Isoalkanes (CAS# 68551-17-7) GreenScreen® for Safer Chemicals (GreenScreen®) Assessment

Prepared for:

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GreenScreen® Executive Summary for Isoalkanes (CAS # 68551-17-7)

Isoalkanes is a chemical that is used as a solvent in automotive products, paints and coatings, degreasers, wood/floor wax, as a diluent in asphalt applications, and as a pesticide carrier base.

Isoalkanes was assigned a GreenScreen® Benchmark Score of 2 ("Use but Search for Safer Substitutes") as it has High persistence (P), High bioaccumulation (B), Moderate Group I Human Toxicity (carcinogenicity (C) and endocrine activity (E)), Moderate Group II Human Toxicity (neurotoxicity single dose (Ns)), and Moderate Group II* Human Toxicity (neurotoxicity repeated dose (Nr*)). This corresponds to GreenScreen® benchmark classifications 2a, 2b, 2c, 2d, and 2e in CPA 2011. Data gaps (DG) exist for respiratory sensitization (SnR*) and systemic toxicity single dose (STs). As outlined in CPA (2013) Section 12.2 (Step 8 – Conduct a Data Gap Analysis to assign a final Benchmark score), isoalkanes meets requirements for a GreenScreen® Benchmark Score of 2 despite the hazard data gaps. In a worst-case scenario, if isoalkanes were assigned a High score for the data gap respiratory sensitization (SnR*), or a Very High score for systemic toxicity single dose (STs), it would be categorized as a Benchmark 1 Chemical.

GreenScreen® Benchmark Score for Relevant Route of Exposure:
As a standard approach for GreenScreen® evaluations, all exposure routes (oral, dermal, and inhalation) were evaluated together, so the GreenScreen® Benchmark Score of 2 ("Use but Search for Safer Substitutes") is applicable for all routes of exposure.

GreenScreen® Hazard Ratings for Isoalkanes

Group I Human					Group II and II* Human									Ecotox		Fate		Physical	
C	M	R	D	E	AT	ST		N		SnS*	SnR*	IrS	IrE	AA	CA	P	B	Rx	F
						single	repeated*	single	repeated*										
M	**L**	**L**	**L**	*M*	**L**	DG	**L**	**M**	*M*	*L*	DG	*L*	*L*	**L**	**L**	*H*	**H**	*L*	**M**

Note: Hazard levels (Very High (vH), High (H), Moderate (M), Low (L), Very Low (vL)) in *italics* reflect estimated values, authoritative B lists, screening lists, weak analogues, and lower confidence. Hazard levels in **BOLD** font are used with good quality data, authoritative A lists, or strong analogues. Group II Human Health endpoints differ from Group II* Human Health endpoints in that they have four hazard scores (i.e., vH, H, M, and L) instead of three (i.e., H, M, and L), and are based on single exposures instead of repeated exposures. Please see Appendix A for a glossary of hazard acronyms.

GreenScreen® Assessment for Isoalkanes(CAS # 68551-17-7)

Method Version: GreenScreen® Version 1.2[1]
Assessment Type[2]: Certified

Chemical Name: Isoalkanes

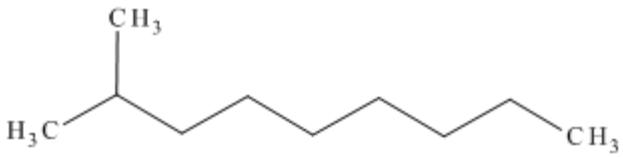
CAS Number: 68551-17-7

GreenScreen® Assessment Prepared By:
Name: Jennifer Rutkiewicz, Ph.D.
Title: Toxicologist
Organization: ToxServices LLC
Date: October 7, 2014
Assessor Type: Licensed GreenScreen® Profiler

Quality Control Performed By:
Name: Bingxuan Wang, Ph.D.
Title: Toxicologist
Organization: ToxServices LLC
Date: October 16, 2014

Confirm application of the *de minimus* rule[3]: N/A

Chemical Structure(s):



(representative C_{10} isoalkane, ChemIDplus 2014)

Also called: C10-13 Isoparaffin; Alkanes, C10-13-iso- (ChemIDplus 2014)

Chemical Structure(s) of Chemical Surrogates Used in the GreenScreen®:
No data were identified specifically for isoalkanes (C10-13 Isoparaffin). This chemical is a mixture of petroleum-derived alkyl-branched hydrocarbons primarily with carbon numbers between 10 and 13. It is a member of OECD's C9-C14 Aliphatic [≤2% aromatic] Hydrocarbon Solvents Category. Compounds in this category are compositionally similar and have similar functional groups (aliphatic constituents) and physicochemical properties, and available data support similar metabolism and a similar order of toxicity (OECD 2012). Isoparaffin mixtures similar in size to isoalkanes identified in the OECD assessment and REACH dossier (ECHA 2014) were selected as ideal surrogates based on a high degree of structural similarity. These chemicals include:

- Alkanes, C9-12-iso (CAS# 90622-57-4)
- Alkanes, C11-15-iso (CAS# 90622-58-5)
- Hydrocarbons, C10-C12, containing isoalkanes with less than 2% aromatics (No CAS#)

[1] Use GreenScreen® Assessment Procedure (Guidance) V1.2

[2] GreenScreen® reports are either "UNACCREDITED" (by unaccredited person), "AUTHORIZED" (by Authorized GreenScreen® Practitioner), "CERTIFIED" (by Licensed GreenScreen® Profiler or equivalent) or "CERTIFIED WITH VERIFICATION" (Certified or Authorized assessment that has passed GreenScreen® Verification Program)

[3] Every chemical in a material or formulation should be assessed if it is:
1. intentionally added and/or
2. present at greater than or equal to 100 ppm

To fill additional data gaps, studies for other members of OECD's Hydrocarbon Solvents Category including linear paraffins and cyclic hydrocarbons were also assessed. These chemicals include:

- Stoddard solvent (CAS# 64742-88-7)
- Undecane (CAS# 1120-21-4)
- Decane (CAS# 124-18-5)
- Alkylate naphtha distillate (CAS# 64741-66-8)
- White Spirit (CAS# 8052-41-3, 64742-82-1, and 64742-88-7)

Structures for these compounds are unspecified as they are mixtures.

Identify Applications/Functional Uses:
1. Solvent in automotive products, paints and coatings, degreasers, and wood/floor wax
2. Diluent in asphalt applications
3. Pesticide carrier base (OECD 2012)

GreenScreen® Summary Rating for Isoalkanes[4]: Isoalkanes was assigned a GreenScreen® Benchmark Score of 2 ("Use but Search for Safer Substitutes") as it has High persistence (P), High bioaccumulation (B), Moderate Group I Human Toxicity (carcinogenicity (C) and endocrine activity (E)), Moderate Group II Human Toxicity (neurotoxicity single dose (Ns)), and Moderate Group II* Human Toxicity (neurotoxicity repeated dose (Nr*)). This corresponds to GreenScreen® benchmark classifications 2a, 2b, 2c, 2d, and 2e in CPA 2011. Data gaps (DG) exist for respiratory sensitization (SnR*) and systemic toxicity single dose (STs). As outlined in CPA (2013) Section 12.2 (Step 8 – Conduct a Data Gap Analysis to assign a final Benchmark score), isoalkanes meets requirements for a GreenScreen® Benchmark Score of 2 despite the hazard data gaps. In a worst-case scenario, if isoalkanes were assigned a High score for the data gap respiratory sensitization (SnR*), or a Very High score for systemic toxicity single dose (STs), it would be categorized as a Benchmark 1 Chemical.

Figure 1: GreenScreen® Hazard Ratings for Isoalkanes

Group I Human					Group II and II* Human									Ecotox		Fate		Physical	
C	M	R	D	E	AT	ST		N		SnS*	SnR*	IrS	IrE	AA	CA	P	B	Rx	F
						single	repeated*	single	repeated*										
M	L	L	L	*M*	L	DG	L	M	*M*	*L*	DG	*L*	*L*	L	L	*H*	H	*L*	M

Note: Hazard levels (Very High (vH), High (H), Moderate (M), Low (L), Very Low (vL)) in *italics* reflect estimated (modeled) values, authoritative B lists, screening lists, weak analogues and lower confidence. Hazard levels in **BOLD** font are used with good quality data, authoritative A lists, or strong analogues. Group II Human Health endpoints differ from Group II* Human Health endpoints in that they have four hazard scores (i.e. vH, H, M, and L) instead of three (i.e. H, M, and L), and are based on single exposures instead of repeated exposures. Please see Appendix A for a glossary of hazard acronyms.

[4] For inorganic chemicals with low human and ecotoxicity across all hazard endpoints and low bioaccumulation potential, persistence alone will not be deemed problematic. Inorganic chemicals that are only persistent will be evaluated under the criteria for Benchmark 4.

