



Safety data sheet

according to Regulation (EC) No 1907/2006, Article 31

Printing date 19.07.2026

Version number 1

Revision: 19.07.2026

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Trade name: Methyl tert Butyl Ether (MTBE)

CAS number:

1634-04-4

EC number:

216-653-1

Index number:

603-181-00-X

REACH registration number: 01-2119452786-27-0048

1.2 Relevant identified uses of the substance or mixture and uses advised against

Application of the substance / the preparation:

Relevant identified uses:

Formulation & (re)packing of substances and mixtures.

Use as an intermediate.

Use as a process chemical or extraction solvent.

Distribution of substance.

Use as a fuel.

1.3 Details of the supplier of the safety data sheet

Manufacturer/Supplier:

Dor Chemicals Ltd.

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Israel 2624892

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Further information obtainable from:

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38025 Grenoble, FRANCE

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Fax: +33 476 295 870

Email: clients@reach-compliance.eu

Web: www.reachteam.eu

1.4 Emergency telephone number(s):

Ireland - National Poisons Information Centre: 01 837 9964 or 01 809 2566 (healthcare professionals only).

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008

Flam. Liq. 2 H225 Highly flammable liquid and vapour.

Skin Irrit. 2 H315 Causes skin irritation.

2.2 Label elements

Labelling according to Regulation (EC) No 1272/2008:

The substance is classified and labelled according to the CLP regulation.

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Trade name: Methyl tert Butyl Ether (MTBE)**Hazard pictograms:**

GHS02 GHS07

Signal word: Danger**Hazard statements:**

H225 Highly flammable liquid and vapour.

H315 Causes skin irritation.

Precautionary statements:

P210 Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

P243 Take action to prevent static discharges.

P280 Wear protective gloves/protective clothing/eye protection/face protection/hearing protection.

P302+P352 IF ON SKIN: Wash with plenty of water.

P403+P235 Store in a well-ventilated place. Keep cool.

P501 Dispose of contents/container in accordance with local/regional/national/international regulations.

2.3 Other hazards**Results of PBT and vPvB assessment****PBT:** No PBT.**vPvB:** No vPvB.**Determination of endocrine-disrupting properties**

The product does not contain substances with endocrine disrupting properties.

SECTION 3: Composition/information on ingredients**3.1 Substances****CAS Number. Description.**

1634-04-4 Methyl tert Butyl Ether

Identification number(s)**EC number:** 216-653-1**Index number:** 603-181-00-X**Additional information:** Purity: $\geq 98.0\%$ **SECTION 4: First aid measures****4.1 Description of first aid measures****After inhalation:** Move patient to fresh air, if symptoms persist consult a doctor.**After skin contact:**

Immediately wash with water and soap and rinse thoroughly.

If skin irritation continues, consult a doctor.

After eye contact:

Rinse opened eye for several minutes under running water. If symptoms persist, consult a doctor.

After swallowing:

Rinse out mouth and then drink plenty of water.

Call a doctor immediately.

4.2 Most important symptoms and effects, both acute and delayed Skin irritation**4.3 Indication of any immediate medical attention and special treatment needed**

Treat symptomatically.

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SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing agents:

CO₂, powder or water spray. Fight larger fires with water spray or alcohol resistant foam.

5.2 Special hazards arising from the substance or mixture

During combustion, CO₂, CO or unidentified organic compounds may be formed.

5.3 Advice for firefighters

Protective equipment:

Fire fighters should wear full protective clothing and self-contained breathing apparatus in positive pressure mode.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Keep away from ignition sources.

Use personal protective equipment. Keep unprotected persons away.

6.2 Environmental precautions

Do not allow product to reach sewage system or any water course.

Inform respective authorities in case of seepage into water course or sewage system.

6.3 Methods and material for containment and cleaning up

Stop leak if you can do so without risk. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers.

6.4 Reference to other sections

See Section 7 for information on safe handling.

See Section 8 for information on personal protection equipment.

See Section 13 for disposal information.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Ensure good ventilation/exhaustion at the workplace.

Avoid contact with the eyes and skin.

Avoid breathing vapours.

Information about fire and explosion protection:

Keep ignition sources away - Do not smoke.

Protect against electrostatic charges.

7.2 Conditions for safe storage, including any incompatibilities

Requirements to be met by storerooms and receptacles: Store in a dry, cool and well-ventilated area.**Information about storage in one common storage facility:** Store away from oxidising agents.**Further information about storage conditions:** Keep container tightly closed.**7.3 Specific end use(s):** No further relevant information available.

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Ingredients with limit values that require monitoring at the workplace:

1634-04-4 Methyl tert Butyl Ether

OEL	Short-term value: 367 mg/m ³ , 100 ppm
	Long-term value: 183.5 mg/m ³ , 50 ppm
IOELV	

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DNELs		
Oral	DNEL - Long-term exposure - systemic effects	7.1 mg/kg bw/day (General Population)
Dermal	DNEL - Long-term exposure - systemic effects	3,570 mg/kg bw/day (General Population) 5,100 mg/kg bw/day (worker)
Inhalation	DNEL - Acute- local effects	214 mg/m ³ (General Population) 357 mg/m ³ (worker)
	DNEL (EC) - Long-term exposure - systemic effects	53.6 mg/m ³ (General Population) 178.5 mg/m ³ (worker)
PNECs		
PNEC	5.1 mg/l (Water (Freshwater)) 0.26 mg/l (Water (Marine Water)) 71 mg/l (Sewage Treatment Plant (STP))	
PNEC	1.17 mg/kg sedim. dw (Sediment (Marine Water)) 23 mg/kg sedim. dw (Sediment (Freshwater))	
PNEC	1.56 mg/kg soil dw (Soil)	

8.2 Exposure controls

Individual protection measures, such as personal protective equipment

General protective and hygienic measures:

Ensure good ventilation/exhaustion at the workplace.

Avoid contact with the eyes and skin.

Avoid breathing vapours.

Respiratory protection:

In case of brief exposure use respiratory filter device. In case of intensive or longer exposure use self-contained respiratory protective device.

Hand protection



Protective gloves.

Eye/face protection



Safety goggles (EN 166).

Body protection: Protective work clothing.

Environmental exposure controls

Avoid the release of the product into the environment. Comply with local and national law.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

General Information

Physical state

Liquid.

Colour:

Colourless.

Odour:

Characteristic.

Odour threshold:

Not determined.

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Trade name: Methyl tert Butyl Ether (MTBE)

Melting point/freezing point:	-108.6 °C
Boiling point or initial boiling point and boiling range	55.3 °C
Flammability	Highly flammable.
Lower and upper explosion limit	
Lower:	1.6 Vol %
Upper:	8.4 Vol %
Flash point:	-28 °C
Auto-ignition temperature:	460 °C
Decomposition temperature:	Not determined
pH	Not determined
VOC (EC):	
Kinematic viscosity at 20 °C	0.464 mm ² /s
Dynamic:	Not determined
Solubility	
Water at 20 °C:	41.85 g/l
Partition coefficient n-octanol/water (log value) at 20 °C	1.06
Vapour pressure at 25 °C:	33 KPa
Density and/or relative density	
Density at 20 °C:	0.74 g/cm ³
Relative density	Not determined
Vapour density	Not determined

9.2 Other information

Appearance:

Form:

Liquid.

