



CHEMICAL UPDATE WORKSHEET

Chemical Name:	2,4-Dinitrophenol
CAS #:	51-28-5
Revised By:	RRD Toxicology Unit
Revision Date:	September 24, 2015

(A) Chemical-Physical Properties

	Part 201 Value	Updated Value	Reference Source	Comments
Molecular Weight (g/mol)	184.11	184.11	EPI	EXP
Physical State at ambient temp	Solid	Solid	MDEQ	
Melting Point (°C)	115.5	115.50	EPI	EXP
Boiling Point (°C)	332.13	NA	NA	
Solubility (ug/L)	6.0E+6	2.790E+06	EPI	EXP
Vapor Pressure (mmHg at 25°C)	3.90E-4	3.90E-04	EPI	EXP
HLC (atm-m³/mol at 25°C)	8.60E-8	8.60E-08	EPI	EXP
Log Kow (log P; octanol-water)	1.67	1.67	EPI	EXP
Koc (organic carbon; L/Kg)	460.8	460.8	EPI	EST
Ionizing Koc (L/kg)		0.01	SSG	EST
Diffusivity in Air (Di; cm²/s)	2.73E-2	4.07E-02	W9	EST
Diffusivity in Water (Dw; cm²/s)	9.06E-6	9.0756E-06	W9	EST

	Part 201 Value	Updated Value	Reference Source	Comments
Soil Water Partition Coefficient (Kd; inorganics)	NR	NR	NA	NA
Flash Point (°C)	NA	NA	NA	NA
Lower Explosivity Level (LEL; unit less)	NA	NA	NA	NA
Critical Temperature (K)		827.85	EPA2001	EXP
Enthalpy of Vaporization (cal/mol)		2.50E+04	EPA2001	EXP
Density (g/mL, g/cm ³)		1.683	CRC	EXP
EMSOFT Flux Residential 2 m (mg/day/cm ²)	NA	4.87E-07	EMSOFT	EST
EMSOFT Flux Residential 5 m (mg/day/cm ²)	NA	4.87E-07	EMSOFT	EST
EMSOFT Flux Nonresidential 2 m (mg/day/cm ²)	NA	6.11E-07	EMSOFT	EST
EMSOFT Flux Nonresidential 5 m (mg/day/cm ²)	NA	6.11E-07	EMSOFT	EST

(B) Toxicity Values/Benchmarks

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
Reference Dose (RfD) (mg/kg/day)	--	2.0E-3	PPRTV, 2007	
RfD details	NA	<p>Tier 2 Source: PPRTV: Basis: PPRTV (9/25/2007) chronic RfD = 2.0E-3 mg/kg-day. PPRTV is the most recent data evaluation. PPRTV: PPRTV derived a subchronic p-RfD of 2.0E-2 mg/kg-day based on the information below. Applying an additional UF of 10 for subchronic to chronic duration extrapolation, PPRTV calculated a chronic pRfD = 2.0E-3 mg/kg-day, a value similar to the IRIS value. Subchronic p-RfD: Critical Study: Horner, W.D. 1942. Dinitrophenol and its relation to formation of cataracts. Arch. Ophthal. 27: 1097; Horner, W.D. 1946. Cataract following dinitrophenol treatment for obesity. Arch. Ophthal. 76: 447. Method(s): In 29 cases, the duration of treatment with 2,4-DNP varied from 3 months to 24 months. Neither the length of treatment nor the total dose seemed to have any bearing on the occurrence of cataracts. The available data do not allow the calculation of a minimum effect level for 2,4-DNP-induced cataract formation in humans. Critical effect: cataract development End point or Point of Departure (POD): subchronic LOAEL = 2 mg/kg-day <i>Uncertainty Factors:</i> UF = 1000 (10 each for intraspecies variability, subchronic to chronic, and use of a LOAEL) Source and Date: PPRTV, 9/25/2007</p> <p>Tier 1 and 2 Sources: IRIS: IRIS (1991) RfD = 2.0E-3 mg/kg-day. Critical Study: Horner, W.D. 1942. Dinitrophenol and its relation to formation of cataracts. Arch. Ophthal. 27: 1097. Method(s): Human exposures: Over 100 anecdotal cases of cataracts resulting</p>	Complete	



