



## CHEMICAL UPDATE WORKSHEET

<b>Chemical Name:</b>	<b>Dimethylsulfoxide</b>
<b>CAS #:</b>	<b>67-68-5</b>
<b>Revised By:</b>	RRD Toxicology Unit
<b>Revision Date:</b>	November 23, 2015

### (A) Chemical-Physical Properties

	Part 201 Value	Updated Value	Reference Source	Comments
<b>Molecular Weight (g/mol)</b>	78.14	78.13	EPI	EXP
<b>Physical State at ambient temp</b>	Liquid	Liquid	MDEQ	
<b>Melting Point (°C)</b>	---	18.50	EPI	EXP
<b>Boiling Point (°C)</b>	189	189.00	EPI	EXP
<b>Solubility (ug/L)</b>	1.66E+8	1E+09	EPI	EXP
<b>Vapor Pressure (mmHg at 25°C)</b>	0.541	6.10E-01	EPI	EXP
<b>HLC (atm-m<sup>3</sup>/mol at 25°C)</b>	5.80E-8	1.51E-09	EPI	EXP
<b>Log Kow (log P; octanol-water)</b>	-1.66	-1.35	EPI	EXP
<b>Koc (organic carbon; L/Kg)</b>	0.0234	2.082	EPI	EST
<b>Ionizing Koc (L/kg)</b>		NR	NA	NA
<b>Diffusivity in Air (Di; cm<sup>2</sup>/s)</b>	0.08	9.86E-02	W9	EST
<b>Diffusivity in Water (Dw; cm<sup>2</sup>/s)</b>	8.0E-6	1.1767E-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	95	CRC	EXP
Lower Explosivity Level (LEL; unit less)	NA	0.026	CRC	EXP
Critical Temperature (K)		707	CRC	EXP
Enthalpy of Vaporization (cal/mol)		1.03E+04	CRC	EXP
Density (g/mL, g/cm <sup>3</sup> )		1.101	CRC	EXP
EMSOFT Flux Residential 2 m (mg/day/cm <sup>2</sup> )	NA	1.41E-06	EMSOFT	EST
EMSOFT Flux Residential 5 m (mg/day/cm <sup>2</sup> )	NA	1.41E-06	EMSOFT	EST
EMSOFT Flux Nonresidential 2 m (mg/day/cm <sup>2</sup> )	NA	1.75E-06	EMSOFT	EST
EMSOFT Flux Nonresidential 5 m (mg/day/cm <sup>2</sup> )	NA	1.75E-06	EMSOFT	EST

**(B) Toxicity Values/Benchmarks**

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
Reference Dose (RfD) (mg/kg/day)	3.0E+1	1.0E+0	MDEQ, 2015/OPP, 2006	
RfD details	NOAEL of 3ml/kg (2970 mg/kg/d) in male and female Rhesus monkeys dosed by gavage for 18 months. Critical effects = ophthalmologic effect; UF = 100. CCD RRD date: 6/11/1992.	<p><b>Tier 3 Source:</b>  <b>MDEQ:</b>  <b>Basis:</b> MDEQ-RRD used the NOAEL of 1,000 mg/kg-day from a rat developmental study (Regnier, 1998; In OPP Memorandum, 2006) and uncertainty factor of 1,000 (10 each for interspecies variability, interspecies extrapolation, and database deficiency) to derive a chronic RfD of 1.0E+0 mg/kg-day. MDEQ (1992) value is based on ophthalmologic effect. Texas value derivation is not available. See details below.</p> <p><b>Tier 1 and 2 Sources:</b>  <b>IRIS:</b> No IRIS file available at this time.  <b>EPA-OPP:</b> An OPP Memorandum: Inert Reassessments: One Exemption from the Requirement of Tolerance for Dimethyl Sulfoxide (CAS Reg. No. 67-68-5) dated 6/16/2006 indicate that “DMSO has been demonstrated to be of low toxicity. Developmental toxicity was observed only at maternally toxic doses at concentrations greater than the limit dose. Based on this information, there is no concern for increased sensitivity to infants and children when used as an inert ingredient in pesticide formulations.” This document reports a developmental toxicity NOAEL = 1,000 mg/kg-day based on fetal effects:  <b>Critical Study:</b> Regnier, JF and Richard, J. 1998. Toxicologist 42 (1-s): 256-257  <b>Method(s):</b> groups of 25 female Sprague-Dawley rats were exposed to 0, 200, 1000, or 5,000 mg/kg-day DMSO in water on gestation days 6-15.  <b>Critical effect:</b> decreased fetal body weight and delayed rib ossification  <b>End point or Point of Departure (POD):</b> NOAEL = 1,000 mg/kg-day</p> <p><b>PPRTV:</b> No PPRTV record available at this time.  <b>MRL:</b> No MRL record available at this time.</p> <p><b>Tier 3 Sources:</b></p>		Complete