Explosive properties:

Product is not explosive. However, formation of explosive air/vapour mixtures is possible.

Softening point/range

Oxidising properties

Not oxidising.

Evaporation rate

Not determined.

Information with regard to physical hazard classes

Explosives

Not applicable.

Flammable gases

Not applicable.

Aerosols

Not applicable.

Oxidising gases

Not applicable.

Gases under pressure

Not applicable.

Flammable liquids

Highly flammable liquid and vapour.

Flammable solids

Not applicable.

Self-reactive substances and mixtures

Not applicable.

Pyrophoric liquids

Not applicable.

Pyrophoric solids

Not applicable.

Self-heating substances and mixtures

Not applicable.

Substances and mixtures, which emit flammable

gases in contact with water

Not applicable.

Oxidising liquids

Not applicable.

Oxidising solids

Not applicable.

Organic peroxides

Not applicable.

Corrosive to metals

Not applicable.

Desensitised explosives

Not applicable.

SECTION 10: Stability and reactivity

10.1 Reactivity Stable under normal conditions of use, storage, and transport.

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Trade name: Methyl tert Butyl Ether (MTBE)**10.2 Chemical stability****Thermal decomposition / conditions to be avoided:**

No decomposition if used and stored according to specifications.

10.3 Possibility of hazardous reactions No dangerous reactions known.**10.4 Conditions to avoid** Avoid all sources of ignition: heat, sparks, open flames.**10.5 Incompatible materials**

Strong acids

Oxidizing agents.

10.6 Hazardous decomposition products

Formation of toxic gases is possible during heating or in case of fire.

SECTION 11: Toxicological information**11.1 Information on hazard classes as defined in Regulation (EC) No 1272/2008****Acute toxicity** Based on available data, the classification criteria are not met.**LD/LC₅₀ values:**

Oral	LD ₅₀	>2,000 mg/kg (Rat) (OECD 401)
Dermal	LD ₅₀	>2,000 mg/kg (Rat) (OECD 402)
Inhalation	LC ₅₀ /4h	85 mg/l (Rat) (OECD 403)

Potential Health Effects:**Primary irritant effect:****Skin corrosion/irritation:** Irritating, rabbit, OECD 404.**Serious eye damage/irritation:** not irritating, rabbit, OECD 405**Respiratory or skin sensitisation:** not sensitising, guinea pig, OECD 406**Germ cell mutagenicity:**

In vitro genetic toxicity studies were negative. Animal genetic toxicity studies were negative.

OECD 471, 473, 476, 486, EPA OPPTS 870.538

Carcinogenicity: Inhalation NOAEC: 400 ppm, rat, EPA OTS 798.3300**Reproductive toxicity:** Based on available data, the classification criteria are not met.**STOT-single exposure:** Based on available data, the classification criteria are not met.**STOT-repeated exposure:** Based on available data, the classification criteria are not met.**Aspiration hazard:** Based on available data, the classification criteria are not met.**Reproductive toxicity:****Reproductive toxicity NOAEL values**

Inhalation	NOAEC (reproduction toxicity)	28.56 mg/l (Rat)
	NOAEC (developmental toxicity)	8.925 mg/l (Rat) (OECD 414)

Additional toxicological information:**Repeated dose toxicity**

Oral	NOAEL/LOAEL / 13 weeks	209 mg/kg bw/day (Rat) (OECD 408)
Inhalation	NOAEC	800 ppm (Rat) (EPA OTS 798.2450)

11.2 Information on other hazards**11.2.1 Endocrine disrupting properties** Substance is not listed.**SECTION 12: Ecological information****12.1 Toxicity****Aquatic toxicity:**

LC ₅₀ /96h	672 mg/l (Fish) (US EPA 1981)
IC ₅₀ /96h	491 mg/l (algae) (ASTM E1218-90)

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Trade name: Methyl tert Butyl Ether (MTBE)

EC ₅₀ /48h	472 mg/l (Daphnia Magna) (EPA OPPTS 850.1010)
NOEC	299 mg/l (Fish) (ASTM E1241-92)
NOEC/21d	51 mg/l (Daphnia Magna) (EPA OPPTS 850.1300)

12.2 Persistence and degradability

DT50 101.6 days in soil

Not readily biodegradable.

Hydrolysis is not expected.

12.3 Bioaccumulative potential

Bioaccumulation is not expected due to log K_{ow}.

Bioconcentration factor (BCF) 1.5

12.4 Mobility in soil

log K_{oc}: 0.96

12.5 Results of PBT and vPvB assessment

PBT: No PBT.

vPvB: No vPvB.

12.6 Endocrine disrupting properties

The product does not contain substances with endocrine disrupting properties.

12.7 Other adverse effects

Additional environmental information:

General notes:

Water hazard class 1 (German Regulation) (Assessment by list): Slightly hazardous for water.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Recommendation: Must be specially treated adhering to official regulations.

Uncleaned packaging:

Recommendation:

Packaging that may not be cleansed must be disposed of in the same manner as the product.

SECTION 14: Transport information

14.1 UN number or ID number

ADR, IMDG, IATA

UN2398

14.2 UN proper shipping name

ADR

2398 METHYL tert-BUTYL ETHER

IMDG, IATA

METHYL tert-BUTYL ETHER

14.3 Transport hazard class(es)

ADR, IMDG, IATA



Class

3 Flammable liquids.

Label

3

14.4 Packing group

ADR, IMDG, IATA

II

14.5 Environmental hazards

Marine pollutant:

No

14.6 Special precautions for user

Warning: Flammable liquids.

Hazard identification number (Kemler code):

33

EMS Number:

F-E, S-D

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Trade name: Methyl tert Butyl Ether (MTBE)**Stowage Category**

E

14.7 Maritime transport in bulk according to IMO instruments

Not applicable

Transport/Additional information:**ADR****Tunnel restriction code:**

D/E

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006, as amended (including amendments introduced by Regulation (EU) 2020/878).

Directive 2012/18/EU**Named dangerous substances - ANNEX I** The substance is not listed**Seveso category** P5c FLAMMABLE LIQUIDS**Qualifying quantity (tonnes) for the application of lower-tier requirements** 5,000 t**Qualifying quantity (tonnes) for the application of upper-tier requirements** 50,000 t**REGULATION (EC) No 1907/2006 ANNEX XVII** Conditions of restriction: 3, 40, 75**DIRECTIVE 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment – Annex II**

Substance is not listed.

REGULATION (EU) 2019/1148**Annex I - RESTRICTED EXPLOSIVES PRECURSORS** (Upper limit value for the purpose of licensing under Article 5(3))

Substance is not listed.

Annex II - REPORTABLE EXPLOSIVES PRECURSORS Substance is not listed.**15.2 Chemical safety assessment** A Chemical Safety Assessment has been carried out.

