcinogen Weight-of-Evidence (WOE) Class**: "suggestive evidence of carcinogenic potential" following exposure by all routes of exposure **IRIS WOE Basis**: Information is available on the carcinogenic effects of THF via the inhalation route demonstrates that tumors occur in tissues remote from the site of absorption. Information on the carcinogenic effects of THF via the oral and dermal routes in humans or animals is not is available. Based on the observance of systemic tumors following inhalation exposure, and in the absence of information to indicate otherwise, it is assumed that an internal dose will be achieved regardless of the route of exposure.		Complete

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		Source and Date: IRIS, Last revision date – 2/21/2012 **Tier 1 and 2 Sources:** **IRIS:** Per IRIS (2/12/2012), no value at this time. **PPRTV:** No PPRTV record is available at this time. **MRL:** NA; MRLs are for non-cancer effects only. **Tier 3 Source:** **MDEQ:** Per DEQ-CCD, no value at this time.		
Mutagenic Mode of Action (MMOA)? (Y/N)	--	NO	USEPA, 2015	
MMOA Details	--	NA Not listed as a carcinogen with mutagenic MOA in the USEPA OSWER List.		
Developmental or Reproductive Effector? (Y/N)	No	YES-oral. The RfD is based on a reproductive-developmental effect. Oral Exposure Pathways- Full Term Exposure No-inhalation. The RfC/ITSL is not based on a reproductive-developmental effect.	MDEQ, 2015	
Developmental or Reproductive Toxicity Details	NA	NA		
State Drinking Water Standard (SDWS) (ug/L)	--	NO	SDWA, 1976	
SDWS details	NA	MI Safe Drinking Water Act (SDWA) 1976 PA 399		
Secondary Maximum Contaminant Level (SMCL) (ug/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 for	NO	Not evaluated.	NA	

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
drinking water? (Y/N)				
Aesthetic value (ug/L)	NA	NA	NA	
Aesthetic Value details	NA	NA		
Phytotoxicity Value? (Y/N)	NO	Not evaluated.	NA	
Phytotoxicity details	NA	NA	NA	
Others				

(C) Chemical-specific Exposure Factors

	Part 201 Value	Update	Source/Reference/ Dates	Comments/Notes /Issues
Gastrointestinal absorption efficiency value (ABSgi)	---	1.0	MDEQ, 2015/USEPA RAGS-E, 2004	
ABSgi details		RAGS E (USEPA, 2004) Default Value		
Skin absorption efficiency value (AEd)	---	0.1	MDEQ, 2015	
AEd details				
Ingestion Absorption Efficiency (AEi)		1.0	MDEQ, 2015	
AEi 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)	11,000 (X)
Updated GSI value (µg/L)	11,000 (X)
Rule 57 Drinking Water Value (µg/L)	350

	Rule 57 Value (µg/L)	Verification Date
Human Non-cancer Values- Drinking water source (HNV-drink)	350	2/1998
Human Non-Cancer Values- Non-drinking water sources (HNV-Non-drink)	26,000	2/1998
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)	11,000	6/1998
Aquatic maximum value (AMV)	74,000	6/1998
Final Acute Value (FAV)	150,000	6/1998

Sources:

1. MDEQ Surface Water Assessment Section Rule 57 website
2. MDEQ Rule 57 table

(E) Analytical Information

	Value	Source
Target Detection Limit – Soil (µg/kg)	1,000	MDEQ, 2015
Target Detection Limit – Water (µg/L)	90	MDEQ, 2015
Target Detection Limit – Air (ppbv)	6.00E+00	MDEQ, 2015
Target Detection Limit – Soil Gas (ppbv)	2.20E+00	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