Transformation Products and Ratings:

Identify feasible and relevant fate and transformation products (i.e., dissociation products, transformation products, valence states) **and/or moieties of concern**[5]

Isoalkanes and other C9-C14 alophatic hydrocarbon solvents do not undergo hydrolysis as they do not contain hydrolysable functional groups. These compounds are also poorly susceptible to photolysis. Isoalkanes is likely to undergo slow biodegradation (OECD 2012). No biodegradation products were identified.

Introduction

Isoalkanes (CAS# 68551-17-7) is a mixture of various isomers of petroleum-derived alkyl-branched hydrocarbons primarily with carbon numbers between 10 and 13. It is used as a solvent in automotive products, paints and coatings, degreasers, wood/floor wax, as a diluent in asphalt applications, and as a pesticide carrier base (OECD 2012).

ToxServices assessed isoalkanes against GreenScreen® Version 1.2 (CPA 2013) following procedures outlined in ToxServices' SOP 1.69 (GreenScreen® Hazard Assessment) (ToxServices 2013).

GreenScreen® List Translator Screening Results

The GreenScreen® List Translator identifies specific authoritative or screening lists that should be searched to identify GreenScreen® benchmark 1 chemicals (CPA 2012b). Pharos (Pharos 2014) is an online list-searching tool that is used to screen chemicals against the List Translator electronically. It checks all of the lists in the List Translator with the exception of the U.S. Department of Transportation (U.S. DOT) lists (U.S. DOT 2008a,b) and these should be checked separately in conjunction with running the Pharos query. The output indicates benchmark or possible benchmark scores for each human health and environmental endpoint. The output for isoalkanes can be found in Appendix C and a summary of the results can be found below:

- Aquatic Toxicity
    - Environment Canada - Domestic Substances List (DSL) Inherently Toxic in the Environment

PhysicoChemical Properties of Isoalkanes

Isoalkanes is a liquid at room temperature. Its vapor pressure of 0.03 mmHg indicates that it may volatilize. It has a low estimated water solubility of 0.713 mg/L, and its estimated log K_{ow} of 5.31 indicates a potential for bioaccumulation.

Table 1: Physical and Chemical Properties of Isoalkanes (CAS # 68551-17-7)

Property	Value	Reference
Molecular formula	Unspecified	ChemIDplus 2014
SMILES Notation	CC(CCCCCCC)C (representative C_{10} isoalkane	ChemIDplus 2014
Molecular weight	Unspecified	ChemIDplus 2014
Physical state	Liquid	ECHA 2014

[5] A moiety is a discrete chemical entity that is a constituent part or component of a substance. A moiety of concern is often the parent substance itself for organic compounds. For inorganic compounds, the moiety of concern is typically a dissociated component of the substance or a transformation product.

Table 1: Physical and Chemical Properties of Isoalkanes (CAS # 68551-17-7)		
Property	**Value**	**Reference**
Appearance	Colorless	ECHA 2014
Melting point	- 114°C	ECHA 2014
Vapor pressure	0.04 kPa (0.03 mmHg) at 20°C (calc.)	ECHA 2014
Water solubility	Negligible 0.713 mg/L (est.)	Chevron 2013 U.S. EPA 2012
Dissociation constant	Not identified	
Density/specific gravity	0.76 g/cm^3	ECHA 2014
Partition coefficient	log K_{ow} = 5.31 (est.)	U.S. EPA 2012

Hazard Classification Summary Section:

Group I Human Health Effects (Group I Human)

Carcinogenicity (C) Score (H, M, or L): *M*
Isoalkanes was assigned a score of Moderate for carcinogenicity based on evidence of adrenal gland tumors in male rats and equivocal evidence of liver tumors in female mice for the surrogate Stoddard solvent. GreenScreen® criteria classify chemicals as a Moderate hazard for carcinogenicity when there is limited or marginal evidence of carcinogenicity in animals (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists

Isoalkanes (CAS# 68551-17-7)

- No data were identified

Stoddard solvent (CAS# 64742-88-7)

- OECD 2012
  - In a carcinogenicity study directed by NTP, Stoddard solvent was administered to male and female F344 rats (50/sex/dose) at levels of 0, 0.138 (males only), 0.55, 1.1, or 2.2 (females only) mg/L for 6 hour/day, 5 days/week for 105 weeks. In males, there was an increase in adrenal gland tumors. No treatment-related neoplasms were seen in females. NTP concluded that there was some evidence of carcinogenicity in male rats and no evidence of carcinogenicity in female rats.
  - In a carcinogenicity study directed by NTP, Stoddard solvent was administered to male and female C6C3F1 mice (50/sex/dose) at levels of 0, 0.55, 1.1, or 2.2 mg/L for 105 weeks. There was no evidence of carcinogenicity in males. In females there was an increase in liver tumors which was considered by NTP to be equivocal evidence of carcinogenicity because the tumors were secondary to an increase in body weight.
- Based on the weight of evidence, a conservative score of Moderate was assigned due to evidence of carcinogenicity in male rats and equivocal evidence of carcinogenicity in female mice for Stoddard solvent. Stoddard solvent is a mixture containing linear, branched, and/or cyclic paraffins with carbon numbers predominantly between C9 to C14 (OECD 2012). Confidence in this score is reduced because it is unclear whether the effects are due to the isoalkanes in the mixture or to linear and cyclic compounds.

Mutagenicity/Genotoxicity (M) Score (H, M, or L): L

Isoalkanes was assigned a score of Low for mutagenicity/genotoxicity based on negative results in numerous *in vitro* and *in vivo* mutagenicity and clastogenicity assays of isoalkanes and the surrogates C9-12 and C11-15 isoalkanes. GreenScreen® criteria classify chemicals as a Low hazard for mutagenicity/genotoxicity when adequate data are available and are negative for both mutagenicity and clastogenicity, and the chemical is not present on authoritative or screening lists (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists

Isoalkanes (CAS# 68551-17-7)

- CIR 2012
  - Isoalkanes was not mutagenic in an Ames reverse mutation assay in *S. typhimurium* strains TA98, TA100, TA1535, TA537, and TA1538 when tested at doses up to 10,000 µg/plate with and without metabolic activation.
  - Isoalkanes was not mutagenic in an *in vitro* mammalian cell forward mutation assay in L5178Y lymphoma cells when tested at doses up to 1,000 µg/mL with and without metabolic activation.
  - Isoalkanes was negative in an *in vitro* sister chromatid exchange assay in Chinese hamster ovary (CHO) cells when tested at doses up to those that caused cytotoxicity.

C9-C14 Aliphatic [≤2% aromatic] Hydrocarbon Solvents Category

- OECD 2012
  - C9-14 aliphatic hydrocarbons have tested negative in several *in vitro* bacterial and mammalian cell mutagenicity assays, *in vitro* chromosome aberration and sister chromatid exchange assays, and *in vivo* chromosome aberration assays and dominant lethal tests.

Alkanes, C9-12-iso (CAS# 90622-57-4)

- ESIS 2000a
  - Alkanes, C9-12-iso was negative in a GLP-compliant Ames test in *S. typhimurium* strains TA98, TA100, TA1535, TA1537, and TA1538 with and without metabolic activation. No additional details were provided.
  - Alkanes, C9-12-iso was negative in a GLP-compliant DNA damage and repair assay in *E. coli* Pol A+A-. No additional details were provided.
  - Alkanes, C9-12-iso was negative in a GLP-compliant reverse mutation assay in *E. coli* WP2. No additional details were provided.
  - Alkanes, C9-12-iso was negative in an *in vivo* dominant lethal assay in Sprague-Dawley rats that were administered 300 or 900 ppm via inhalation for 5 days. No additional details were provided.
  - Alkanes, C9-12-iso was negative in an *in vivo* micronucleus assay in animals that were tested 48 and 72 hours after i.p. exposure. No additional details were provided.

Alkanes, C11-15-iso (CAS# 90622-58-5)

- ESIS 2000b
  - Alkanes, C11-15-iso was negative in a GLP-compliant Ames test in *S. typhimurium* strains TA98, TA100, TA1535, TA1537, and TA1538 with and without metabolic activation. No additional details were provided.
  - Alkanes, C11-15-iso was negative in an *in vivo* micronucleus assay in CD-1 mice that were administered 1.25, 2.5, or 5.0 g/kg via gavage and sacrificed 24, 48, or 72 hours after exposure. No additional details were provided.

Reproductive Toxicity (R) Score (H, M, or L): L

Isoalkanes was assigned a score of Low for reproductive toxicity based on a lack of effects on reproduction in reproductive toxicity screening studies of C10 and C11 paraffins in rats. GreenScreen® criteria classify chemicals as a Low hazard for reproductive toxicity when adequate data are available and are negative for reproductive toxicity, and the chemical is not present on authoritative or screening lists (CPA 2012a).