SECTION 16: Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

Abbreviations and acronyms:

WEL: Workplace Exposure Limits

ADR: Accord relatif au transport international des marchandises dangereuses par route (European Agreement Concerning the International Carriage of Dangerous Goods by Road)

IMDG: International Maritime Code for Dangerous Goods

IATA: International Air Transport Association

GHS: Globally Harmonised System of Classification and Labelling of Chemicals

EINECS: European Inventory of Existing Commercial Chemical Substances

CAS: Chemical Abstracts Service (division of the American Chemical Society)

DNEL: Derived No-Effect Level (REACH)

PNEC: Predicted No-Effect Concentration (REACH)

LC₅₀: Lethal concentration, 50 percentLD₅₀: Lethal dose, 50 percentEC₅₀: Effective concentration, 50 percent.IC₅₀: Inhibitory concentration, 50 percent.

NOEC: No observed effect concentration.

Flam. Liq. 2: Flammable liquids – Category 2

Skin Irrit. 2: Skin corrosion/irritation – Category 2

9.1 Exposure scenario 1. Manufacture of substance. - Industrial.

MTBE is manufactured in industrial manufacturing of bulk, large scale chemicals as fuel additive in fuels by use in closed, continuous process with occasional controlled exposure. MTBE is typically manufactured in petroleum refineries but also in plants manufacturing industrial organic chemicals. MTBE is prepared principally by reacting isobutene with methanol over an acidic ion-exchange resin catalyst at 38-93C and 100-200 psi. It can also be prepared from methanol, tert-butyl alcohol (TBA) and diazomethane (WHO, 1998 as referred to in European Commission, 2002). The manufacturing of MTBE is considered to be in an automated and principally closed outdoor system with a connection to central waste gas system.

MTBE is produced in closed systems in either wet or dry processes. Atmospheric emissions are expected from both types of processes and release to water primarily from the wet process. In the wet process of manufacturing MTBE, water is used to wash a hydrocarbon-methanol stream to extract the methanol from the hydrocarbon stream and recycle it. In the dry process, there is no water wash used to extract the methanol. The excess methanol is extracted by other means and recycled to the feed. During the manufacturing process of MTBE, the product is never in direct contact with water. Water is used in some processes (the so called wet processes) to wash the methanol from the methanol-hydrocarbon stream. The MTBE product is extracted before the wash. However, some traces of MTBE can be present in the MeOH-HC stream. To avoid concentration of the water stream, a very small side stream is extracted from the water stream and led to the wastewater unit. This stream can contain MTBE in small amounts (<0.1 ppm) but these traces are removed in the wastewater unit to levels below detection. The European production, import and export volumes are shown in the following table. These values have been compiled from estimates published by the European Fuel Oxygenates Association and made available on their website (<http://www.efoa.eu/en/home-99.aspx>). In addition, production MTBE capacities from 2002-2010 published by Concawe were consulted to arrive at reasonable estimates of MTBE production and import (Concawe, 2012).

MTBE in Europe	tonnes/yr
Production volume of MTBE in EU	1.16E+06
Fraction of EU production volume for region	0.25
Regional production volume of MTBE	2.90E+05
Continental production volume of MTBE	8.70E+05
Volume of MTBE imported to EU	1.55E+06
Volume of MTBE exported from EU	1.08E+05
Tonnage of MTBE in Europe	2.68E+06

It is important to note that EUSES modeling of the manufacturing exposure scenario uses the European production volume of MTBE, whereas all other industrial scenarios use the tonnage of MTBE in Europe in accordance with the following two formulas:

$$\text{Tonnage} = \text{Prodvol} + \text{Import} - \text{Export} \quad (1)$$

Tonnage - tonnage of MTBE in EU
Prodvol - production volume of MTBE in EU
Import - volume of MTBE imported
Export - volume of MTBE exported from EU

$$\text{Tonnage}_x = \text{Ftonnage}_x \times \text{Tonnage} \quad (2)$$

Ftonnage - fraction of production volume for application x
Tonnage_x - relevant MTBE tonnage for application x

The tonnages described above served as the starting point for calculating the regional tonnages for each environmental exposure scenario. In some cases, these tonnages were in excess of the nominally reported usage rates (i.e., the M_{spc} value) that accompany each SpERC, which is not unusual since the M_{spc} values are only intended for use when insufficient information is available for a regional tonnage determination in a

particular downstream application.

(<http://www.cefic.org/Documents/IndustrySupport/REACH-Implementation/Guidance-and-Tools/SPERCs-Specific-Environmental-Release-Classes.pdf>). In the case of MTBE, however, robust information is available on regional use volumes so this information was used in preference to the generic M_{spere} values as advocated in the SpERC guidance. These volume adjustments have no impact on the SpERC emission factors that were ultimately used in conjunction with the environmental exposure modelling.

Exposure scenario:

Based on ECHA Template CSA&IR Part D June 08 combined with the GES Narrative Format.

Section 1	
Title.	MTBE. Manufacture of substance. CAS:1634-04-4.
Sector(s) of Use:	Industrial (SU3).
Environmental Release Category(ies):	ERC1.
Process Category(ies):	PROC1, PROC2, PROC3, PROC4, PROC8a, PROC8b, PROC15.
Processes, tasks, activities covered:	Manufacture of the substance or use as a process chemical or extraction agent. Includes recycling/ recovery, material transfers, storage, maintenance and loading (including marine vessel/barge, road/rail car and bulk container), sampling and associated laboratory activities [GES1_I].
Assessment method:	Health: Used ECETOC TRA model [EE1]. (v3). Environment: Used EUSES model [EE4].
Section 2:	Operational conditions and risk management measures.

Section 2.1	
Product Characteristics:	Substance is a unique structure [PrC1]. Predominantly hydrophobic [PrC4a]. Readily biodegradable [PrC5a].
Regional production volume (tonne per year).	290,000 tpa (967,108 kg/day).
Fraction of EU production volume for region	0.25
Frequency and duration of use:	Continuous process [CS54]. 300 days per year of operation.
Environmental factors not influenced by risk management:	Local freshwater dilution factor [EF1]: 10. Local marine water dilution factor [EF2]: 100.
Other operational conditions of use affecting environmental exposure.	No specific measures required.
Technical onsite conditions and measures to reduce or limit discharges, air emissions.	ES1-E1: ERC1. Release fraction to air from process (initial release prior to RMM) [OOC4]: 0.005. Release fraction to wastewater from process (initial release prior to RMM) [OOC5]: 0.01. Release fraction to soil from process (initial release prior to RMM) [OOC6]: 0.0001. Fraction of main source: 0.4 No air emission controls required; required removal efficiency is 0% [TCR5]. Soil emission controls are not applicable as there is no direct release to soil [TCR4]. Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency of $\geq$ (%) [TCR8]: 99.

