



CHEMICAL UPDATE WORKSHEET

Chemical Name:	Dimethylformamide
CAS #:	68-12-2
Revised By:	RRD Toxicology Unit
Revision Date:	August 17, 2015

(A) Chemical-Physical Properties

	Part 201 Value	Updated Value	Reference Source	Comments
Molecular Weight (g/mol)	73.1	73.10	EPI	EXP
Physical State at ambient temp	Liquid	Liquid	MDEQ	
Melting Point (°C)	---	-60.40	EPI	EXP
Boiling Point (°C)	153	153.00	EPI	EXP
Solubility (ug/L)	1.0E+9	1E+09	EPI	EXP
Vapor Pressure (mmHg at 25°C)	3.651	3.87E+00	EPI	EXP
HLC (atm-m ³ /mol at 25°C)	7.39E-8	7.39E-08	EPI	EXP
Log Kow (log P; octanol-water)	-1.01	-1.01	EPI	EXP
Koc (organic carbon; L/Kg)	0.102	1	EPI	EST
Ionizing Koc (L/kg)		NR	NA	NA
Diffusivity in Air (Di; cm ² /s)	0.08	9.72E-02	W9	EST
Diffusivity in Water (Dw; cm ² /s)	8.0E-6	1.117E-05	W9	EST
Soil Water Partition Coefficient (Kd; inorganics)	NR	NR	NA	NA

	Part 201 Value	Updated Value	Reference Source	Comments
Flash Point (°C)	136 F	58	CRC	EXP
Lower Explosivity Level (LEL; unit less)	NA	0.022	CRC	EXP
Critical Temperature (K)		649.6	CRC	EXP
Enthalpy of Vaporization (cal/mol)		NA	NA	NA
Density (g/mL, g/cm ³)		0.9445	CRC	EXP
EMSOFT Flux Residential 2 m (mg/day/cm ²)	NA	3.57E-06	EMSOFT	EST
EMSOFT Flux Residential 5 m (mg/day/cm ²)	NA	3.57E-06	EMSOFT	EST
EMSOFT Flux Nonresidential 2 m (mg/day/cm ²)	NA	4.51E-06	EMSOFT	EST
EMSOFT Flux Nonresidential 5 m (mg/day/cm ²)	NA	4.51E-06	EMSOFT	EST