- Authoritative and Screening Lists
    - *Authoritative:* Not present on any authoritative lists
    - *Screening:* Not present on any screening lists

Isoalkanes (CAS# 68551-17-7)

- No data were identified

Undecane (CAS# 1120-21-4)

- OECD 2012
    - In a combined reproduction and developmental toxicity screening test (similar to OECD Guideline 422) of undecane, a C11 paraffin, in Sprague-Dawley rats, animals were administered 0, 100, 300, or 1,000 mg/kg/day undecane via gavage for 14 days prior to mating, through the mating period, and for a total of 46 days (males) or through lactation day 3 (females). There were no effects on the sex cycle of females, copulation and conception, pathological changes to the testis, epididymis, ovary, or number of pups. Authors identified a NOAEL of 1,000 mg/kg/day for reproductive toxicity. No additional details were provided.

Decane (CAS# 124-18-5)

- OECD 2012
    - In a combined reproduction and developmental toxicity screening test (similar to OECD Guideline 422) of decane, a C10 paraffin, in Sprague-Dawley rats, animals were administered 0, 25, 150, or 1,000 mg/kg/day undecane via gavage. Duration of treatment was not specified. There were no effects on reproductive parameters including reproductive performance (mating, conception, gestation length, and litter size) or offspring survival (gestation and postnatal survival indices, percent pre- and post-implantation loss). Authors identified a NOAEL of 1,000 mg/kg/day for reproductive toxicity.

Developmental Toxicity incl. Developmental Neurotoxicity (D) Score (H, M, or L): L

Isoalkanes was assigned a score of Low for developmental toxicity based on negative results in an inhalation developmental toxicity study in rats for the surrogate C9-12 isoalkanes. GreenScreen® criteria classify chemicals as a Low hazard for developmental toxicity when adequate data are available and are negative for developmental toxicity, and the chemical is not present on authoritative or screening lists (CPA 2012a).

- Authoritative and Screening Lists
    - *Authoritative:* Not present on any authoritative lists
    - *Screening:* Not present on any screening lists

Isoalkanes (CAS# 68551-17-7)

- No data were identified

C9-C14 Aliphatic [≤2% aromatic] Hydrocarbon Solvents Category

- OECD 2012
    - In numerous reproductive and developmental toxicity studies on category members, there were no effects on fetal development. C9-C14 aliphatic hydrocarbons are not expected to be developmental toxicants.

Alkanes, C9-12-iso (CAS# 90622-57-4)

- OECD 2012
    - In an inhalation toxicity study in Sprague-Dawley rats, dams were administered 300 or 900 ppm alkanes, C9-12-iso via inhalation for 6 hours/day on gestation days 6-15. No additional treatment details were provided. Other than a slight increase in excessive lacrimation in females at the high dose and brown flakes in the fur of the head, there was no evidence of maternal toxicity. There were no treatment-related effects on external, visceral, or soft tissue malformations. There were no effects on fetal size, sex distribution, ossification variation, fetal examination endpoints, pregnancy rate, mortality, body weight gain and gross postmortem observations. OECD identified a NOAEC of 900 ppm (5.222 mg/L).

Endocrine Activity (E) Score (H, M, or L): *M*
Isoalkanes was assigned a score of Moderate for endocrine disruption based on adrenal tumors induced by a weak surrogate in male rats only. Confidence level was reduced due to the equivocal nature of this effect, the use of a weak surrogate, and lack of information on hormone levels. GreenScreen® criteria classify chemicals as a Moderate hazard for endocrine activity when there is evidence of endocrine activity (CPA 2012a).

- Authoritative and Screening Lists
    - *Authoritative:* Not present on any authoritative lists
    - *Screening:* Not present on any screening lists
- Not listed as a potential endocrine disruptor on the EU Priority List of Suspected Endocrine Disruptors.
- Not listed as a potential endocrine disruptor on the OSPAR List of Chemicals of Possible Concern.

<u>Isoalkanes (CAS# 68551-17-7)</u>

- No data were identified

<u>Stoddard solvent (CAS# 64742-88-7)</u>

- OECD 2012
    - In a carcinogenicity study directed by NTP, Stoddard solvent was administered to male and female F344 rats (50/sex/dose) at levels of 0, 0.138 (males only), 0.55, 1.1, or 2.2 (females only) mg/L for 6 hour/day, 5 days/week for 105 weeks. In males, there was an increase in adrenal gland tumors. No treatment-related neoplasms were seen in females. NTP concluded that there was some evidence of carcinogenicity in male rats and no evidence of carcinogenicity in female rats.

<u>Group II and II* Human Health Effects (Group II and II* Human)</u>
Note: Group II and Group II* endpoints are distinguished in the v 1.2 Benchmark system. For Systemic Toxicity and Neurotoxicity, Group II and II* are considered sub-endpoints and test data for single or repeated exposures may be used. If data exist for single OR repeated exposures, then the endpoint is not considered a data gap. If data are available for both single and repeated exposures, then the more conservative value is used.

Acute Mammalian Toxicity (AT) Group II Score (vH, H, M, or L): L
Isoalkanes was assigned a score of Low for acute toxicity based on oral LD_{50} values of greater than 34.6 g/kg for isoalkanes and greater than 5,000 mg/kg for the surrogates C9-12 and C11-15 isoalkanes in rats, and dermal LD_{50} values of 15.4 g/kg for isoalkanes and greater than 3,160 mg/kg for the surrogates C9-12 and C11-15 isoalkanes in rabbits. GreenScreen® criteria classify chemicals as a Low hazard for acute toxicity when oral and dermal LD_{50} values are greater than 2,000 mg/kg (CPA 2012a).

- Authoritative and Screening Lists
    - *Authoritative:* Not present on any authoritative lists

- *Screening:* Not present on any screening lists

Isoalkanes (CAS# 68551-17-7)

- CIR 2012
  - *Oral*: LD_{50} (rat, sex and strain not specified) > 34.6 g/kg
  - *Dermal*: LD_{50} (rabbit, sex and strain not specified) = 15.4 g/kg
  - *Inhalation*: LC_{50} (rat, sex and strain not specified) > 8.2 mg/L/6h

C9-C14 Aliphatic [≤2% aromatic] Hydrocarbon Solvents Category

- OECD 2012
  - C9-14 aliphatic hydrocarbons are of low acute toxicity. Oral LD_{50} values of category members range from > 5 to > 1.88 g/kg in rats, and dermal LD_{50} values are > 2,000 mg/kg in rats and rabbits. Inhalation LC_{50} values are greater than the maximum attainable concentrations.

Alkanes, C9-12-iso (CAS# 90622-57-4)

- ESIS 2000a
  - *Oral*: LD_{50} (rat, sex and strain not specified) > 5,000 mg/kg
  - *Dermal*: LD_{50} (rabbit, sex and strain not specified) > 3,160 mg/kg
  - *Inhalation*: LD_{50} (rat, sex and strain not specified) > 2,240 ppm/4 h (saturated) = 11.7 mg/L[6]
  - *Inhalation*: LC_{50} (rat, sex and strain not specified) > 2,000 ppm/4h = 10.5 mg/L
  - *Inhalation*: LC_{50} (rat, sex and strain not specified) > 975 ppm/4h = 5.1 mg/L

Alkanes, C11-15-iso (CAS# 90622-58-5)

- ESIS 2000b
  - *Oral*: LD_{50} (rat, sex and strain not specified) > 5,000 mg/kg
  - *Dermal*: LD_{50} (rabbit, sex and strain not specified) > 3,160 mg/kg
  - *Inhalation*: LD_{50} (rat, sex and strain not specified) > 715 ppm/4 h (saturated) = 4.6 m/L[7]
  - *Inhalation*: LC_{50} (rat, sex and strain not specified) > 290 ppm/4h (saturated) = 1.9 mg/L

Systemic Toxicity/Organ Effects incl. Immunotoxicity (ST)

***Group II Score (single dose)* (vH, H, M, or L):** DG

Isoalkanes was assigned a score of Data Gap for systemic toxicity (single dose) based on a lack of data for this endpoint.

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists
- No data were identified.

