

Category A 'aliphatic and cyclic C5 and higher' - Chemical Category Justification

(NB : all compositions are in w/w for liquids and v/v for gases)

Category definition and its members	
1.1.	Category Definition
1.1.a.	Category Hypothesis
<p>The aliphatic and cyclic C5 and higher category covers hydrocarbon streams typically produced by the distillation of products from an aromatic process or distillation of hydrotreated naphtha. These hydrocarbon streams have a carbon number distribution that is predominantly C5-C7. All of the streams in this category a complex substances containing >20% alkyl and/or >20% cyclic hydrocarbons and between 0.1 and 15% benzene. Companies importing streams will need to confirm that such streams meet the chemical description and are in domain.</p> <p>It is reasonable to assume that the phys-chem and environmental fate properties of the category members will be very similar due to the small spread of carbon numbers. The streams will have similar environmental effects as their constituents cover a narrow carbon range and all act in similar manner, via narcosis. With regard to mammalian endpoints, category members are volatile liquids with inhalation and skin contact representing the primary routes of exposure. CNS depression, skin irritation (marker substance: cyclohexane) and irreversible effects (the latter linked to the presence of n-hexane, toluene and benzene) are likely to have the greatest impact on the health hazard assessment. It can therefore be assumed that streams meeting the applicability domain will behave in a similar manner and therefore the use of read-across is valid. For mammalian endpoints, the classification of these streams will be driven by the content of benzene, which is between 0.1 and 15% for all category members. Although these streams may be classified for aspiration hazard, this is not considered to represent a relevant health effect of these streams under conditions of normal use.</p>	
1.1.b.	Applicability domain (AD) of the category
<p>The category applies to substances with predominantly the following PIONA* analysis: > 20% aliphatics and/or > 20% cyclics with between 0.1 and 15% benzene and a carbon number distribution of predominantly 5-7.</p> <p>Boiling Point –the streams in this category will boil predominantly in the range of 30 - 100°C.</p> <p>Specific components (The range entered below is that currently based on received analytical data, it is not intended to be prescriptive. See section 1.3).</p> <p><i>Benzene: 0.1 – 15%</i></p> <p><i>Toluene: 0.1 – 25%</i></p> <p><i>Hexane: 1 -25%</i></p> <p><i>Pentane: 1 – 35%</i></p> <p><i>Isoprene: up to 20%</i></p> <p><i>1,3-butadiene - <0.1% to 1%</i></p> <p>PIONA*</p> <p>Paraffins – 20 - 50% : C# 4 - 7</p> <p>Isoparaffins – 4 – 60% : C# 4 - 7</p> <p>Olefins – 0 – 75% : C# 4 – 7</p>	

Naphthenics – 0 – 90% : C# 4 – 7

Aromatics – up to 40%

*: PIONA refers to a description of the type of hydrocarbons present, paraffins, isoparaffins, olefins, naphthenics (cycloparaffins) and aromatics. It does not refer to a specific type of analysis or determination.

1.2. Category Members

CAS Number	CAS Description	Registered Substance Name
102110-14-5	Hydrocarbons, C3-6, C5-rich, steam-cracked naphtha	Hydrocarbons, C3-6, C5-rich, steam-cracked naphtha
64741-84-0	Naphtha (petroleum), solvent-refined light	Naphtha (petroleum), solvent-refined light
64742-49-0	Naphtha (petroleum), hydrotreated light	Naphtha (petroleum), hydrotreated light
68476-55-1	Hydrocarbons, C5-rich	Hydrocarbons, C5-rich
68956-55-8	Hydrocarbons, C5-unsatd.	Hydrocarbons, C5-unsatd.
92128-65-9	Hydrocarbons, C5-8	Hydrocarbons, C5 - C8

1.3. Purity / Impurities

The substances in this category are UVCBs and as such are considered to be 100% pure. The term impurity is not relevant for UVCBs, however, substances will be described using the following:

- Known constituents present at 10% or greater (if any), identified by IUPAC name and EC number/CAS number, indicating typical concentrations and/or concentration ranges;
- Constituents relevant for hazard classification (if any);
- Constituents relevant for PBT assessment (if any).

Primary marker

Benzene (CAS# 71-43-2): tox classification: T, Carc Cat 1 R45, Mut Cat 2 R46, R36/38, R48/23/24/25, R65

Toxicity statements:

Benzene is a regulated as a non-threshold carcinogen shown to cause heritable genetic damage in germ cells in experimental animals and toxicity to blood forming elements present in bone marrow. It is irritating to eyes and skin and presents an aspiration hazard.