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<p><b>MDEQ:</b> CCD/RRD RfD = 3.0E+1 mg/kg-day.  <b>Critical Study:</b> Vogin, E; Carson, S., Cannon G., et al. 1970. Toxicol. Appl. Pharmacol. 16:606-612.  <b>Method(s):</b> Rhesus monkeys (4-6/group) were exposed to 0, 1, 3, or 9 dimethylsulfoxide (DMSO) (0, 0.099, 2.97, or 8.91 g/kg-day) by gavage for 18 months (74-87 weeks).  <b>Critical effect:</b> ophthalmologic effect  <b>End point or Point of Departure (POD):</b> NOAEL = 3 ml/kg-day (2970 mg/kg/d)  <b>Uncertainty Factors:</b> UF = 100 (10 each for interspecies variability and interspecies extrapolation)  <b>Source and date:</b> MDEQ-CCD/RRD, 6/11/1992</p> <p><b>Texas CEQ:</b> RfD = 3.3E+1 mg/kg-day:                      Source: TCEQ. Summary of Updates to the Tables Accompanying the Texas Risk Reduction Program (TRRP) Rule, 2014. Table 11</p> <p><b>OTHERS:</b> No value is available at this time from these Tier 3 sources/databases: HEAST, NTP ROC, health and environmental agencies of California, Massachusetts, Minnesota, New Jersey, and New York, Canada, The Netherlands (RIVM), WHO (IARC), WHO (IPCS/INCHEM), ECHA (REACH) and OECD HPV.</p>		
<b>Oral Cancer Slope Factor (CSF) (mg/kg-day)<sup>-1</sup></b>	--	NA	MDEQ, 2015	
<b>CSF details</b>	NA	<p><b>Weight of Evidence:</b> Animal studies suggested DMSO was not a carcinogen. There are mixed results in mutagenicity studies, but the majority of the data do not suggest a significant genotoxic risk from exposure to DMSO.  <b>Source and Date:</b> EPA-OPP Memo: Inert Reassessments: One Exemption from the Requirement of Tolerance for Dimethyl Sulfoxide (CAS Reg. No. 67-68-5) dated 6/16/2006</p> <p><b>Tier 1 and 2 Sources:</b>  <b>IRIS:</b> No IRIS file available at this time.  <b>PPRTV:</b> No PPRTV record available at this time.</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<p><b>MRL:</b> NA; MRLs are for non-cancer effects only.</p> <p><b>Tier 3 Source:</b></p> <p><b>MDEQ:</b> Per DEQ-CCD, no value at this time.</p>		
Reference Concentration (RfC) or Initial Threshold Screening Level (ITSL) (µg/m³)	2.0E+1	2.0E+1	MDEQ, 2005	
RfC/ITSL details	Based on 6 week rat inhalation study.	<p><b>Tier 3 Source:</b></p> <p><b>MDEQ:</b></p> <p><b>Basis:</b> MDEQ (2005) value. No available value from other Tier sources at this time. See details below.</p> <p><b>Tier 1 and 2 Sources:</b></p> <p><b>IRIS:</b> No IRIS file available at this time.</p> <p><b>PPRTV:</b> No PPRTV record available at this time.</p> <p><b>MRL:</b> No MRL record available at this time.</p> <p><b>Tier 3 Sources:</b></p> <p><b>MDEQ:</b> AQD (2005) ITSL = 2.0E+1. Annual averaging time.</p> <p><b>Critical Study:</b> Fishman, EG. Jenkins LJ, Coon RA, et al. Effects of acute and repeated inhalation of dimethyl sulfoxide in rats.1969. Toxicol Appl Pharmacol. 15:74-82.</p> <p><b>Method(s):</b> Sprague-Dawley rats were exposed to 200 mg/m<sup>3</sup> for 7 hrs. /day, 5 days/wk., for 30 exposures (6-week) by inhalation.</p> <p><b>Critical effect:</b> no adverse effects</p> <p><b>End point or Point of Departure (POD):</b> free-standing NOAEL = 200 mg/m<sup>3</sup></p> <p><b>Uncertainty Factors:</b> UF = 100 (10 each for interspecies variability and interspecies extrapolation); Additional uncertainty factor of 35 to account for study duration.</p> <p><b>Adjustment</b> for continuous exposure: NOAEL x (7 hrs. per day / 24 hrs. per day)</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<p><b>Source and date:</b> MDEQ-CCC/AQD, 12/13/2005</p> <p><b>OTHERS:</b> No value is available at this time from these Tier 3 sources/databases: HEAST, NTP ROC, health and environmental agencies of California, Massachusetts, Minnesota, New Jersey, New York, and Texas, Canada, The Netherlands (RIVM), WHO (IARC), WHO (IPCS/INCHEM), ECHA (REACH) and OECD HPV.</p>		
Inhalation Unit Risk Factor (IURF) (( $\mu\text{g}/\text{m}^3$ ) <sup>-1</sup> )	--	NA	MDEQ, 2015	
IURF details	NA	<p><b>Weight of Evidence:</b> Animal studies suggested DMSO was not a carcinogen. There are mixed results in mutagenicity studies, but the majority of the data do not suggest a significant genotoxic risk from exposure to DMSO.</p> <p><b>Source and Date:</b> EPA-OPP Memo: Inert Reassessments: One Exemption from the Requirement of Tolerance for Dimethyl Sulfoxide (CAS Reg. No. 67-68-5) dated 6/16/2006</p> <p><b>Tier 1 and 2 Sources:</b>  <b>IRIS:</b> No IRIS file available at this time.  <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, no value at this time.</p>		Complete
Mutagenic Mode of Action (MMOA)? (Y/N)	--	NO	USEPA, 2015	
MMOA Details	--	<p>NA</p> <p>Not listed as a carcinogen with mutagenic MOA in the USEPA OSWER List.</p>		
Developmental or Reproductive Effector? (Y/N)	No	No. The RfD and ITSL are not based on a reproductive-developmental effect.	MDEQ, 2015	
Developmental or Reproductive	NA	Possible developmental endpoint. Needs further evaluation.		