Organisation measures to prevent/limit release from site.	Prevent discharge of undissolved substance to or recover from onsite wastewater [TCR14].
Conditions and measures related to municipal sewage treatment plant.	Estimated substance removal from wastewater via domestic sewage treatment (%) [STP3]: 99. Assumed domestic sewage treatment plant flow (m ³ /d) [STP5]: 2000.
Conditions and measures related to external treatment of waste for disposal.	External treatment and disposal of waste should comply with applicable local and/or national regulations [ETW3].
Conditions and measures related to external recovery of waste.	External recovery and recycling of waste should comply with applicable local and/or national regulations [ERW1].
Other environmental control measures additional to above:	none.
Section 2.2: Control of worker exposure.	
Product Characteristics:	
Physical form of product:	Liquid, vapour pressure > 10 kPa at STP [OC5].
Concentration of substance in product:	Covers percentage substance in the product up to 100 % (unless stated differently) [G13].
Amounts used:	Not applicable.
Frequency and duration of use:	Covers daily exposures up to 8-hours (unless stated differently) [G2]. Continuous process [CS54].
Human factors not influenced by risk management:	none.
Other operational conditions affecting worker exposure:	Assumes a good basic standard of occupational hygiene is implemented [G1]. Assumes use at not more than 20°C above ambient temperature, unless stated differently [G15]. Outdoor use [OOC1].
Technical conditions and measures at a process level to prevent release and technical conditions and measures to control dispersion from source towards workers:	Common practices vary across sites thus conservative process release estimates used [TCS1].
Contributing Scenarios:	Risk Management Measures: Note: list RMM standard phrases according to the control hierarchy indicated in the ECHA template: 1. Technical measures to prevent release, 2. Technical measures to prevent dispersion, 3. Organisational measures, 4. Personal protection.
General measures (skin irritants) [G19]:	Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin problems that may develop [E3].
ES1-CS1: PROC1. General exposures (closed systems) [CS15].	No specific measures identified [EI18].
ES1-CS2: PROC2. General exposures (closed systems) [CS15]. with sample collection [CS56].	Ensure operation is undertaken outdoors [E69].

ES1-CS3: PROC3. General exposures (closed systems) [CS15]. Use in contained batch processes [CS37]. with sample collection [CS56].	Provide extract ventilation to points where emissions occur [E54].
ES1-CS4: PROC4. General exposures (open systems) [CS16]. Batch process [CS55]. with sample collection [CS56]. Filling / preparation of equipment from drums or containers. [CS45].	Ensure material transfers are under containment or extract ventilation [E66].
ES1-CS5: PROC8b. Process sampling [CS2]. Dedicated facility [CS81].	Provide extract ventilation to points where emissions occur [E54]. Avoid carrying out activities involving exposure for more than 1-hour [OC27].
ES1-CS6: PROC15. Laboratory activities [CS36]. Cleaning [CS47]. Wiping [CS50]. Rolling, Brushing [CS51].	Handle in a fume cupboard or under extract ventilation [E83].
ES1-CS7: PROC8b. Bulk closed loading and unloading [CS501]. Dedicated facility [CS81].	Avoid carrying out activities involving exposure for more than 4 hours [OC28], or wear a respirator conforming to EN140 with Type A filter or better [PPE22].
ES1-CS8: PROC8a. Equipment cleaning and maintenance [CS39]. Non-dedicated facility [CS82].	Drain down and flush system prior to equipment break-in or maintenance [E55]. Avoid carrying out activities involving exposure for more than 4 hours [OC28], or wear a respirator conforming to EN140 with Type A filter or better [PPE22].
ES1-CS9: PROC1. Storage [CS67]. General exposures (closed systems) [CS15].	No specific measures identified [E118].
ES1-CS10: PROC2. Storage [CS67]. General exposures (closed systems) [CS15]. with sample collection [CS56].	Avoid carrying out activities involving exposure for more than 4 hours [OC28], or wear a respirator conforming to EN140 with Type A filter or better [PPE22].
Section 3:	Exposure estimation:
Environment:	Maximum exposure resulting from contributing scenarios described.
	ES1-E1: PEC for microorganisms in STP: 0.0104 mg/l. Risk characterisation ratio: 1.46E-04. Local PEC in surface water: 0.00188 mg/l. Risk characterisation ratio: 3.69E-04. Local PEC in fresh water sediment: 0.0018 mg/kgww. Risk characterisation ratio: 3.60E-04. Local PEC in sea water during emission episode: 0.000213 mg/l. Risk characterisation ratio: 8.19E-04. Local PEC in marine sediment: 0.000203 mg/kgww. Risk characterisation ratio: 8.12E-04. Local PEC in agricultural soil (30-day average): 0.0456 mg/kgww. Risk characterisation ratio: 3.30E-02. Local PEC in grassland (180-day average): 0.0465 mg/kgww. Risk characterisation ratio: 3.37E-02. Risk from environmental exposure is driven by soil [TCR1f].

Health: Inhalation (vapour).	exposure resulting from contributing scenario ES1-CS1: 8-hour average 0.01 ppm - Risk characterisation ratio: <0.01. 15-minute average 0.04 ppm - Risk characterisation ratio: <0.01.
	exposure resulting from contributing scenario ES1-CS2: 8-hour average 18 ppm - Risk characterisation ratio: 0.35. 15-minute average 35 ppm - Risk characterisation ratio: 0.35.
	exposure resulting from contributing scenario ES1-CS3: 8-hour average 5 ppm - Risk characterisation ratio: 0.1. 15-minute average 20 ppm - Risk characterisation ratio: 0.2.
	exposure resulting from contributing scenario ES1-CS4: 8-hour average 10 ppm - Risk characterisation ratio: 0.2. 15-minute average 40 ppm - Risk characterisation ratio: 0.4.
	exposure resulting from contributing scenario ES1-CS5: 8-hour average 1.5 ppm - Risk characterisation ratio: 0.03. 15-minute average 30 ppm - Risk characterisation ratio: 0.3.
	exposure resulting from contributing scenario ES1-CS6: 8-hour average 5 ppm - Risk characterisation ratio: 0.1. 15-minute average 20 ppm - Risk characterisation ratio: 0.2.
	exposure resulting from contributing scenario ES1-CS7: 8-hour average 27 ppm - Risk characterisation ratio: 0.54. 15-minute average 49 ppm - Risk characterisation ratio: 0.49.
	exposure resulting from contributing scenario ES1-CS8: 8-hour average 15 ppm - Risk characterisation ratio: 0.3. 15-minute average 50 ppm - Risk characterisation ratio: 0.5.
	exposure resulting from contributing scenario ES1-CS9: 8-hour average 0.01 ppm - Risk characterisation ratio: <0.01. 15-minute average 0.04 ppm - Risk characterisation ratio: <0.01.
	exposure resulting from contributing scenario ES1-CS10: 8-hour average 15 ppm - Risk characterisation ratio: 0.3. 15-minute average 50 ppm - Risk characterisation ratio: 0.5.
	Risk management measures described will protect against acute exposure.
Health: Dermal:	exposure resulting from contributing scenario ES1-CS1: 0.03 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES1-CS2: 0.27 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES1-CS3: 0.013 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES1-CS4: 0.13 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES1-CS5: 0.027 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES1-CS6: 0.0068 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES1-CS7: 1.6 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES1-CS8: 1.6 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES1-CS9: 0.03 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES1-CS10: 0.16 mg/kg/day. Risk characterisation ratio: <0.001.
	Available hazard data do not enable the derivation of a DNEL for dermal irritant effects [G32]. Risk Management Measures are based on qualitative risk characterisation [G37].
Section 4:	Guidance to check compliance with the exposure scenario:

Environment:	Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures [DSU1]. If scaling reveals a condition of unsafe use (i.e., RCRs > 1), additional RMMs or a site-specific chemical safety assessment is required [DSU8].
Health:	No data

Notes on exposure scenario and exposure estimation, including deviations and additions to ECETOC TRA defaults:

The situations leading to exposure include the production of neat MTBE. When modelling resulted in risk characterization ratios above 1 exposure data was used to estimate exposure (tier-2). Only tier-2 data as presented in the EU RAR for MTBE (European Commission, 2002) was used (see Annex B1.2, containing a summary of data from the EU RAR of MTBE).