2. Category justification

The **aliphatic and cyclic C5 and higher** category is a UVCB category and covers hydrocarbon streams typically produced by the distillation of products from an aromatic process or distillation of hydrotreated naphtha. These hydrocarbon streams have a carbon number distribution that is predominantly C5-C7. All of the streams in this category are complex substances containing >20% alkyl and/or >20% cyclic hydrocarbons and between 0.1 and 15% benzene. The physico-chemical properties associated with these types of UVCBs indicated that they comprise a category based on the range of boiling points (from 24°C to 101.9°C) and will have similar behaviour in the environment. The log Kow ranges from 2.2-6.1 and the streams in this category are not considered to be readily biodegradable. The mammalian toxicity information and environmental assessment also indicated that the streams in this category exert similar effects.

3. Data matrix

The **aliphatic and cyclic C5 and higher** is a UCVB category and therefore identification of trends between category members is not appropriate and therefore, according to the ECHA Guidance on information requirements and chemical assessment Chapter R.6, it is not feasible to establish a full data matrix for this category. Consequently, a data set that applies to all members of this category has been developed.

4. Conclusions per endpoint for C&L, PBT/vPvB and dose descriptor

CLASSIFICATION AND LABELLING

Physico-chemical Hazard Assessment

- **Boiling point** - The boiling point of streams in this category is in the range 24°C to 101.9°C.
- **Partition coefficient** - The streams in this category have partition coefficients ranges from log Kow 2.2-6.1.
- **Flash point** - The flash point of streams in this category is \leq -24.0°C.

Aliphatic & cyclics C5 and higher - flashpoint <23°C and initial boiling point \leq 35°C.

Flam. Liquid 1 (Hazard statement: H224: Extremely flammable liquid and vapour.).

Aliphatic & cyclics C5 and higher - flashpoint <23°C and initial boiling point \geq 35°C.

Flam. Liquid 2 (Hazard statement: H225: Highly flammable liquid and vapour).

Human Health Hazard Assessment

- **Toxicokinetics** – The marker substances, in their pure form, have well-defined toxicokinetic parameters that have been taken into account during the derivation of their respective DNEL's. The overall DNEL of this category is driven by the DNELs for benzene and n-hexane.
- **Acute toxicity** – Aliphatics and Cyclics C5 and Higher streams are of low acute toxicity by the oral, dermal, and inhalation routes and do not warrant classification for these end-points.
- **Irritation** – Aliphatic and Cyclic C5 and Higher streams should be considered to be irritating to skin and eyes and that classification is appropriate with respect to the skin.
- **Sensitisation** – Not skin or respiratory sensitisers.
- **Repeat dose toxicity** – The repeat dose toxicity data on streams within this category are limited to a single 28 day inhalation study (OECD 422) on Pyrolysis C5 (CAS 68476-55-1). This study

showed limited systemic toxicity to the liver (centrilobular hepatocyte hypertrophy) and kidney (hyaline droplets and increased basophilia in cortical tubules) at 1012 ppm. However, there are substantial data on the repeated dose toxicity of a number of specific components present in some streams i.e. benzene, toluene and n-hexane which demonstrate significant target organ toxicity and when present at concentrations greater than or equal to 1%, 10% or 10%, respectively, will drive the mammalian toxicity effects.

- **Genetic toxicity** – The genotoxicity data on streams within this category are limited to an in vitro bacterial reverse mutation assay and an in vivo mouse micronucleus test on Pyrolysis C5 (CAS 68476-55-1). These studies showed no evidence of genotoxicity. However, there are substantial data on the genotoxicity of a number of specific components present in some streams. Of these, benzene, isoprene and 1,3-butadiene have been shown to be mutagenic in vivo. As benzene is a Category 2 mutagen and is present in all streams at a concentration of 0.1% or greater then Aliphatics and Cyclics C5 and Higher streams are considered to be mutagenic in vivo.
- **Carcinogenicity** – There are no specific carcinogenicity data on any of the streams within this category (CAS Numbers; 102110-14-5, 64741-84-0, 64742-49-0, 68476-55-1, 68956-55-8, 92128-65-9). However, there are substantial data on the carcinogenicity of several components present in some streams. Of these, benzene, isoprene and 1,3-butadiene have been shown to be carcinogenic. As benzene is a Category 1 carcinogen and is present in all streams at a concentration of 0.1% or greater then Aliphatic and Cyclic C5 and Higher streams are considered to be carcinogens.
- **Toxic to reproduction** – It is recognised that there are data gaps for both developmental toxicity study and multi-generation studies. These studies do not need to be conducted as Aliphatics and Cyclics C5 and Higher streams contain at least 0.1% benzene which is known to be mutagenic and carcinogenic. Available data on one stream and on marker substances are sufficient for classification and labelling purposes. For streams that contain n-hexane at concentrations greater than or equal to 5% (EU/DPD) or 3% (GHS/CLP), classification is required for effects on fertility. For streams that contain toluene at concentrations greater than or equal to 5% (EU/DPD) or 3% (GHS/CLP), classification is required for developmental toxicity.