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		<p>from therapeutic use of 2,4- dinitrophenol were reviewed. In 29 cases, the duration of treatment with 2,4-DNP varied from 3 months to 24 months. Neither the length of treatment nor the total dose seemed to have any bearing on the occurrence of cataracts. The available data do not allow the calculation of a minimum effect level for 2,4-DNP-induced cataract formation in humans.</p> <p>Critical effect: Cataract formation</p> <p>End point or Point of Departure (POD): LOAEL = 2 mg/kg-day)</p> <p>Uncertainty Factors: UF = 1000 (10 each for intraspecies variability, interspecies extrapolation and use of a LOAEL)</p> <p>Source and date: IRIS, Last revision date – 7/01/1991</p> <p>Note: Per IRIS; A comprehensive review of toxicological studies published through May 2005 was conducted. No new health effects data were identified that would be directly useful in the revision of the existing RfD for 2,4-Dinitrophenol and a change in the RfD is not warranted at this time.</p> <p>MRL: Per ATSDR April 2015 List, no oral chronic at this time. Oral acute MRL = 0.01 mg/kg-day was derived on 8/1995 as follows:</p> <p>Critical Studies:</p> <p>1) Tainter ML, Stockton AB, Cutting WC. 1935b. Dinitrophenol in the treatment of obesity: Final report. JAMA 105:332-337.Method: 37 humans who took 2,4-DNP for weight reduction for an average of 14 days.</p> <p>Critical effect: sensation of warmth, increased perspiration, and body weight loss</p> <p>End point or Point of Departure (POD): LOAEL = 1.2 mg/kg.day</p> <p>Uncertainty Factors: UF = 100 (10 each for intraspecies variability and lack of NOAEL)</p> <p>Source and date: ATSDR, 08/1995</p> <p>Tier 3 Source:</p> <p>MDEQ: Per DEQ/RRD (11/24/2009), RfD = 1.0E-2 mg/kg-day:</p> <p>Critical Studies:</p> <p>1) Takahashi, M. et al. (2009). Reproductive and Developmental Toxicity</p>		

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		<p>Screening Study of 2,4-Dinitrophenol in Rats. Environ. Toxicol. 24: 74-81.</p> <p>2) Koizumi, M., Y. Yamamoto, Y. Ito, M. Takano, T. Enami, E. Kamata and R. Hasegawa. 2001. Comparative study of toxicity of 4-nitrophenol and 2,4-dinitrophenol in newborn and young rats. J Toxicol Sci. 26: 299-311.</p> <p>Method(s):</p> <p>1) 10 week old male and female rats (n=12 per dose group; 0, 3, 10, or 30 mg/kg/day) were dosed once daily via gastric intubation. Male rats were dosed for 46 days, beginning 14 days before mating. Female rats were dosed for 40 to 47 days, beginning 14 days before mating to day 3 of lactation. Female rats were mated with male rats of the same dose group.</p> <p>2) Toxicity comparison between newborn and young Sprague Dawley rats. Newborn rats from unexposed dams were exposed by gastric intubation on postnatal days 4 to 21 in a range finding study (5/sex/dose; 0, 3, 10, or 30 mg/kg/day) and a main study (6/sex/dose; 0, 3, 10, or 20 mg/kg/day) that included a recovery period. Young rats (5 to 6 weeks old) were exposed by gastric intubation for 14 days in a range finding study (0, 0.6, 2, 6, 20, or 60 mg/kg/day) or for 28 days in the main study (0, 3, 10, 30, or 80 mg/kg/day) that also included a recovery period.</p> <p>Critical effect: number of live pups on postnatal days 0 and 4, live birth index and body weight of live male and female pups on postnatal days 0 and 1 for the 30 mg/kg/day dose group, organ weights (liver, kidneys, and heart)</p> <p>End point or Point of Departure (POD): NOAEL = 10 mg/kg-day for general and developmental toxicity (Takahashi, 2009) and decreased absolute weights of testes in newborn rats (Koizumi, 2001)</p> <p>Uncertainty Factors: UF = 1,000 (10 each for inttraspecies variability, interspecies extrapolation and use of a subchronic study)</p> <p>Source and Date: MDEQ, 11/14/2009. An RRD Toxicological Assessment is available.</p> <p>Other Tier 3 Sources: 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 York, and Texas, WHO (IARC), WHO</p>		