***Group II* Score (repeated dose)* (H, M, or L): L**

Isoalkanes was assigned a score of Low for systemic toxicity (repeated dose) based on a lack of systemic effects in numerous subchronic toxicity studies of members of OECD's class of C9-C14 aliphatic hydrocarbon solvents and supporting chemicals. GreenScreen® criteria classify chemicals as a Low hazard for systemic toxicity (repeated dose) when adequate data are available and no evidence of systemic toxicity is seen below the guidance values of 100 mg/kg/day for an oral study, 200 mg/kg/day for a dermal study, and 1.0 mg/L for an inhalation study (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists

[6] (2,240 ppm * 128)/24,450 = 11.7 mg/L assuming molecular weight of 128 for C9 isoalkane
[7] (715 ppm * 156)/24,450 = 4.6 mg/L assuming molecular weight of 128 for C11 isoalkane

Isoalkanes (CAS# 68551-17-7)

- No data were identified

C9-C14 Aliphatic [≤2% aromatic] Hydrocarbon Solvents Category

- OECD 2012
    - *Oral*: OECD briefly reviewed several subchronic oral toxicity studies of C9-C14 aliphatic category members and supporting chemicals, including isoalkanes with carbon lengths between 10 and 13. In some studies liver weights were increased without corresponding changes in liver enzymes and effects resolved after 28-day recovery periods. Kidney effects were seen in male rats exposed to lower molecular weight solvents and were attributed to an alpha 2u-globulin mediated response that is not relevant to human health. OECD reports NOAELs of 1,000 mg/kg/day, the highest dose tested, for hydrocarbons C10-C12 isoalkanes (<2% aromatics) (CAS# 64742-47-8) in a 90-day repeated dose toxicity study according to OECD Guideline 408 in Sprague-Dawley rats and for hydrocarbons C12 isoalkanes (<25% aromatics) (CAS# 93685-81-5) in a 90-day repeated dose toxicity study according to OECD Guideline 408 in Wistar rats. Other NOAELs reported include 5,000 mg/kg/day for hydrocarbons C10-C11, n-alkanes, isoalkanes, cyclics (< 2% aromatics) (CAS# 64742-48-9) in a 90-day study in Sprague-Dawley rats, 1,000 mg/kg/day for hydrocarbons C11-C14, n-alkanes, isoalkanes, cyclics (<2% aromatics) (CAS# 64742-47-8) in a 90-day study in Sprague-Dawley rats, 1,000 mg/kg/day for hydrocarbons C10 normal paraffins (<2% aromatics) (CAS# 124-18-5) in a repeated dose/reproductive toxicity screening test according to OECD Guideline 422 in Wistar rats, 1,000 mg/kg/day for hydrocarbons C11 normal paraffins (<2% aromatics) (CAS# 1120-21-4) in a repeated dose/reproductive toxicity screening test according to OECD Guideline 422 in Sprague-Dawley rats, and 3,000 mg/kg for tetramethylcyclohexane (C10 analogue cycloparaffinic substance, no CAS#) in 90-day studies in rats and beagle dogs. No additional details were provided.
    - *Dermal*: There was no evidence of systemic toxicity in a 28-day dermal toxicity study in New Zealand white rabbits that were administered 0, 100, 500, or 2,000 mg/kg/day C12-C14 normal paraffins (< 2% aromatics) (CAS# 64771-72-8) daily. The only treatment-related effect was severe dermal irritation resulting from repeated occlusive application of the test substance at the high dose. OECD identified a NOAEL of 500 mg/kg/day based on dermal effects at the high dose.
    - *Inhalation*: OECD briefly reviewed several subchronic inhalation toxicity studies of C9-C14 aliphatic category members and supporting chemicals, including isoalkanes with carbon lengths between 10 and 13. These studied showed no effects on mortality, and only one showed effects on body weight gain. Several studies demonstrated effects on the kidney of male rats consistent with an α2u-globulin-mediated response which is not relevant to humans. OECD reports NOAECs of 10.4 mg/L, the highest dose tested, in a 90-day study of C10-C12 isoparaffins (< 2% aromatics) (CAS# 64741-65-7) in albino rats, 5.22 mg/L, the highest dose tested, in a 90-day study of C10-C12 isoalkanes (<2% aromatics) (CAS# 60742-48-9) in Sprague-Dawley rats, and 6.257 mg/L, the highest dose tested in a 90-day study of C12 isoparaffins (<2% aromatics) (CAS# 93685-81-5) in Wistar rats. In another 90-day study of C12 isoparaffins (<2% aromatics) (CAS# 93685-81-5) in Wistar rats, the NOAEC was 1.39 mg/L based on effects on female body weight at higher doses. In studies of other category members, the NOAECs were 5.22 mg/L in a 90-day study of C9-C11 n-paraffins, isoparaffins, cyclics (<2% aromatics) (CAS# 64742-48-9) in Sprague-Dawley rats, 6.0 mg/L in a 90-day study of C11-C14 n-paraffins, isoparaffins, cyclics (CAS# 64742-47-8) in albino rats, and 4.2 mg/L in a 28-day study of C10-C13 n-alkanes, isoalkanes, cyclics (<2% aromatics) (CAS# 64742-48-9) in rhesus monkeys.

- OECD concluded that C9-C14 aliphatic hydrocarbon solvents do not produce significant systemic toxicity based on repeated dose studies on category members and supporting chemicals.

Neurotoxicity (N)
***Group II Score (single dose)* (vH, H, M, or L): M**
Isoalkanes was assigned a score of Moderate for neurotoxicity (single dose) based on transient effects on locomotor activity in mice exposed to C9-C11 isoparaffinic solvent via inhalation for 30 minutes. GreenScreen® criteria classify chemicals as a Moderate hazard for neurotoxicity (single dose) when available data indicate that GHS Category 3 classification for transient narcotic effects is appropriate (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists
- Not classified as a developmental neurotoxicant (Grandjean and Landrigan 2006, 2014).

<u>Isoalkanes (CAS# 68551-17-7)</u>

- No data were identified

<u>C9-C14 Aliphatic [≤2% aromatic] Hydrocarbon Solvents Category</u>

- OECD 2012
  - Members of the C9-C14 aliphatic hydrocarbons category with carbon numbers up to approximately 10 may cause acute, reversible CNS effects. Hydrocarbons with carbon numbers greater than 10 do not produce CNS effects at the maximum attainable concentrations.
  - The potential for acute neurotoxicity of C9-C11 and C10-C12 isoparaffinic solvents was tested in CFW mice that were exposed to vapors in operant conditioning chambers for 30 minutes. Locomotor activity and the ability to respond in tests of schedule-controlled operant behavior were assessed. Mice that were exposed to the C9-C11 solvent displayed increased locomotor activity relative to controls at concentrations of 4,000 and 6,000 ppm (23.231 and 34.846 mg/L) but showed no effects on schedule-controlled operant behavior. There were no treatment related effects in mice exposed to C10-C12 solvent, but authors noted that it was difficult to produce high vapor concentrations of this compound.

<u>Alkanes, C9-12-iso (CAS# 90622-57-4)</u>

- OECD 2012
  - Rats (strain not specified) that were exposed to 0, 0.5, 1.5, or 5.0 mg/L C10-C12 isoalkanes (CAS# 90622-57-4) for 8 hours/day for 5 consecutive days showed mild effects on learned performance measures (performance speed and correct choice latency) at the high dose. There were no significant effects on functional observation measurements or measurements of motor activity. Effects were mild and did not persist. OECD concluded that effects were consistent with narcosis and identified a NOAEC of 1.5 mg/L.
- Based on the weight of evidence, a conservative score of Moderate was assigned. While there were no effects on locomotor activity or schedule-controlled operant behavior in mice exposed to C10-C12 isoparaffinic solvent, authors acknowledged difficulty obtaining high vapor concentrations, and locomotor activity was increased in mice exposed to C9-C11 solvent. In addition, OECD reports that transient neurological effects are seen with exposure to isoparaffinic solvents with carbon numbers up to approximately 10, and isoalkanes (C10-C13) contains some constituents of this size. Narcotic effects in a short-term (3 day) inhalation study of C10-C12 isoalkanes also indicate a potential for CNS effects. Therefore a score of Moderate for transient narcotic effects (GHS Category 3) was assigned.

Group II* Score (repeated dose) **(H, M, or L):** *M*

Isoalkanes was assigned a score of Moderate for neurotoxicity (repeated dose) based on neurological effects in humans with chronic exposure to a C9-C11 aliphatic hydrocarbon solvent containing 15-20% aromatics. GreenScreen® criteria classify chemicals as a Moderate hazard for neurotoxicity (repeated dose) when available data indicate that GHS Category 2 classification is warranted (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists
- Not classified as a developmental neurotoxicant (Grandjean and Landrigan 2006, 2014).

White Spirits (CAS# 8052-41-3, 64742-82-1, and 64742-88-7)

- OECD 2012
  - OECD summarized a review of human literature demonstrating the potential for hydrocarbon solvents to cause chronic neurological effects in humans. The review focused on IPCS, SCOEL, and ECHA Committee for Risk Assessment evaluations of epidemiological studies of white spirits, which is a C9-C11 aliphatic hydrocarbon solvent containing 15-20% aromatics. In epidemiological studies, this solvent has been associated with complaints of memory fatigue, impaired concentration, irritability, dizziness, headache, anxiety and apathy, and impairment in short-term visual memory tests and the symbol-digit test. Effects increased with duration of exposure. ECHA's RAC concluded that chronic exposure to white spirits can cause effects in psychomotor, perception, and memory parameters, and disturbances in mood which can progress in severity. Studies are confounded by co-exposure to other solvents.

