



## CHEMICAL UPDATE WORKSHEET

<b>Chemical Name:</b>	<b>N-Methyl-morpholine</b>
<b>CAS #:</b>	<b>109-02-4</b>
<b>Revised By:</b>	RRD Toxicology Unit
<b>Revision Date:</b>	September 16, 2015

### (A) Chemical-Physical Properties

	Part 201 Value	Updated Value	Reference Source	Comments
Molecular Weight (g/mol)	101.17	101.15	EPI	EXP
Physical State at ambient temp	Liquid	Liquid	MDEQ	
Melting Point (°C)	---	-64.40	CRC	EXP
Boiling Point (°C)	116	116.00	EPI	EXP
Solubility (ug/L)	1.0E+9	1000000000	EPI	EXP
Vapor Pressure (mmHg at 25°C)	13.2	1.32E+01	PP	EST
HLC (atm-m <sup>3</sup> /mol at 25°C)	2.50E-7	2.50E-07	PP	EST
Log Kow (log P; octanol-water)	-0.33	-0.33	EPI	EXP
Koc (organic carbon; L/Kg)	0.474	7.231	EPI	EST
Ionizing Koc (L/kg)		NR	NA	NA
Diffusivity in Air (Di; cm <sup>2</sup> /s)	0.08	7.32E-02	W9	EST
Diffusivity in Water (Dw; cm <sup>2</sup> /s)	8.0E-6	8.96E-06	W9	EST
Soil Water Partition Coefficient (Kd; inorganics)	NR	NR	NA	NA

	Part 201 Value	Updated Value	Reference Source	Comments
Flash Point (°C)	NA	24	CRC	EXP
Lower Explosivity Level (LEL; unitless)	NA	NA	NA	NA
Critical Temperature (K)		NA	NA	NA
Enthalpy of Vaporization (cal/mol)		NA	NA	NA
Density (g/mL, g/cm <sup>3</sup> )		0.9051	CRC	EXP
EMSOFT Flux Residential 2 m (mg/day/cm <sup>2</sup> )	NA	4.61E-06	EMSOFT	EST
EMSOFT Flux Residential 5 m (mg/day/cm <sup>2</sup> )	NA	4.61E-06	EMSOFT	EST
EMSOFT Flux Nonresidential 2 m (mg/day/cm <sup>2</sup> )	NA	5.83E-06	EMSOFT	EST
EMSOFT Flux Nonresidential 5 m (mg/day/cm <sup>2</sup> )	NA	5.83E-06	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>	2.7E-3	7.0E-2	ECHA, 2015/MDEQ, 2015	
<b>RfD details</b>	<p>Per RD (&amp;WRD): The RfD is based on an oral LD50 study in male Carworth-Wistar rats (Smyth et al., 1949). Non-fasted rats (5/dose) were exposed via gastric intubation and observed up to 14 days after dosing. LD50 = 2.72 g/kg. UF = 100 (10 each for interspecies extrapolation and intraspecies variability). Acute-to-chronic application factor = 0.0001. Calculation date is 5/28/1992.</p>	<p><b>Tier 3 Source:</b>  <b>ECHA (REACH):</b>  <b>Basis:</b> The ECHA value, based on an unpublished 2003 subacute 28-day oral toxicity study in rodents (in Japanese), is selected with modifications. MDEQ applied an additional UF of 10 to account for database deficiency. Therefore, a total UF of 3,000 is applied to the NOAEL (200 mg/kg-day) to derive a RfD of 7.0E-2 mg/kg-day. ECHA’s database UF is 1. The 1992 MDEQ value is based on a 1949 range finding toxicity study’s lethal dose endpoint (LD50). See details below.</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> No MRL record available at this time.</p> <p><b>Tier 3 Sources:</b>  <b>MDEQ-CCD-RRD (5/28/1992):</b> RfD = 2.7E-3 (same for WRD).  <b>Critical Study:</b> Smyth, 1949. Journal of Industrial Hygiene and Toxicology 30:60-62. Range finding toxicity data, List III.  <b>Methods:</b> LD50 study using male Carworth-Wistar rats.  <b>Critical effect:</b> Death.  <b>End point or Point of Departure (POD):</b> LD50 = 2.72 g/kg.  <b>Uncertainty Factors:</b> UF = 100 and an acute to chronic application factor of 0.0001.  <b>Source and date:</b> MDEQ-CCD/WRD &amp; RRD, 05/28/1992.</p> <p><b>ECHA (REACH):</b> DNEL (Derived No Effect Level) = 0.67 (7.0E-1) mg/kg/day.  <b>Basis:</b>                      Most sensitive endpoint: repeated dose toxicity</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		<p>Reference type: public database, 2003.</p> <p>Guideline: OECD Guideline 407 (Repeated Dose 28-Day Oral Toxicity in Rodents)</p> <p>Key study: read-across from supporting substance (structural analogue or surrogate)</p> <p><u>Note:</u> The original study report is in Japanese language, although the figures and tables are in English. An English summary is available from the Japanese authorities and an extensive summary is present in the OECD HPV program files.</p> <p>Method: male and female Cjr:CD(SD)IGS rats were exposed to 0, 50, 200, 800 mg/kg bw/day N-ethylmorpholine (CAS # 100-74-3) orally (by gavage) daily for 28 days.</p> <p>NOAEL: 200 mg/kg bw/day; based on toxicologically adverse effects at 800 mg/kg bw/d only. The NOAEL for oral repeated dose toxicity in Cjr:CD(SD)IGS rats are considered to be 50 mg/kg bw/day for both sexes based on cage licking and chewing at 200 and 800 mg/kg bw/d. These clinical signs do not represent a toxicologically adverse effect and are furthermore not mentioned in an OECD 421 study, performed in the same lab with the same rat strain. As relevant adverse effects are observed at 800 mg/kg bw/d only, a NOAEL of 200 mg/kg bw/d is proposed.</p> <p>Overall assessment factor (AF): 300</p> <p>AF for differences in duration of exposure: 6 (subacute to chronic)</p> <p>AF for interspecies differences (allometric scaling): 2.5</p> <p>AF for other interspecies differences: 4 (rat)</p> <p>AF for intraspecies differences: 5</p> <p><b>Source:</b> ECHA REACH Dossier for N-Methyl-Morpholine (accessed 9/2015)</p> <p><b>Other Tier 3:</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, WHO (IARC), WHO (IPCS/INCHEM), Canada, The Netherlands (RIVM) and OECD HPV.</p>		