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		(IPCS/INCHEM), Canada, The Netherlands (RIVM) and OECD HPV.		
Oral Cancer Slope Factor (CSF) (mg/kg-day)⁻¹	--	NA	MDEQ, 2015	
CSF details	NA	<p>Carcinogen Weight-of-Evidence (WOE) Class: inadequate information to assess carcinogenic potential</p> <p>IRIS WOE Basis: inadequate human data and inadequate animal data and mixed results in genotoxicity based on several short-term mutagenesis assays in bacteria, and in in vitro and in vivo mammalian systems.</p> <p>Source and Date: PPRTV, 9/25/2007</p> <p>Tier 1 and 2 Sources:</p> <p>IRIS: Per IRIS (7/1/1991), no value at this time.</p> <p>PPRTV: Per PPRTV (9/25/2007), no value at this time.</p> <p>MRL: NA; MRLs are for non-cancer effects only.</p> <p>Tier 3 Source:</p> <p>MDEQ: Per DEQ-CCD, no value at this time.</p>		Complete
Reference Concentration (RfC) or Initial Threshold Screening Level (ITSL) (µg/m³)	--	7.0E+0	MDEQ, 2006	
RfC/ITSL details	NA	<p>Tier 3 Source:</p> <p>MDEQ:</p> <p>Basis: ITSL is based on conversion of IRIS RfD of 2.0E-3 mg/kg-day to an inhalation concentration assuming 70 kg body weight and 20 m³/day inhalation rate. NJ is based on IRIS which currently has no available value and details for ECHA are not available.</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		<p>Tier 1 and 2 Sources: IRIS: Per IRIS (7/1/1991), no value at this time. PPRTV: Per PPRTV (9/25/2007), no value at this time. MRL: No MRL record available at this time.</p> <p>Tier 3 Sources: MDEQ: AQD (2006) ITSL = 7.0E+0 µg/m³ with 24 hour averaging time Basis: ITSL is based on conversion of IRIS RfD of 2.0E-3 mg/kg-day to an inhalation concentration assuming 70 kg body weight and 20 m³/day inhalation rate. IRIS (7/1/1991) RfD basis: Critical Study: Horner, W.D. 1942. Dinitrophenol and its relation to formation of cataracts. Arch. Ophthal. 27: 1097. Method(s): Human exposures: In 29 cases, the duration of treatment with 2,4-DNP varied from 3 months to 24 months. Neither the length of treatment nor the total dose seemed to have any bearing on the occurrence of cataracts. The available data do not allow the calculation of a minimum effect level for 2,4-DNP-induced cataract formation in humans. Critical effect: Cataract formation End point or Point of Departure (POD): LOAEL = 2 mg/kg-day Uncertainty Factors: UF = 1000 (10 each for intraspecies variability, interspecies extrapolation and use of a LOAEL) Source and date: MDEQ-CCD/AQD, 10/03/2006</p> <p>New Jersey DEP 8/2009: RfC = 7.0 µg/m³. Based on IRIS (1991) RfD = 2 µg/kg/day. Same as MDEQ derivation.</p> <p>ECHA: Derived no effects level (DNEL) = 0.0291 mg/m³. No further inhalation detail available, therefore not considered by MDEQ.</p> <p>Other Tier 3: No value is available at this time from these Tier 3</p>		

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		sources/databases: HEAST, NTP ROC, health and environmental agencies of California, Massachusetts, Minnesota, New York, and Texas, WHO (IARC), WHO (IPCS/INCHEM), Canada, The Netherlands (RIVM) and OECD HPV.		
Inhalation Unit Risk Factor (IURF) (($\mu\text{g}/\text{m}^3$) ⁻¹)	--	NA	MDEQ, 2015	
IURF details	NA	<p>Carcinogen Weight-of-Evidence (WOE) Class: inadequate information to assess carcinogenic potential</p> <p>IRIS WOE Basis: inadequate human data and inadequate animal data and mixed results in genotoxicity based on several short-term mutagenesis assays in bacteria, and in in vitro and in vivo mammalian systems.</p> <p>Source and Date: PPRTV, 9/25/2007</p> <p>Tier 1 and 2 Sources:</p> <p>IRIS: Per IRIS (7/1/1991), no value at this time.</p> <p>PPRTV: Per PPRTV (9/25/2007), no value at this time.</p> <p>MRL: NA; MRLs are for non-cancer effects only.</p> <p>Tier 3 Source:</p> <p>MDEQ: 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 or RfCITSL is not based on a reproductive-developmental effect; however, a Tier 3 (MDEQ) RfD value is based on a developmental effect.	MDEQ, 2015	
Developmental or Reproductive Toxicity Details	NA	See Updated Value RfD details – Tier 3 Values.		
State Drinking Water Standard (SDWS) (ug/L)	--	NO	SDWA, 1976	



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
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		
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	MDEQ, 2015/USEPA RAGS-E	
ABS _{gi} details		RAGS E (EPA, 2004) Default Value		
Skin absorption efficiency value (A _{Ed})	---	NA	MDEQ, 2015	
A _{Ed} details				
Ingestion Absorption Efficiency (A _{Ei})		1	MDEQ, 2015	
A _{Ei} Details				
Relative Source Contribution for Water (RSC _w)		NA	MDEQ, 2015	
Relative Source Contribution for Soil (RSC _s)		NA	MDEQ, 2015	
Relative Source Contribution for Air (RSC _A)		1	MDEQ, 2015	
Others				

(D) Rule 57 Water Quality Values and GSI Criteria

Current GSI value (µg/L)	25 (M); 19
Updated GSI value (µg/L)	25 (M); 19
Rule 57 Drinking Water Value (µg/L)	55

	Rule 57 Value (µg/L)	Verification Date
Human Non-cancer Values- Drinking water source (HNV-drink)	55	7/1997
Human Non-Cancer Values- Non-drinking water sources (HNV-Non-drink)	2,800	7/1997
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)	19	1/2003
Aquatic maximum value (AMV)	130	1/2003
Final Acute Value (FAV)	270	1/2003

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 ($\mu\text{g}/\text{kg}$)	830	MDEQ, 2015
Target Detection Limit – Water ($\mu\text{g}/\text{L}$)	25	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