Alkylate naphtha distillate (CAS# 64741-66-8)

- OECD 2012
  - In a 13-week study, rats were exposed to 668, 2,220, or 6,646 ppm (2.4, 8.1, or 24.3 mg/L) alkylate naphtha distillate containing isoparaffinic hydrocarbons for 6 hours/day, 5 days/week for 13 weeks via whole body inhalation. Evaluations of motor activity and functional observation battery were performed on weeks 5, 9, 14, and 18 (in a recovery group). Nervous tissue was also evaluated in 6 animals/group. No additional experimental details were provided. There were no treatment-related effects in the functional observation battery. Effects on motor activity (not described) were considered by authors to be indicative of acute CNS depression rather than cumulative neurotoxicity. There were no effects on pathology of the brain, spinal cord, or peripheral nerves. Authors identified a NOAEL of 24.3 mg/L for neurotoxicity.
- Based on the weight of evidence, a conservative score of Moderate was assigned. Human data for white spirits indicate the potential for neurological effects with repeated exposures, although studies are confounded by co-exposure to other solvents. GHS Guidance allows for Category 2 classification based on human evidence when human evidence is not sufficiently convincing to place in Category 1. Due to the study deficiencies, these data are not sufficiently convincing for Category 1 and therefore Category 2, which corresponds to a score of Moderate, was assigned. Confidence in this score is reduced because no data for isoparaffins were available and it is unclear whether effects might have been due to aromatic constituents.

Skin Sensitization (SnS) Group II* Score (H, M, or L): *L*

Isoalkanes was assigned a score of Low for skin sensitization based on negative results in human patch tests for the surrogates C9-12 isoalkanes and C11-15 isoalkanes. GreenScreen® criteria classify chemicals as a Low hazard for skin sensitization when adequate data are available and are negative for sensitization, and the chemical is not present on authoritative or screening lists (CPA 2012a).

- Authoritative and Screening Lists
    - *Authoritative:* Not present on any authoritative lists
    - *Screening:* Not present on any screening lists

Isoalkanes (CAS# 68551-17-7)

- No data were identified

C9-C14 Aliphatic [≤2% aromatic] Hydrocarbon Solvents Category

- OECD 2012
    - C9-14 aliphatic hydrocarbon category members do not produce dermal sensitization.

Alkanes, C9-12-iso (CAS# 90622-57-4)

- ESIS 2000a
    - C9-12 isoalkanes were not sensitizing in a human patch test. There were no significant responses during challenge. No additional details were provided.

Alkanes, C11-15-iso (CAS# 90622-58-5)

- ESIS 2000b
    - C11-15 isoalkanes were not sensitizing in a human patch test. There were no significant responses during challenge. No additional details were provided.
- Based on the weight of evidence, a score of Low was assigned. OECD reports that C9-C14 aliphatic hydrocarbon solvents are not sensitizing, and C9-12 and C11-15 isoalkanes were not sensitizing in a human patch test. Confidence in this score is reduced due to the lack of available study details.

Respiratory Sensitization (SnR) Group II* Score (H, M, or L): DG

Isoalkanes was assigned a score of Data Gap for respiratory sensitization based on a lack of data for this endpoint.

- Authoritative and Screening Lists
    - *Authoritative:* Not present on any authoritative lists
    - *Screening:* Not present on any screening lists
- No data were identified.

Skin Irritation/Corrosivity (IrS) Group II Score (vH, H, M, or L): *L*

Isoalkanes was assigned a score of Low for skin irritation/corrosivity based on negative results in GLP-compliant skin irritation studies in rabbits for the surrogates C9-12 isoalkanes and C11-15 isoalkanes. GreenScreen® criteria classify chemicals as a Low hazard for skin irritation/corrosivity when adequate data are available and are negative for irritation, and the chemical is not present on authoritative or screening lists (CPA 2012a).

- Authoritative and Screening Lists
    - *Authoritative:* Not present on any authoritative lists
    - *Screening:* Not present on any screening lists

Isoalkanes (CAS# 68551-17-7)

- CIR 2012
    - Isoalkanes was a moderate irritant (grade 5.7) in one dermal irritation study in rabbits, and produced very slight to severe irritation when applied to intact or abraded skin in a second irritation study in rabbits.

C9-C14 Aliphatic [≤2% aromatic] Hydrocarbon Solvents Category

- OECD 2012
    - C9-14 aliphatic hydrocarbon category members produce at most minimal to slight skin irritation when tested in rabbits. They are not irritating to human skin but can cause irritant dermatitis with repeated exposures due to defatting of the skin.

Alkanes, C9-12-iso (CAS# 90622-57-4)

- ESIS 2000a
    - C9-12 isoalkanes was not irritating in a GLP-compliant OECD Guideline 404 study in rabbits. No additional details were provided.

Alkanes, C11-15-iso (CAS# 90622-58-5)

- ESIS 2000b
    - C11-15 isoalkanes was not irritating in a GLP-compliant OECD Guideline 404 study in rabbits. No additional details were provided.
- Based on the weight of evidence, a score of Low was assigned as both C9-12 and C11-15 alkanes were negative in GLP-compliant OECD Guideline 404 studies in rabbits. The CIR reports that isoalkanes (C10-13) produced very slight to severe irritation in rabbits, but no details were provided and the studies of C9-12 and C11-15 isoalkanes were weighted more heavily as they were GLP-compliant and conducted according to OECD Guidelines. Confidence in this score is reduced due to conflicting data.

Eye Irritation/Corrosivity (IrE) Group II Score (vH, H, M, or L): *L*

Isoalkanes was assigned a score of Low for eye irritation/corrosivity based on negative results in ocular irritation studies in rabbits. GreenScreen® criteria classify chemicals as a Low hazard for eye irritation/corrosivity when adequate data are available and are negative for irritation, and the chemical is not present on authoritative or screening lists (CPA 2012a).

- Authoritative and Screening Lists
    - *Authoritative:* Not present on any authoritative lists
    - *Screening:* Not present on any screening lists

Isoalkanes (CAS# 68551-17-7)

- CIR 2012
    - Isoalkanes produced mild conjunctival irritation (grade 1) but no corneal opacity when instilled into the eyes of rabbits. No additional details were provided.

C9-C14 Aliphatic [≤2% aromatic] Hydrocarbon Solvents Category

- OECD 2012
    - C9-14 aliphatic hydrocarbon category members produce at most minimal to slight eye irritation when tested in rabbits.

Alkanes, C9-12-iso (CAS# 90622-57-4)

- ESIS 2000a
    - C9-12 isoalkanes was not irritating to the eyes of rabbits. No additional details were provided.

Alkanes, C11-15-iso (CAS# 90622-58-5)

- ESIS 2000b
    - C11-15 isoalkanes was not irritating to the eyes of rabbits. No additional details were provided.
- Based on the weight of evidence, a score of Low was assigned due to OECD's report that C9-14 aliphatic hydrocarbon category members are not irritating, and negative ocular irritation studies in rabbits for the category members alkanes, C9-12-iso and alkanes, C11-15-iso. Confidence in this score is reduced because the ocular irritation studies in rabbits were not conducted according to guideline and few experimental details were available.

Ecotoxicity (Ecotox)

Acute Aquatic Toxicity (AA) Score (vH, H, M, or L): L

Isoalkanes was assigned a score of Low for acute aquatic toxicity based on LC/EC_{50} values of greater than 1,000 mg/L in fish, invertebrates, and algae for C10-C12 hydrocarbons containing isoalkanes. GreenScreen® criteria classify chemicals as a Low hazard for acute aquatic toxicity when LC/EC_{50} values are greater than 100 mg/L (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Environment Canada - Domestic Substances List (DSL) Inherently Toxic in the Environment

Isoalkanes (CAS# 68551-17-7)

- OECD 2014
  - Isoalkanes is classified on Environment Canada's DSL as inherently toxic to aquatic organisms based on Ecosar modeling results.

C9-C14 Aliphatic [≤2% aromatic] Hydrocarbon Solvents Category

- OECD 2012
  - Paraffinic hydrocarbons with a carbon number of 11 or greater do not exhibit acute aquatic toxicity, while those with a carbon number of 10 or less are expected to have aquatic toxicity in the range of 1-10 mg/L (nominal).