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
<b>Oral Cancer Slope Factor (CSF) (mg/kg-day)<sup>-1</sup></b>	--	NA	MDEQ, 2015	
<b>CSF details</b>	No IRIS file and no entries into CCD.	<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.  <b>Tier 3 Source:</b> <b>MDEQ:</b> Per DEQ-CCD, 1992, no value at this time.		Complete
<b>Reference Concentration (RfC) or Initial Threshold Screening Level (ITSL) (µg/m<sup>3</sup>)</b>	NA	NA	MDEQ, 2105	
<b>RfC/ITSL details</b>	No AQD entry into CCD.	<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> No MRL record available at this time.  <b>Tier 3 Source:</b> DEQ-CCD-AQD: no value reported.		Complete
<b>Inhalation Unit Risk Factor (IURF) ((µg/m<sup>3</sup>)<sup>-1</sup>)</b>	NA	NA	MDEQ, 2015	
<b>IURF details</b>	No entry into CCD.	<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> No MRL record available at this time.  <b>Tier 3 Source:</b> <b>DEQ-CCD-AQD:</b> no value reported.		Complete



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
<b>Mutagenic Mode of Action (MMOA)? (Y/N)</b>	--	No	USEPA, 2015	
<b>MMOA Details</b>	--	Not listed as a carcinogen with mutagenic MOA in the USEPA OSWER List		
<b>Developmental or Reproductive Effector? (Y/N)</b>	No	No, the RfD is not based on a reproductive-developmental effect.	MDEQ, 2015	
<b>Developmental or Reproductive Toxicity Details</b>		NA		
<b>State Drinking Water Standard (SDWS) (µg/L)</b>	NA	NO	SDWA, 1976	
<b>SDWS details</b>		MI Safe Drinking Water Act (SDWA) 1976 PA 399		
<b>Secondary Maximum Contaminant Level (SMCL) (µg/L)</b>	NA	NO	SDWA, 1976 and USEPA SMCL List	
<b>SMCL details</b>		MI Safe Drinking Water Act (SDWA) 1976 PA 399 and USEPA SMCL List, 2015		
<b>Is there an Aesthetic Value? (Y/N)</b>	No	Not evaluated.	NA	
<b>Aesthetic value details</b>	NA	NA		
<b>Is there a Phytotoxicity Value? (Y/N)</b>	No	Not evaluated.	NA	
<b>Phytotoxicity details</b>	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>	NA
<b>Updated GSI value (µg/L)</b>	NA
<b>Rule 57 Drinking Water Value (µg/L)</b>	NA

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

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