The workers' exposure to MTBE may principally occur only during incidental leaks and spills from pipeline and valve connections (fugitive emissions) and maintenance operations. Sampling and laboratory work, handling products containing MTBE for analyses, lead to exposure of laboratory assistants. The mechanics are exposed daily during removal of pumps and repairing repellers. They are also doing maintenance on pipelines and vapour recovery equipment. The maintenance tasks are such that the workers are exposed to MTBE vapours and their hands are in contact with petrol products.

Deviations due to availability of measured data:

Measured data is available for the following contributing scenarios (see annex B)

Contributing scenario	Measured data available	Modification justification
CS2 and CS10 PROC 2 (sampling)	Sampling of neat MTBE; sampling vessel (n=5), sampling pipeline (n=3) and sampling rail car (n=5): highest short-term value: $63 \text{ mg/m}^3 = 17 \text{ ppm}$ (see table 4.4 of EU risk assessment report, 2002).	The default approach in the ECETOC TRA tool of estimating the short-term exposure as 4x the long-term exposure estimate seems excessive. The available measured data is used to justify reducing this factor to 2x
CS7 PROC 8b(bulk loading and unloading)	Full-shift exposure: Tier 2 estimation of long-term inhalatory exposure: transportation of neat MTBE long-term inhalatory exposure: $100 \text{ mg/m}^3 = 27 \text{ ppm}$ (RWC OC: 4 hours OC: 4hr; conclusion adopted from EU risk assessment report, 2002 section 4.1.1.1.4.). Short-term exposure: transportation of neat MTBE short-term inhalatory exposure: $180 \text{ mg/m}^3 = 49 \text{ ppm}$ (maximum exposure level during transportation of neat MTBE); see table 4.8 of risk assessment report, 2002.	The measured data is used in place of estimated data. Measured data is used in place of estimated data.
CS8 PROC 8a (Equipment maintenance)	Maintenance neat MTBE emptying operations (n=14), start up (n=6), tank roof (n=7), highest short-term exposure 57 mg/m^3 (16 ppm) - see table 4.4 of risk assessment report, 2002.	The default approach in the ECETOC TRA tool of estimating the short-term exposure as 4x the long-term exposure estimate seems excessive. The available measured data is used to justify reducing this factor to 2x

Other justified deviations

Contributing scenario	Additional RMM	Justification for exposure reduction
CS8 PROC 8a (Equipment maintenance)	Drain down and flush system prior to equipment break-in or maintenance [E55])	Draining prior to maintenance is assumed to deliver a reduction of 90% of the inhalation exposure estimate in industrial settings. Reduction is based on comparison of CONCAWE data on exposures resulting from spills and those arising from same/similar task when Standard Operating Procedures invoked.

9.2 Exposure scenario 2. Formulation & (re)packing of substances and mixtures. - Industrial.

Formulation of MTBE covers the blending of petrol with MTBE, both on site and off site. The formulation of MTBE into petrol is considered to be in an automated and principally closed outdoor system with a connection to central waste gas system. Emissions into environment are mainly atmospheric.

There are two formulation techniques for blending petrol with MTBE, in-line blending and batch blending. In in-line blending the petrol components (including MTBE) are pumped from their storage tanks to a common line and pumped further through the common line to the product storage tank. The components are blended both during the pumping through the common line and in the product tank. In batch blending the petrol components are pumped through separate lines to the storage tank. The blending of the components hence takes place only in the product tank.

When MTBE is blended in to petrol outside the refineries, e.g. in commercial terminals, both techniques can be used for the blending. Batch blending is however usually more used. There are 4-8 commercial terminals within the EU that blend petrol. Approximately 5% or less of the MTBE used in Europe are blended outside the refineries (Information supplied by Fortum, 2000). It is expected that the MTBE emissions in these terminals should not differ from the emissions from blending activities in the refineries since the techniques used are similar.

Air, water, and soil emission factors were adopted without modification from ESVOC SpERC 2.2.v1 (#4). This SpERC covers the formulation, packing and re-packing of the substance and its mixtures in batch or continuous operations, including storage, materials transfers, mixing, tableting, compression, pelletisation, extrusion, large and small scale packing, sampling, maintenance and associated laboratory activities. These emission factors are applicable to petroleum substances (e.g., aliphatic and aromatic hydrocarbons) and petrochemicals. Further details on the creation and suitability of this SpERC can be found in the ESVOC factsheet located Annex D.

Exposure scenario

Based on ECHA Template CSA&IR Part D June 08 combined with the GES Narrative Format.

Section 1	
Title:	MTBE. Formulation & (re)packing of substances and mixtures. CAS:1634-04-4.
Sector(s) of Use:	Industrial (SU3).
Environmental Release Category(ies):	ERC2. ESVOC SpERC 2.2v1
Process Category(ies):	PROC1, PROC2, PROC3, PROC4, PROC5, PROC8a, PROC8b, PROC9, PROC15.
Processes, tasks, activities covered:	Formulation, packing and re-packing of the substance and its mixtures in batch or continuous operations, including storage, materials transfers, mixing, tableting, compression, pelletisation, extrusion, large and small scale packing, sampling, maintenance and associated laboratory activities [GES2_I].
Assessment method:	Health: Used ECETOC TRA model [EE1]. (v3). Environment: Used EUSES model [EE4]. Used ESVOC SpERC #4.
Section 2: Operational conditions and risk management measures.	
Section 2.1	
Product Characteristics:	Substance is a unique structure [PrC1]. Predominantly hydrophobic [PrC4a]. Readily biodegradable [PrC5a].
Regional tonnage of MTBE (tonne per year).	659,000 tpa (2,197,125 kg/day).

Fraction of EU production volume for region	0.25
Fraction of tonnage for application	0.985
Fraction of chemical in formulation	0.15
Frequency and duration of use:	Continuous process [CS54]. 300 days per year of operation.
Environmental factors not influenced by risk management:	Local freshwater dilution factor [EF1]: 10. Local marine water dilution factor [EF2]: 100.
Other operational conditions of use affecting environmental exposure.	No specific measures required.
Technical onsite conditions and measures to reduce or limit discharges, air emissions.	Conditions given in SPERC fact sheet give rise to following releases fractions [OOC29]. ES2-E1: ERC2. ESVOC SpERC 2.2v1. Release fraction to air from process (initial release prior to RMM) [OOC4]: 0.025. Release fraction to wastewater from process (initial release prior to RMM) [OOC5]: 0.005. Release fraction to soil from process (initial release prior to RMM) [OOC6]: 0.0001. Fraction of main source: 0.05
	No air emission controls required; required removal efficiency is 0% [TCR5]. Soil emission controls are not applicable as there is no direct release to soil [TCR4]. Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency of $\geq$ (%) [TCR8]: 99. Assumed industrial waste water treatment plant flow (m ³ /d): 2000.
Organisation measures to prevent/limit release from site.	Prevent discharge of undissolved substance to or recover from onsite wastewater [TCR14].
Conditions and measures related to municipal sewage treatment plant.	Estimated substance removal from wastewater via domestic sewage treatment (%) [STP3]: 99. Assumed domestic sewage treatment plant flow (m ³ /d) [STP5]: 2000.
Conditions and measures related to external treatment of waste for disposal.	External treatment and disposal of waste should comply with applicable local and/or national regulations [ETW3].
Conditions and measures related to external recovery of waste.	External recovery and recycling of waste should comply with applicable local and/or national regulations [ERW1].
Other environmental control measures additional to above:	none.
Section 2.2: Control of worker exposure.	
Product Characteristics:	
Physical form of product:	Liquid, vapour pressure > 10 kPa at STP [OC5].
Concentration of substance in product:	Covers percentage substance in the product up to 100 % (unless stated differently) [G13].
Amounts used:	Not applicable.
Frequency and duration of use:	Covers daily exposures up to 8-hours (unless stated differently) [G2]. Continuous process [CS54].
Human factors not influenced by risk management:	none.