(B) Toxicity Values/Benchmarks

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
Reference Dose (RfD) (mg/kg/day)	9.6E-2	1.0E-1	PPRTV, 2007	
RfD details	NOAEL of 540ppm in feed (96mg/kg/d) for female CD-1 mice exposed for 119 days. Critical effects = liver effects. UF = 1000 (Becci, 1983). HEAST value rounded to 2 significant figures. CCD/RRD date: 10/22/1991	<p>Tier 2 Source: PPRTV: Basis: PPRTV is a Tier 2 source. PPRTS (2007) chronic p-RfD = 1.0E-1 mg/kg-day (0.096 mg/kg/d): Critical Study: Becci, P.J., K.A. Voss, W.D. Johnson, et al. 1983. Sub chronic feeding study of N,N-dimethylformamide in rats and mice. J. Am. Coll. Toxicol. 2:371-378. Method(s): Wistar rats (25/sex/group) were exposed to 0, 215, 750, 2500 ppm N,N-dimethylformamide in diet for 104 days (Males: 0, 18, 61, 210 mg/kg-day; Females: 0, 20, 69, 235 mg/kg-day). CD-1 mice (30/sex/group) were exposed to 0, 160, 540, 1850 ppm N,N-dimethylformamide for 119 days (Males: 0, 22, 70, 246 mg/kg-day; Females: 0, 28, 96, 326 mg/kg-day) Critical effect: liver toxicity End point or Point of Departure (POD): NOAEL = 96 mg/kg/day Uncertainty Factors: UF = 1,000 (10 each for interspecies variability, interspecies extrapolation and use of a sub chronic study) Source and date: PPRTV, 9/27/2007</p> <p>Tier 1 and 2 Sources: IRIS: Per IRIS (10/01/1990), no value at this time. MRL: No MRL record available at this time.</p> <p>Tier 3 Source: MDEQ: Per DEQ-CCD/RRD (date), RfD = 9.6 mg/kg-day. See Part 201 Value RfD details.</p>		Complete
Oral Cancer Slope Factor (CSF) (mg/kg-day) ⁻¹	--	NA	MDEQ, 2015	
CSF details	NA	<p>Carcinogen Weight-of-Evidence (WOE) Class: data are inadequate for an assessment of human carcinogenic potential for dimethylformamide IRIS WOE Basis: inadequate evidence in humans and negative evidence in</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<p>adequate inhalation assays in rats and mice Source and Date: PPRTV, 9/27/2007 Tier 1 and 2 Sources: IRIS: Per IRIS (10/01/1990), no value at this time. PPRTV: Per PPRTV (9/27/2007), no value at this time. MRL: NA; MRLs are for non-cancer effects only.</p> <p>Tier 3 Sources: MDEQ: Per DEQ-CCD, no value at this time.</p> <p>Other Tier 3: 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, WHO (IARC), WHO (IPCS/INCHEM), Canada, The Netherlands (RIVM), OECD HPV, and ECHA (REACH).</p>		
Reference Concentration (RfC) or Initial Threshold Screening Level (ITSL) ($\mu\text{g}/\text{m}^3$)	3.0E+1	7.0E+0	PPRTV, 2007/MDEQ, 2015	
RfC/ITSL details	<p>Based on EPAs RfC, from Cirila et al 1984 and Catenacci et al 1984. CCD/AQD date: 8/23/1990</p>	<p>Tier 2 Source: PPRTV: Basis: PPRTV (2007) sub chronic p-RfC = $7 \text{ E-}2 \text{ mg}/\text{m}^3$. MDEQ applied an additional UF of 10 to account for use of sub chronic exposure studies to derive the chronic RfC = $7.1 \text{ E-}3 \text{ mg}/\text{m}^3$. This value is based on more current assessment (PPRTV, 2007) and newer high quality studies (Fiorito et al. (1997) and Cai et al. (1992) than IRIS. PPRTV is the most current assessment of dimethylformamide data. PPRTV: PPRTV (2007) derived a provisional sub chronic p-RfC of $7.0\text{E-}2 \text{ mg}/\text{m}^3$ based on occupational studies of Cirila et al. (1984), Fiorito et al. (1997) and Cai et al. (1992). These studies together set a LOAEL of 6 to $22 \text{ mg}/\text{m}^3$ and a NOAEL of $1.8 \text{ mg}/\text{m}^3$ for hepatotoxicity in workers sub chronically exposed to</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		<p>dimethylformamide. This RfC is accorded medium-to-high confidence based on the medium-to-high confidence in the co-principal studies and database.</p> <p>Critical Studies:</p> <p>1) Cirila, A.M., G. Pisati, E. Invernizzi and P. Torricelli. 1984. Epidemiological study on workers exposed to low dimethylformamide concentrations. G. Ital. Med. Lav. 6:149-156.</p> <p>2) Fiorito, A., F. Larese, S. Molinari and T. Zanin. 1997. Liver function alterations in synthetic leather workers exposed to dimethylformamide. Am. J. Ind. Med. 32:255-260.</p> <p>3) Cai, S.-X., M.-Y. Huang, L.-Q.-Xi, et al. 1992. Occupational dimethylformamide exposure. 3. Health effects of dimethylformamide after occupational exposure at low concentrations. Int. Arch. Occup. Environ. Health. 63:461-468.</p> <p>Method: epidemiologic studies</p> <p>Critical effect: elevated liver enzyme changes (in Fiorito et al., 1979; represents critical liver function)</p> <p>End point or Point of Departure (POD): LOAEL_{ADJ} = 7.14 mg/m³</p> <p>Uncertainty Factors: UF = 100 (10 each for interspecies variability and use of a LOAEL). Final total UF = 1000.</p> <p>Source and date: PPRTV, 9/27/2007</p> <p>Tier 1 and 2 Sources:</p> <p>IRIS: IRIS (1990) RfC = 3.0E-2 mg/ m³:</p> <p>Critical Study:</p> <p>1) Cirila, A.M., G. Pisati, E. Invernizzi and P. Torricelli. 1984. Epidemiological study on workers exposed to low dimethylformamide concentrations. G. Ital. Med. Lav. 6(3-4): 149-156.</p> <p>2) Catenacci, G., D. Grampella, R. Terzi, A. Sala and G. Polline. 1984. Hepatic function in subjects exposed to environmental concentrations of DMF lower than they actually proposed TLV. G. Ital. Med. Lav. 6(3-4): 157-158.</p> <p>Method(s):</p> <p>1) Epidemiological study of 100 workers exposed to a mean concentration of 22 mg/m³ DMF (range of 8 to 58 mg/m³, determined with personal air sampler) for</p>		