Environmental Hazard Assessment

- **Biodegradation** - Based on two experimental studies the streams in this category have not been shown to be readily biodegradable and will not be considered readily biodegradable
- **Bioaccumulation** - Log BCF have been calculated for various representative components of these streams. The calculated values range from 1.1-2.4.
- **Ecotoxicity** - Results are based both on nominal loading rates (WAF) and mean measured concentrations. Data reported is based on WAF, which better represent the potential toxicity of the test substance. Algae were found to be less sensitive than either invertebrates or fish which had similar sensitivity to the test substance (EL50 6.96 mg/l WAF and LL50 14.1 mg/l WAF respectively).

Based on the results of the hazard assessment the streams in this category are classified as: Aquatic Chronic 2 (Hazard statement: H411: Toxic to aquatic life with long lasting effects).

CONCLUSION FOR PBT

The screening assessment of the available data indicates that the properties of the members of this category do not meet the specific criteria detailed in Annex XIII or do not allow a direct comparison with all the criteria in Annex XIII but nevertheless indicate that the substance would not have these properties and

therefore are not considered PBT/vPvB.

CONCLUSION FOR DOSE DESCRIPTOR

Environment: Deriving PNECs for UVCB substances based on WAF information is inappropriate. As the substance is a hydrocarbon UVCB the hydrocarbon block method has been used for environmental risk assessment (see REACH guidance, R7, app.13-1). The Petrorisk model (Redman, A. (2010). PETRORISK Users Guide, HydroQual, Inc., for Conservation of Clean Air and Water in Europe (CONCAWE)), was used for the environmental assessment. Blocks of C5-C6 carbon atoms and with a boiling point range of 34.5 °C to 100.6 °C were used in the modelling exercise. The model assigns individual structures from the library to the hydrocarbon blocks that the user enters. The input parameters are provided in Appendix B of the CSR. Details of the library structure mapping, some relevant physico-chemical properties and the mass fraction that is assigned to each chemical are also found in this appendix.

Human Health:

Risk characterization will be based on the premise that a marker substance with a low DN(M)EL present at high concentration in a stream will possess a greater relative hazard potential than a marker substance with a higher DN(M)EL present at the same or lower concentration. It will also focus on the potential of the markers to cause serious long-term health effects rather than on short-term or irritation-related effects.

In the case of this stream, the most hazardous marker substances present are highlighted in the following table:

Marker substance	Indicative concentration (%)	Inhalation		Dermal	
		DN(M)EL mg/m ³	Relative hazard potential (max % ÷ DN(M)EL)	DN(M)EL mg/kg bw/d	Relative hazard potential (max % ÷ DN(M)EL)
benzene	>0.1 - 15	3.25	4.62	23.4	0.64
toluene	0.1 - 25	192	0.13	384	0.07
hexane	1 - 25	72	0.35	25.9	0.97
pentane	1 - 35	<i>no systemic toxicity, no DNELs required</i>			
isoprene	Up to 20	8.40	2.38	23.7	0.84
1,3-butadiene	<0.1 - 1	2.21	0.90	na	na

Although benzene and isoprene have slightly lower dermal DNELs n- hexane leads to a marginally greater relative hazard and has therefore been selected as the basis for the dermal DNEL. Based on this analysis, demonstration of “safe use” for hazards associated with the presence of 15% benzene and 25% hexane will also provide adequate protection against hazards arising from toluene, isoprene and 1,3-butadiene that are also present.

The long-term inhalation DNEL for benzene and long term dermal DNEL for hexane will therefore be used for worker risk characterization.