Other operational conditions affecting worker exposure:	Assumes a good basic standard of occupational hygiene is implemented [G1]. Assumes use at not more than 20°C above ambient temperature, unless stated differently [G15]. Outdoor use [OOC1].
Technical conditions and measures at a process level to prevent release and technical conditions and measures to control dispersion from source towards workers:	Common practices vary across sites thus conservative process release estimates used [TCS1].
Contributing Scenarios:	Risk Management Measures: Note: list RMM standard phrases according to the control hierarchy indicated in the ECHA template: 1. Technical measures to prevent release, 2. Technical measures to prevent dispersion, 3. Organisational measures, 4. Personal protection.
General measures (skin irritants) [G19]:	Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin problems that may develop [E3].
ES2-CS1: PROC1. General exposures (closed systems) [CS15].	No specific measures identified [EI18].
ES2-CS2: PROC2. General exposures (closed systems) [CS15]. with sample collection [CS56].	Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11].
ES2-CS3: PROC3. General exposures (closed systems) [CS15]. Use in contained batch processes [CS37]. with sample collection [CS56].	Provide extract ventilation to points where emissions occur [E54].
ES2-CS4: PROC4. General exposures (open systems) [CS16]. Batch process [CS55]. with sample collection [CS56]. Filling / preparation of equipment from drums or containers. [CS45].	Provide extract ventilation to points where emissions occur [E54].
ES2-CS5: PROC3. General exposures (open systems) [CS16]. Batch processes at elevated temperatures [CS136]. with sample collection [CS56].	Provide extract ventilation to points where emissions occur [E54]. Formulate in enclosed or ventilated mixing vessels [E46].
ES2-CS6: PROC3. Process sampling [CS2].	Provide extract ventilation to points where emissions occur [E54]. Avoid carrying out activities involving exposure for more than 15-minutes [OC26], or wear a respirator conforming to EN140 with Type A filter or better [PPE22].
ES2-CS7: PROC15. Laboratory activities [CS36]. Cleaning [CS47]. Wiping [CS50]. Rolling, Brushing [CS51].	Handle in a fume cupboard or under extract ventilation [E83].

ES2-CS8: PROC8b. Bulk transfers [CS14]. Dedicated facility [CS81]. (eg road/railcar bottom loading/unloading, marine vessel/barge loading/unloading).	Provide extract ventilation to material transfer points and other openings [E82].
ES2-CS9: PROC5. Mixing operations (open systems) [CS30]. Batch process [CS55].	Provide extract ventilation to points where emissions occur [E54].
ES2-CS10: PROC8a. Manual [CS34]. Transfer from/pouring from containers [CS22]. Non-dedicated facility [CS82].	Ensure material transfers are under containment or extract ventilation [E66]. Avoid carrying out activities involving exposure for more than 1-hour [OC27], or wear a respirator conforming to EN140 with Type A filter or better [PPE22].
ES2-CS11: PROC8b. Drum/batch transfers [CS8]. Dedicated facility [CS81].	Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings [E60]. Avoid carrying out activities involving exposure for more than 1-hour [OC27], or wear a respirator conforming to EN140 with Type A filter or better [PPE22]. Use drum pumps [E53].
ES2-CS12: PROC9. Drum and small package filling [CS6]. Dedicated facility [CS81].	Fill containers/cans at dedicated fill points supplied with local extract ventilation [E51]. Use drum pumps [E53].
ES2-CS13: PROC8a. Equipment cleaning and maintenance [CS39]. Non-dedicated facility [CS82].	Avoid carrying out activities involving exposure for more than 4 hours [OC28], or wear a respirator conforming to EN140 with Type A filter or better [PPE22]. Drain down and flush system prior to equipment break-in or maintenance [E55].
ES2-CS14: PROC1. Storage [CS67]. General exposures (closed systems) [CS15].	No specific measures identified [EI18].
ES2-CS15: PROC2. Storage [CS67]. General exposures (closed systems) [CS15]. with sample collection [CS56].	Avoid carrying out activities involving exposure for more than 4 hours [OC28], or wear a respirator conforming to EN140 with Type A filter or better [PPE22].
Section 3:	Exposure estimation:
Environment:	Maximum exposure resulting from contributing scenarios described.
	ES2-E1: PEC for microorganisms in STP: 0.0101 mg/l. Risk characterisation ratio: 1.42E-04. Local PEC in surface water: 0.00185 mg/l. Risk characterisation ratio: 3.63E-04. Local PEC in fresh water sediment: 0.00177 mg/kgww. Risk characterisation ratio: 3.54E-04. Local PEC in sea water during emission episode: 0.000211 mg/l. Risk characterisation ratio: 8.12E-04. Local PEC in marine sediment: 0.000201 mg/kgww. Risk characterisation ratio: 8.04E-04. Local PEC in agricultural soil (30-day average): 0.0995 mg/kgww. Risk characterisation ratio: 7.21E-02. Local PEC in grassland (180-day average): 0.106 mg/kgww. Risk characterisation ratio: 7.68E-02. Risk from environmental exposure is driven by soil [TCR1f].
Health: Inhalation (vapour).	exposure resulting from contributing scenario ES2-CS1: 8-hour average 0.01 ppm - Risk characterisation ratio: <0.01. 15-minute average 0.04 ppm - Risk characterisation ratio: <0.01.