Hydrocarbons, C10-C12, containing isoalkanes with less than 2% aromatics

- ECHA 2014
  - 96-hour LC_{50} (*Oncorhynchus mykiss*, rainbow trout) > 1,000 mg/L (nominal)
  - 48-hour EC_{50} (*Daphnia magna*, water flea) > 1,000 mg/L (nominal)
  - 96-hour EC_{50} (*Chaetogammarus marinus*, marine amphipod) > 1,000 mg/L (nominal)
  - 72-hour EC_{50} (*Pseudokirchnerella subcapitata*, green algae) > 1,000 mg/L (nominal), growth and biomass
- Based on the weight of evidence, a score of Low was assigned. Classification as inherently toxic on the DSL was not considered in the assessment as classification was based on modeled data and high quality measured data were available for a strong surrogate.

Chronic Aquatic Toxicity (CA) Score (vH, H, M, or L): L

Isoalkanes was assigned a score of Low for chronic aquatic toxicity based on NOEC values of greater than 1 mg/L in daphnia and 1,000 mg/L in algae for C10-C12 hydrocarbons containing isoalkanes. GreenScreen® criteria classify chemicals as a Low hazard for chronic aquatic toxicity when chronic aquatic toxicity values are greater than 10 mg/L (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Environment Canada - Domestic Substances List (DSL) Inherently Toxic in the Environment

Isoalkanes (CAS# 68551-17-7)

- OECD 2014
  - Isoalkanes is classified on Environment Canada's DSL as inherently toxic to aquatic organisms based on Ecosar modeling results.

Alkanes, C9-12-iso (CAS# 90622-57-4)

- OECD 2012
    - Chronic studies of C10-12 isoparaffins (CAS# 90622-57-4) in *Daphnia magna* showed a NOEC of 0.025 mg/L (measured concentration). The nominal concentration was not reported. No additional details were provided.

Alkanes, C11-15-iso (CAS# 90622-58-5)

- OECD 2012
    - Chronic studies of C11-13 isoparaffins (CAS# 90622-58-5) showed no adverse effects in chronic studies of *Daphnia magna* up to concentrations of 1 mg/L (highest nominal concentration tested).

Hydrocarbons, C10-C12, containing isoalkanes with less than 2% aromatics

- ECHA 2014
    - 21-day NOEC (*Daphnia magna*, water flea) > 1 mg/L (nominal), growth and reproduction
    - 72-hour EC_{50} (*Pseudokirchnerella subcapitata*, green algae) > 1,000 mg/L (nominal), growth and biomass
- Based on the weight of evidence, a score of Low was assigned. Classification as inherently toxic on the DSL was not considered in the assessment as classification was based on modeled data and high quality measured data were available for a strong surrogate. One study of C10-12 isoparaffins reported a NOEC of 0.025 mg/L (measured concentration) in daphnia, but the nominal concentration was not reported. Another study of C10-12 hydrocarbons and a study of C11-13 isoparaffins showed no effects at 1 mg/L, the highest dose tested.

Environmental Fate (Fate)

Persistence (P) Score (vH, H, M, L, or vL): *H*

Isoalkanes was assigned a score of High for persistence based on a measured half-life of more than 41 days in water, its dominant compartment, and that it is inherently biodegradable. GreenScreen® criteria classify chemicals as a High hazard for persistence when the half-life in water is between 40 and 60 days (CPA 2012a).

- Authoritative and Screening Lists
    - *Authoritative:* Not present on any authoritative lists
    - *Screening:* Not present on any screening lists

C9-C14 Aliphatic [≤2% aromatic] Hydrocarbon Solvents Category

- OECD 2012
    - n-Paraffin constituents have the potential to biodegrade rapidly, but iso-paraffinic constituents have a slower rate of biodegradation.

Isoalkanes (CAS# 68551-17-7)

- U.S. EPA 2012
    - The BIOWIN modeling Ready Biodegradable Predictor indicates that isoalkanes is not expected to be readily biodegradable. Fugacity modeling predicts 82.6% will partition to water with a half-life of 37.5 days, 9.57% will partition to air with a half-life of 8.2 hours, and 5.46% will partition to sediment with a half-life of 337.5 days. See Appendix D for modeling output.

Hydrocarbons, C10-C12, containing isoalkanes with less than 2% aromatics

- ECHA 2014
    - Hydrocarbons, C10-C12 (48-60 mg/L) obtained 31% biodegradation after 28 days and 41% after 41 days during a non-acclimated phase and 42% biodegradation after 28 days and 48% after 41 days during an acclimated phase in a ready biodegradation test similar to OECD

Guideline 301F (Ready Biodegradability: Manometric Respirometry Test) using domestic activated sludge inoculum. Authors concluded that the substance is inherently biodegradable.

- Based on the weight of evidence, a score of Moderate was assigned. The surrogate C10-12 hydrocarbons containing isoalkanes was inherently but not readily biodegradable in a manometric respirometry test. Modeling predicts that isoalkanes is not readily biodegradable and that it partitions primarily to water with a half-life of 37.5 days. The manometric respirometry test indicated 41-48% degradation after 41 days, indicating that the biodegradation half-life in water is longer than 40 days. Based on this data and the inherent biodegradability, a score of High was assigned. Confidence in this score is reduced because it is partially based on modeled data.

Bioaccumulation (B) Score (vH, H, M, L, or vL): H
Isoalkanes was assigned a score of High for bioaccumulation based on measured BCF values of 400-4,408 in structurally similar C9-C14 aliphatic hydrocarbons and a modeled BAF of 2,056. GreenScreen® criteria classify chemicals as a High hazard for bioaccumulation when the BAF is between 1,000 and 5,000 (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists

<u>C9-C14 Aliphatic [≤2% aromatic] Hydrocarbon Solvents Category</u>

- OECD 2012
  - Some category members have the potential to bioaccumulate. Measured BCF values of 400 (aqueous) to 4,408 (dietary) for n-dodecane in fathead minnow and rainbow trout and 1,468 for iso-nonanes in carp have been reported

<u>Isoalkanes (CAS# 68551-17-7)</u>

- U.S. EPA 2012
  - BCFBAF predicts a BAF of 2,056 based on a log K_{ow} of 5.31, indicating this chemical is likely to bioaccumulate because the BAF is greater than 1,000 based on a log K_{ow} greater than 5. See Appendix D for modeling output.

Physical Hazards (Physical)

Reactivity (Rx) Score (vH, H, M, or L): *L*
Isoalkanes was assigned a score of Low for reactivity based on an MSDS stating that it has no oxidizing properties. Confidence is reduced due to lack of measured data. GreenScreen® criteria classify chemicals as a Low hazard for reactivity when the chemical has no oxidizing properties and is not otherwise reactive, and the chemical is not present on authoritative or screening lists (CPA 2012a).

- Authoritative and Screening Lists
  - *Authoritative:* Not present on any authoritative lists
  - *Screening:* Not present on any screening lists

<u>Isoalkanes (CAS# 68551-17-7)</u>

- Chevron 2013
  - Isoalkanes has no oxidizing properties.

Flammability (F) Score (vH, H, M, or L): M
Isoalkanes was assigned a score of Moderate for flammability based on its flash point of 67 °C. GreenScreen® criteria classify chemicals as a Moderate hazard for flammability when available data indicate that GHS Category 4 classification as a flammable liquid is warranted (CPA 2012a).

- Authoritative and Screening Lists
    - *Authoritative:* Not present on any authoritative lists
    - *Screening:* Not present on any screening lists

Isoalkanes (CAS# 68551-17-7)

- ECHA 2014
    - Isoalkanes has a measured flash point of 67 °C in a test according to ASTM D 93.
- Based on its flash point of 67 °C, isoalkanes warrants classification as a GHS Category 4 flammable liquid, which applies to chemicals with a flash point > 60 °C and ≤ 93 °C. This corresponds to a score of Moderate.

References

ChemIDplus. 2014. Entry for C10-13 Isoparaffin (CAS #68551-17-7). United States National Library of Medicine. Available at: http://chem.sis.nlm.nih.gov/chemidplus/chemidheavy.jsp.

Chevron Phillips Chemical Company LP. 2013. SOLTROL® 130 Isoparaffin Solvent (CAS# 68551-17-7). Material Safety Data Sheet Version 2.3. Revision Date 2-7-2013. Available at: http://www.cpchem.com/msds/100000068462_SDS_EU_EN.PDF.

Clean Production Action (CPA). 2011. The GreenScreen® for Safer Chemicals Version 1.2 Benchmarks. Dated October 2011. Available at: http://www.greenscreenchemicals.org/.

Clean Production Action (CPA). 2012a. The GreenScreen® for Safer Chemicals Version 1.2 Criteria. Dated: November 2012. Available at: http://www.greenscreenchemicals.org/.