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<p>an average of 5 years (range of 1 to 15 years) and compared the results with those obtained from 100 pair-matched referent controls. The population studied was male, with a mean age of 36 years (range of 21 to 56 years of age).</p> <p>2) Study of 54 workers who had been employed in an acrylic fiber plant for more than 5 years. The workers were divided into two groups; the first group of 28 subjects was exposed to an 8-hour TWA concentration of 18 mg/m³ (range of 12 to 25 mg/m³) DMF, and the second group of 26 subjects was exposed to an 8-hour TWA concentration of 3 mg/m³ (range of 1 to 5 mg/m³) DMF. The duration-adjusted exposures were 6.4 and 1.1 mg/m³, respectively. The control group consisted of 54 workers who were never exposed to solvents.</p> <p>Critical effect: digestive disturbances and minimal hepatic changes suggestive of liver abnormalities</p> <p>End point or Point of Departure (POD): LOAEL = 22 mg/m³; LOAEL_{HEC} = 7.9 mg/m³</p> <p>Uncertainty Factors: UF = 300 (10 each for interspecies variability, interspecies extrapolation and use of a sub chronic study, and 3 for database deficiencies)</p> <p>Source and date: IRIS, Last revision date – 10/01/1990</p> <p>MRL: No MRL record available at this time.</p> <p>Tier 3 Source: MDEQ: Per DEQ-CCD, AQD adopted IRIS RfC. See Part 201 Value RfC details.</p>		
Inhalation Unit Risk Factor (IURF) ((µg/m³)⁻¹)	--	NA	MDEQ, 2015	
IURF details	NA	<p>Carcinogen Weight-of-Evidence (WOE) Class: data are inadequate for an assessment of human carcinogenic potential for dimethylformamide</p> <p>IRIS WOE Basis: inadequate evidence in humans and negative evidence in adequate inhalation assays in rats and mice</p> <p>Source and Date: PPRTV, 9/27/2007</p> <p>Tier 1 and 2 Sources: IRIS: Per IRIS (10/01/1990), no value at this time. PPRTV: Per PPRTV (9/27/2007), no value at this time. MRL: NA; MRLs are for non-cancer effects only.</p>		Complete

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		<p>Tier 3 Sources: MDEQ: Per DEQ-CCD, no value at this time.</p> <p>Other Tier 3: 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, WHO (IARC), WHO (IPCS/INCHEM), Canada, The Netherlands (RIVM), OECD HPV, and ECHA (REACH).</p>		
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	No. The RfD and ITSL are not based on a reproductive-developmental effect. (Note: Developmental toxicity data in animals (BASF, 1974a,b,c; BioDynamics, 1978; Kimmerle and Machemer, 1975) via inhalation, oral, dermal, or intraperitoneal exposure indicate that DMF is embryotoxic.)	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		

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
Is there an aesthetic value for drinking water? (Y/N)	NO	Not evaluated.	NA	
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 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)	---	0.1	MDEQ, 2015	
AE _d details				
Ingestion Absorption Efficiency (AE _i)		1.0	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)	NA
Updated GSI value (µg/L)	NA
Rule 57 Drinking Water Value (µg/L)	NA

	Rule 57 Value (µg/L)	Verification Date
Human Non-cancer Values- Drinking water source (HNV-drink)		
Human Non-Cancer Values- Non-drinking water sources (HNV-Non-drink)		
Wildlife Value (WV)		
Human Cancer Values for Drinking Water Source (HCV-drink)		
Human Cancer values for non-drinking water source (HCV-Non-drink)		
Final Chronic Value (FCV)		
Aquatic maximum value (AMV)		
Final Acute Value (FAV)		

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 ($\mu\text{g}/\text{kg}$)	NA	MDEQ, 2015
Target Detection Limit – Water ($\mu\text{g}/\text{L}$)	NA	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 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