	exposure resulting from contributing scenario ES2-CS2: 8-hour average 18 ppm - Risk characterisation ratio: 0.35. 15-minute average 35 ppm - Risk characterisation ratio: 0.35.
	exposure resulting from contributing scenario ES2-CS3: 8-hour average 5 ppm - Risk characterisation ratio: 0.1. 15-minute average 20 ppm - Risk characterisation ratio: 0.2.
	exposure resulting from contributing scenario ES2-CS4: 8-hour average 10 ppm - Risk characterisation ratio: 0.2. 15-minute average 40 ppm - Risk characterisation ratio: 0.4.
	exposure resulting from contributing scenario ES2-CS5: 8-hour average 5 ppm - Risk characterisation ratio: 0.1. 15-minute average 20 ppm - Risk characterisation ratio: 0.2.
	exposure resulting from contributing scenario ES2-CS6: 8-hour average 0.5 ppm - Risk characterisation ratio: 0.01. 15-minute average 20 ppm - Risk characterisation ratio: 0.2.
	exposure resulting from contributing scenario ES2-CS7: 8-hour average 5 ppm - Risk characterisation ratio: 0.1. 15-minute average 20 ppm - Risk characterisation ratio: 0.2.
	exposure resulting from contributing scenario ES2-CS8: 8-hour average 7.5 ppm - Risk characterisation ratio: 0.15. 15-minute average 30 ppm - Risk characterisation ratio: 0.3.
	exposure resulting from contributing scenario ES2-CS9: 8-hour average 25 ppm - Risk characterisation ratio: 0.5. 15-minute average 50 ppm - Risk characterisation ratio: 0.5.
	exposure resulting from contributing scenario ES2-CS10: 8-hour average 5 ppm - Risk characterisation ratio: 0.1. 15-minute average 50 ppm - Risk characterisation ratio: 0.5.
	exposure resulting from contributing scenario ES2-CS11: 8-hour average 0.3 ppm - Risk characterisation ratio: <0.01. 15-minute average 6 ppm - Risk characterisation ratio: <0.01.
	exposure resulting from contributing scenario ES2-CS12: 8-hour average 4 ppm - Risk characterisation ratio: 0.08. 15-minute average 16 ppm - Risk characterisation ratio: 0.16.
	exposure resulting from contributing scenario ES2-CS13: 8-hour average 15 ppm - Risk characterisation ratio: 0.3. 15-minute average 50 ppm - Risk characterisation ratio: 0.5.
	exposure resulting from contributing scenario ES2-CS14: 8-hour average 0.01 ppm - Risk characterisation ratio: <0.01. 15-minute average 0.04 ppm - Risk characterisation ratio: <0.01.
	exposure resulting from contributing scenario ES2-CS15: 8-hour average 15 ppm - Risk characterisation ratio: 0.3. 15-minute average 50 ppm - Risk characterisation ratio: 0.5.
	Risk management measures described will protect against acute exposure.
Health: Dermal:	exposure resulting from contributing scenario ES2-CS1: 0.03 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES2-CS2: 0.27 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES2-CS3: 0.013 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES2-CS4: 0.13 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES2-CS5: 0.013 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES2-CS6: 0.0013 mg/kg/day. Risk characterisation ratio: <0.001.

	exposure resulting from contributing scenario ES2-CS7: 0.0068 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES2-CS8: 0.13 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES2-CS9: 0.27 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES2-CS10: 0.054 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES2-CS11: 0.027 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES2-CS12: 0.13 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES2-CS13: 1.6 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES2-CS14: 0.03 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES2-CS15: 0.16 mg/kg/day. Risk characterisation ratio: <0.001.
	Available hazard data do not enable the derivation of a DNEL for dermal irritant effects [G32]. Risk Management Measures are based on qualitative risk characterisation [G37].
Section 4:	Guidance to check compliance with the exposure scenario:
Environment:	Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures [DSU1]. If scaling reveals a condition of unsafe use (i.e., RCRs > 1), additional RMMs or a site-specific chemical safety assessment is required [DSU8]. Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html) [DSU4].
Health:	No data

Notes on exposure scenario and exposure estimation, including deviations and additions to ECETOC TRA defaults:

The situations leading to exposure include formulation (blending and storing): petrol blending with MTBE. When modelling resulted in risk characterization ratios above 1, exposure data was used to estimate exposure (tier-2). Only tier-2 data as presented in the EU RAR for MTBE (European Commission, 2002) was used (see Annex B1.2, containing a summary of data from the EU RAR of MTBE).

The workers' exposure to MTBE may principally occur only during incidental leaks and spills from pipeline and valve connections (fugitive emissions) and maintenance operations. In formulation (blending and storing) operations, exposure might either concern neat MTBE or blended fuel. Sampling and laboratory work, handling products containing MTBE for analyses, lead to exposure of laboratory assistants.

The mechanics are daily exposed during removal of pumps and repairing repellers. They are also doing maintenance on pipelines and vapour recovery equipment. The maintenance tasks are such that the workers are exposed to MTBE vapours and their hands are in contact with petrol products.

Deviations due to availability of measured data:

Measured data is available for the following contributing scenarios (see annex B)

Contributing scenario	Measured data available	Modification justification
CS2 and CS15 PROC 2 (sampling)	Sampling of neat MTBE; sampling vessel (n=5), sampling pipeline (n=3) and sampling rail car (n=5): highest short-term	The default approach in the ECETOC TRA tool of estimating the short-term exposure as 4x the long-term exposure estimate

	value: $63 \text{ mg/m}^3 = 17 \text{ ppm}$ (see table 4.4 of EU risk assessment report, 2002).	seems excessive. The available measured data is used to justify reducing this factor to 2x
CS9 PROC5. Mixing operations (open systems). Batch process CS10 PROC8a. Manual Transfer from/pouring from containers; Non-dedicated facility	Formulation neat MTBE short-term exposure during formulation (blending and storing) (USA data): GM: 18,4 mg/m^3 and GSD: 5,6 (n=50) => 90th-percentile = $168 \text{ mg/m}^3 = 46 \text{ ppm}$ (see table 4.7 EU risk assessment report, 2002.)	The default approach in the ECETOC TRA tool of estimating the short-term exposure as 4x the long-term exposure estimate seems excessive. The available measured data is used to justify reducing this factor to 2x
CS13 PROC 8a (Equipment maintenance)	Maintenance neat MTBE emptying operations (n=14), start up (n=6), tank roof (n=7), highest short-term exposure 57 mg/m^3 (16 ppm) - see table 4.4 of risk assessment report, 2002.	The default approach in the ECETOC TRA tool of estimating the short-term exposure as 4x the long-term exposure estimate seems excessive. The available measured data is used to justify reducing this factor to 2x

Other justified deviations

Contributing scenario	Additional RMM	Justification for exposure reduction
CS11 Drum/batch transfers; Dedicated facility CS12 Drum and small package filling, Dedicated facility	Use drum pumps [E53].	Use of drum pumps was shown to deliver an exposure reduction of 80% in CONCAWE report 11/12, 2012.
CS13 PROC 8a (Equipment maintenance)	Drain down and flush system prior to equipment break-in or maintenance [E55])	Draining prior to maintenance is assumed to deliver a reduction of 90% of the inhalation exposure estimate in industrial settings. Reduction is based on comparison of CONCAWE data on exposures resulting from spills and those arising from same/similar task when Standard Operating Procedures invoked.

9.3 Exposure scenario 3. Use as an intermediate. - Industrial.

A small percentage of MTBE is used as an intermediate for isobutylene manufacture.

Air, water, and soil emission factors were adopted without modification from ESVOC SpERC 6.1a.v1 (#2). This SpERC covers the use of a substance as an intermediate (not related to Strictly Controlled Conditions), and includes recycling/ recovery, material transfers, storage, sampling, associated laboratory activities, maintenance and loading (including marine vessel/barge, road/rail car and bulk container). These emission factors are applicable to petroleum substances (e.g., aliphatic and aromatic hydrocarbons) and petrochemicals. Further details on the creation and suitability of this SpERC can be found in the ESVOC factsheet located Annex D.