Clean Production Action (CPA). 2012b. List Translator. Dated February 2012. Available at: http://www.greenscreenchemicals.org/.

Clean Production Action (CPA). 2013. The GreenScreen® for Safer Chemicals Chemical Hazard Assessment Procedure. Version 1.2 Guidance. Dated August 31, 2013. Available at: http://www.greenscreenchemicals.org/.

Cosmetic Ingredient Review (CIR). 2012. Safety Assessment of Isoparaffins as Used in Cosmetics. International Journal of Toxicology 31 (Supplement 3): 269S-295S.

European Chemicals Agency (ECHA). 2014. REACH Dossier for Alkanes, C10-13-iso- (CAS# 68551-17-7). Available at: http://apps.echa.europa.eu/registered/data/dossiers/DISS-97db71da-95c0-656c-e044-00144f67d031/DISS-97db71da-95c0-656c-e044-00144f67d031_DISS-97db71da-95c0-656c-e044-00144f67d031.html.

European Chemical Substances Information System (ESIS). 2000a. IUCLID Dataset for Alkanes, C9-12-iso (CAS# 90622-57-4). Available at: http://esis.jrc.ec.europa.eu/doc/IUCLID/datasheet/90622574.pdf.

European Chemical Substances Information System (ESIS). 2000b. IUCLID Dataset for Alkanes, C11-15-iso (CAS# 90622-58-5). Available at: http://esis.jrc.ec.europa.eu/doc/IUCLID/datasheet/90622585.pdf.

Grandjean, P. and P.J. Landrigan. 2006. Developmental neurotoxicity of industrial chemicals. Lancet 368: 2167-2178.

Grandjean, P. and P.J. Landrigan. 2014. Neurobehavioral effects of developmental toxicity. The Lancet 13: 330-338.

Organization for Economic Cooperation and Development (OECD). 2012. SIDS Initial Assessment Profile for C9-C14 Aliphatic [≤2% aromatic] Hydrocarbon Solvents Category. CoCAM 3, 16-18 October 2012. Available at: http://webnet.oecd.org/Hpv/UI/handler.axd?id=df9ce638-7b33-43c0-8080-bdad8796e192.

Organization for Economic Cooperation and Development (OECD). 2014. Categorization Results from the Canadian Domestic Substance List. Alkanes, C10-13-iso- (CAS# 68551-17-7). Available at: http://webnet.oecd.org/ccrweb/ChemicalDetails.aspx?ChemicalID=4AFD9E18-6698-4DC3-A81F-D6C8D2ECD207.

Pharos. 2014. Pharos Chemical and Material Library Entry for Alkanes, C10-13-iso (CAS #68551-17-7). Available at: http://www.pharosproject.net/material/.

ToxServices. 2013. SOP 1.69: GreenScreen® Hazard Assessments. Dated: August 17, 2013.

United States Department of Transportation (U.S. DOT). 2008a. Chemicals Listed with Classification. 49 CFR § 172.101. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2008-title49-vol2/pdf/CFR-2008-title49-vol2-sec172-101.pdf.

United States Department of Transportation (U.S. DOT). 2008b. Classification Criteria. 49 CFR § 173. Available at: http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&tpl=/ecfrbrowse/Title49/49cfr173_main_02.tpl.

United States Environmental Protection Agency (U.S. EPA). 2012. Estimation Programs Interface (EPI) Suite™ Web, v4.11, Washington, DC, USA. Available at: http://www.epa.gov/opptintr/exposure/pubs/episuitedl.htm.

APPENDIX A: Hazard Benchmark Acronyms
(in alphabetical order)

(AA) Acute Aquatic Toxicity

(AT) Acute Mammalian Toxicity

(B) Bioaccumulation

(C) Carcinogenicity

(CA) Chronic Aquatic Toxicity

(D) Developmental Toxicity

(E) Endocrine Activity

(F) Flammability

(IrE) Eye Irritation/Corrosivity

(IrS) Skin Irritation/Corrosivity

(M) Mutagenicity and Genotoxicity

(N) Neurotoxicity

(P) Persistence

(R) Reproductive Toxicity

(Rx) Reactivity

(SnS) Sensitization- Skin

(SnR) Sensitization- Respiratory

(ST) Systemic/Organ Toxicity

APPENDIX B: Results of Automated GreenScreen® Score Calculation for Isoalkanes (CAS #68551-17-7)

TOXSERVICES
TOXICOLOGY RISK ASSESSMENT CONSULTING

GreenScreen® Score Inspector

Table 1: Hazard Table

			Group I Human					Group II and II* Human									Ecotox		Fate		Physical	
			Carcinogenicity	Mutagenicity/Genotoxicity	Reproductive Toxicity	Developmental Toxicity	Endocrine Activity	Acute Toxicity	Systemic Toxicity		Neurotoxicity		Skin Sensitization*	Respiratory Sensitization*	Skin Irritation	Eye Irritation	Acute Aquatic Toxicity	Chronic Aquatic Toxicity	Persistence	Bioaccumulation	Reactivity	Flammability
Table 2: Chemical Details									S	R *	S	R *	*	*								
Inorganic Chemical?	Chemical Name	CAS#	C	M	R	D	E	AT	STs	STr	Ns	Nr	SNS*	SNR*	IrS	IrE	AA	CA	P	B	Rx	F
No	Isoalkanes	68551-17-7	*M*	L	L	L	*M*	L	DG	L	M	*M*	*L*	DG	*L*	*L*	L	L	*H*	H	*L*	M

Table 3: Hazard Summary Table

Benchmark	a	b	c	d	e	f	g
1	No	No	No	No	No		
2	Yes	Yes	Yes	Yes	Yes	No	No
3	STOP						
4	STOP						

Table 4

Chemical Name	Preliminary GreenScreen® Benchmark Score
Isoalkanes	2

Note: Chemical has not undergone a data gap assessment. Not a Final GreenScreen™ Score

Table 6

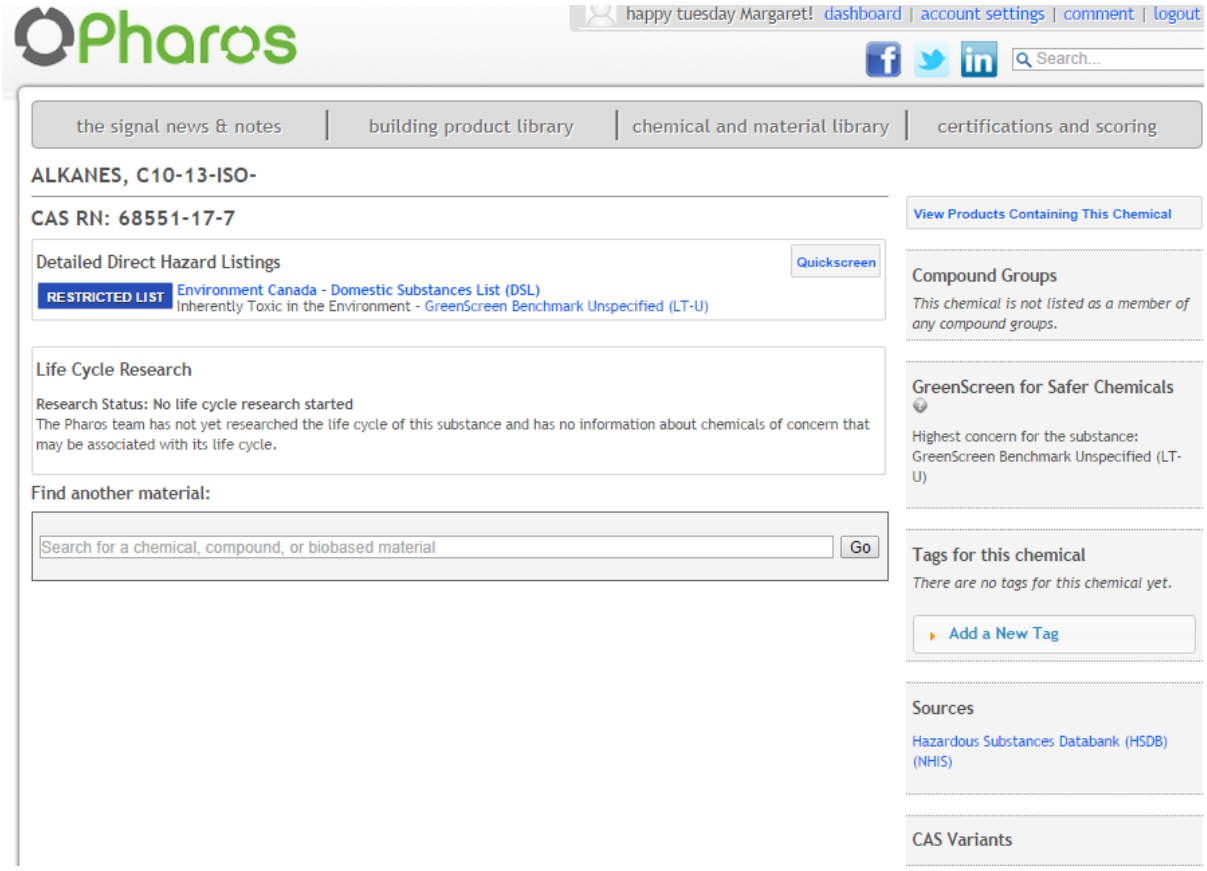
Chemical Name	Final GreenScreen® Benchmark Score
Isoalkanes	2

After Data gap Assessment
Note: No Data gap Assessment Done if Preliminary GS Benchmark Score is 1.