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
<b>Toxicity Details</b>				
<b>State Drinking Water Standard (SDWS) (ug/L)</b>	--	NO	SDWA, 1976	
<b>SDWS details</b>	NA	MI Safe Drinking Water Act (SDWA) 1976 PA 399		
<b>Secondary Maximum Contaminant Level (SMCL) (ug/L)</b>	--	NO	SDWA, 1976 and USEPA SMCL List	
<b>SMCL details</b>	NA	MI Safe Drinking Water Act (SDWA) 1976 PA 399 and USEPA SMCL List, 2015		
<b>Is there an aesthetic value for drinking water? (Y/N)</b>	NO	Not evaluated.	NA	
<b>Aesthetic value (ug/L)</b>	NA	NA	NA	
<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>	190,000
<b>Updated GSI value (µg/L)</b>	190,000
<b>Rule 57 Drinking Water Value (µg/L)</b>	830,000

	<b>Rule 57 Value (µg/L)</b>	<b>Verification Date</b>
<b>Human Non-cancer Values- Drinking water source (HNV-drink)</b>	830,000	7/1998
<b>Human Non-Cancer Values- Non-drinking water sources (HNV-Non-drink)</b>	67,000,000	7/1998
<b>Wildlife Value (WV)</b>	NA	NA
<b>Human Cancer Values for Drinking Water Source (HCV-drink)</b>	NA	NA
<b>Human Cancer values for non-drinking water source (HCV-Non-drink)</b>	NA	NA
<b>Final Chronic Value (FCV)</b>	190,000	9/1997
<b>Aquatic maximum value (AMV)</b>	1,700,000	9/1997
<b>Final Acute Value (FAV)</b>	3,400,000	9/1997

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>	NA	MDEQ, 2015
<b>Target Detection Limit – Water (<math>\mu\text{g}/\text{L}</math>)</b>	NA	MDEQ, 2015
<b>Target Detection Limit – Air (ppbv)</b>	NA	MDEQ, 2015
<b>Target Detection Limit – Soil Gas (ppbv)</b>	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 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