Table 5: Data Gap Assessment Table

Datagap Criteria	a	b	c	d	e	f	g	h	i	j	bm4	End Result
1												
2	Yes	Yes	Yes	Yes	Yes							2
3												
4												

APPENDIX C: Pharos Output for Isoalkanes (CAS #68551-17-7)



APPENDIX D: EPISuite Modeling Results for Isoalkanes (CAS #68551-17-7)

CAS Number: 68551-17-7
SMILES: C(C)(C)C(C)(C)C(C)(C)C=C
CHEM: Alkanes, C10-13-iso-
MOL FOR: C11 H22
MOL WT: 154.30
---------- EPI SUMMARY (v4.11) ----------
Physical Property Inputs:
Log K_{ow} (octanol-water): ------
Boiling Point (deg C): 189.00
Melting Point (deg C): -114.00
Vapor Pressure (mm Hg): 0.03
Water Solubility (mg/L): ------
Henry LC (atm-m^3/mole): ------

Log Octanol-Water Partition Coef (SRC):
Log K_{ow} (K_{ow}WIN v1.68 estimate) = 5.31

Boiling Pt, Melting Pt, Vapor Pressure Estimations (MPBPVP v1.43):
Boiling Pt (deg C): 127.37 (Adapted Stein & Brown method)
Melting Pt (deg C): -55.32 (Mean or Weighted MP)
VP (mm Hg,25 deg C): 0.87 (Mean VP of Antoine & Grain methods)
VP (Pa, 25 deg C): 116 (Mean VP of Antoine & Grain methods)

Water Solubility Estimate from Log K_{ow} (WSK_{ow} v1.42):
Water Solubility at 25 deg C (mg/L): 0.7193
log K_{ow} used: 5.31 (estimated)
melt pt used: -114.00 deg C

Water Sol Estimate from Fragments:
Wat Sol (v1.01 est) = 1.3515 mg/L

ECOSAR Class Program (ECOSAR v1.11):
Class(es) found:
Neutral Organics

Henrys Law Constant (25 deg C) [HENRYWIN v3.20]:
Bond Method: 1.48E+000 atm-m^3/mole (1.50E+005 Pa-m^3/mole)
Group Method: Incomplete
For Henry LC Comparison Purposes:
User-Entered Henry LC: not entered
Henrys LC [via VP/WSol estimate using User-Entered or Estimated values]:
HLC: 8.468E-003 atm-m^3/mole (8.580E+002 Pa-m^3/mole)
VP: 0.03 mm Hg (source: User-Entered)
WS: 0.719 mg/L (source: WSK_{ow}WIN)

Log Octanol-Air Partition Coefficient (25 deg C) [K_{oa}WIN v1.10]:
Log K_{ow} used: 5.31 (K_{ow}Win est)

Log K_{aw} used: 1.782 (HenryWin est)
Log K_{oa} (K_{oa}WIN v1.10 estimate): 3.528
Log K_{oa} (experimental database): None

Probability of Rapid Biodegradation (BIOWIN v4.10):
Biowin1 (Linear Model): 0.3062
Biowin2 (Non-Linear Model): 0.0673
Expert Survey Biodegradation Results:
Biowin3 (Ultimate Survey Model): 2.4340 (weeks-months)
Biowin4 (Primary Survey Model): 3.3182 (days-weeks)
MITI Biodegradation Probability:
Biowin5 (MITI Linear Model): 0.3587
Biowin6 (MITI Non-Linear Model): 0.2634
Anaerobic Biodegradation Probability:
Biowin7 (Anaerobic Linear Model): -0.6962
Ready Biodegradability Prediction: NO

Hydrocarbon Biodegradation (BioHCwin v1.01):
LOG BioHC Half-Life (days): 1.5286
BioHC Half-Life (days): 33.7734

Sorption to aerosols (25 Dec C)[AEROWIN v1.00]:
Vapor pressure (liquid/subcooled): 4 Pa (0.03 mm Hg)
Log K_{oa} (K_{oa}win est): 3.528
Kp (particle/gas partition coef. ($m^3/\mu g$)):
Mackay model: 7.5E-007
Octanol/air (K_{oa}) model: 8.28E-010
Fraction sorbed to airborne particulates (phi):
Junge-Pankow model: 2.71E-005
Mackay model: 6E-005
Octanol/air (K_{oa}) model: 6.62E-008

Atmospheric Oxidation (25 deg C) [AopWin v1.92]:
Hydroxyl Radicals Reaction:
OVERALL OH Rate Constant = 29.6899 E-12 cm^3/molecule-sec
Half-Life = 0.360 Days (12-hr day; 1.5E6 OH/cm^3)
Half-Life = 4.323 Hrs.
Ozone Reaction:
OVERALL Ozone Rate Constant = 0.175000 E-17 cm^3/molecule-sec
Half-Life = 6.549 Days (at 7E11 mol/cm^3)
Fraction sorbed to airborne particulates (phi):
4.35E-005 (Junge-Pankow, Mackay avg)
6.62E-008 (K_{oa} method)
Note: the sorbed fraction may be resistant to atmospheric oxidation

Soil Adsorption Coefficient (K_{oc}WIN v2.00):
K_{oc}: 1197 L/kg (MCI method)
Log K_{oc}: 3.078 (MCI method)
K_{oc}: 4.056E+004 L/kg (K_{ow} method)

Log K_{oc}: 4.608 (K_{ow} method)

Aqueous Base/Acid-Catalyzed Hydrolysis (25 deg C) [HYDROWIN v2.00]:
Rate constants can NOT be estimated for this structure!

Bioaccumulation Estimates (BCFBAF v3.01):
Log BCF from regression-based method = 3.171 (BCF = 1484 L/kg wet-wt)
Log Biotransformation Half-life (HL) = 0.6788 days (HL = 4.773 days)
Log BCF Arnot-Gobas method (upper trophic) = 3.229 (BCF = 1693)
Log BAF Arnot-Gobas method (upper trophic) = 3.313 (BAF = 2056)
log K_{ow} used: 5.31 (estimated)

Volatilization from Water:
Henry LC: 1.48 atm-m^3/mole (estimated by Bond SAR Method)
Half-Life from Model River: 1.268 hours
Half-Life from Model Lake: 118 hours (4.916 days)

Removal in Wastewater Treatment (recommended maximum 95%):
Total removal: 99.88 percent
Total biodegradation: 6.60 percent
Total sludge adsorption: 50.99 percent
Total to Air: 42.29 percent
(using Biowin/EPA draft method)

Level III Fugacity Model:

	Mass Amount (percent)	Half-Life (hr.)	Emissions (kg/hr.)
Air	9.57	8.2	1000
Water	82.6	900	1000
Soil	2.39	1.8e+003	1000
Sediment	5.46	8.1e+003	0

Persistence Time: 95 hr.

Sources to Check for GreenScreen® Hazard Assessment

Note: For a GreenScreen® Hazard Assessment, data queries should be initially limited to the following references. If data gaps exist after these references have been checked, additional references may be utilized.

U.S. EPA High Production Volume Information System (HPVIS):
http://www.epa.gov/hpvis/index.html

UNEP OECD Screening Information Datasets (SIDS):
http://www.chem.unep.ch/irptc/sids/OECDSIDS/sidspub.html

OECD Existing Chemicals Database: http://webnet.oecd.org/hpv/ui/SponsoredChemicals.aspx

European Chemical Substances Information System IUCLID Chemical Data Sheets:
http://esis.jrc.ec.europa.eu/index.php?PGM=dat

National Toxicology Program: http://ntp.niehs.nih.gov/

International Agency for the Research on Cancer:
http://monographs.iarc.fr/ENG/Classification/index.php

Human and Environmental Risk Assessment (HERA) on ingredients of household cleaning products:
http://www.heraproject.com/RiskAssessment.cfm

European Chemicals Agency (ECHA) REACH Dossiers: http://echa.europa.eu/

Licensed GreenScreen® Profilers

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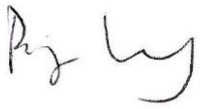

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