Exposure scenario

Based on ECHA Template CSA&IR Part D June 08 combined with the GES Narrative Format.

Section 1	
Title.	MTBE. Use as an intermediate. CAS:1634-04-4.
Sector(s) of Use:	Industrial (SU3).
Environmental Release Category(ies):	ERC6a. ESVOC SpERC 6.1a.v1
Process Category(ies):	PROC1, PROC2, PROC3, PROC4, PROC8a, PROC8b, PROC15.
Processes, tasks, activities covered:	Use of substance as an intermediate (not related to Strictly Controlled Conditions). Includes recycling/ recovery, material transfers, storage, sampling, associated laboratory activities, maintenance and loading (including marine vessel/barge, road/rail car and bulk container) [GES1B_I].
Assessment method:	Health: Used ECETOC TRA model [EE1]. (v3). Environment: Used EUSES model [EE4]. Used ESVOC SpERC #2.
Section 2:	
Operational conditions and risk management measures.	
Section 2.1	
Control of environmental exposure:	
Product Characteristics:	Substance is a unique structure [PrC1]. Predominantly hydrophobic [PrC4a]. Readily biodegradable [PrC5a].
Regional tonnage of MTBE (tonne per year).	8,030 tpa (26,767 kg/day).
Fraction of EU production volume for region	0.25
Fraction of tonnage for application	0.012
Fraction of chemical in formulation	1
Frequency and duration of use:	Continuous process [CS54]. 300 days per year of operation.
Environmental factors not influenced by risk management:	Local freshwater dilution factor [EF1]: 10. Local marine water dilution factor [EF2]: 100.
Other operational conditions of use affecting environmental exposure.	No specific measures required.

Technical onsite conditions and measures to reduce or limit discharges, air emissions.	Conditions given in SPERC fact sheet give rise to following releases fractions [OOC29]. ES3-E1: ERC6a. ESVOC SpERC 2. Release fraction to air from process (initial release prior to RMM) [OOC4]: 0.005. Release fraction to wastewater from process (initial release prior to RMM) [OOC5]: 0.01. Release fraction to soil from process (initial release prior to RMM) [OOC6]: 0.001. Fraction of main source: 1.0 No air emission controls required; required removal efficiency is 0% [TCR5]. Soil emission controls are not applicable as there is no direct release to soil [TCR4]. Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency of $\geq$ (%) [TCR8]: 90. Assumed industrial waste water treatment plant flow (m³/d): 2000.
Organisation measures to prevent/limit release from site.	Prevent discharge of undissolved substance to or recover from onsite wastewater [TCR14].
Conditions and measures related to municipal sewage treatment plant.	Estimated substance removal from wastewater via domestic sewage treatment (%) [STP3]: 90. Assumed domestic sewage treatment plant flow (m ³ /d) [STP5]: 2000.
Conditions and measures related to external treatment of waste for disposal.	External treatment and disposal of waste should comply with applicable local and/or national regulations [ETW3].
Conditions and measures related to external recovery of waste.	External recovery and recycling of waste should comply with applicable local and/or national regulations [ERW1].
Other environmental control measures additional to above:	none.
Section 2.2: Control of worker exposure.	
Product Characteristics:	
Physical form of product:	Liquid, vapour pressure > 10 kPa at STP [OC5].
Concentration of substance in product:	Covers percentage substance in the product up to 100 % (unless stated differently) [G13].
Amounts used:	Not applicable.
Frequency and duration of use:	Covers daily exposures up to 8-hours (unless stated differently) [G2]. Continuous process [CS54].
Human factors not influenced by risk management:	none.
Other operational conditions affecting worker exposure:	Assumes a good basic standard of occupational hygiene is implemented [G1]. Assumes use at not more than 20°C above ambient temperature, unless stated differently [G15]. Outdoor use [OOC1].
Technical conditions and measures at a process level to prevent release and technical conditions and measures to control dispersion from source towards workers:	Common practices vary across sites thus conservative process release estimates used [TCS1].
Contributing Scenarios:	Risk Management Measures: Note: list RMM standard phrases according to the control hierarchy indicated in the ECHA template: 1. Technical measures to prevent release, 2. Technical measures to prevent dispersion, 3. Organisational measures, 4. Personal protection.

General measures (skin irritants) [G19]:	Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin problems that may develop [E3].
ES3-CS1: PROC1. General exposures (closed systems) [CS15].	No specific measures identified [EI18].
ES3-CS2: PROC2. General exposures (closed systems) [CS15]. with sample collection [CS56].	Ensure operation is undertaken outdoors [E69].
ES3-CS3: PROC3. General exposures (closed systems) [CS15]. Use in contained batch processes [CS37]. with sample collection [CS56].	Provide extract ventilation to points where emissions occur [E54].
ES3-CS4: PROC4. General exposures (open systems) [CS16]. Batch process [CS55]. with sample collection [CS56]. Filling / preparation of equipment from drums or containers. [CS45].	Ensure material transfers are under containment or extract ventilation [E66].
ES3-CS5: PROC8b. Process sampling [CS2]. Dedicated facility [CS81].	Provide extract ventilation to points where emissions occur [E54]. Avoid carrying out activities involving exposure for more than 1-hour [OC27].
ES3-CS6: PROC15. Laboratory activities [CS36]. Cleaning [CS47]. Wiping [CS50]. Rolling, Brushing [CS51].	Handle in a fume cupboard or under extract ventilation [E83].
ES3-CS7: PROC8b. Bulk closed loading and unloading [CS501]. Dedicated facility [CS81].	Avoid carrying out activities involving exposure for more than 4 hours [OC28], or wear a respirator conforming to EN140 with Type A filter or better [PPE22].
ES3-CS8: PROC8a. Equipment cleaning and maintenance [CS39]. Non-dedicated facility [CS82].	Drain down and flush system prior to equipment break-in or maintenance [E55]. Avoid carrying out activities involving exposure for more than 4 hours [OC28], or wear a respirator conforming to EN140 with Type A filter or better [PPE22].
ES3-CS9: PROC1. Storage [CS67]. Bulk transfers [CS14].	No specific measures identified [EI18].
ES3-CS10: PROC2. Storage [CS67]. General exposures (closed systems) [CS15]. Batch process [CS55].	Avoid carrying out activities involving exposure for more than 4 hours [OC28], or wear a respirator conforming to EN140 with Type A filter or better [PPE22].
Section 3:	Exposure estimation:
Environment:	Maximum exposure resulting from contributing scenarios described.

	ES3-E1: PEC for microorganisms in STP: 0.0101 mg/l. Risk characterisation ratio: 1.42E-04. Local PEC in surface water: 0.00185 mg/l. Risk characterisation ratio: 3.63E-04. Local PEC in fresh water sediment: 0.00177 mg/kgww. Risk characterisation ratio: 3.63E-04. Local PEC in sea water during emission episode: 0.000211 mg/l. Risk characterisation ratio: 8.12E-04. Local PEC in marine sediment: 0.0002 mg/kgww. Risk characterisation ratio: 8.00E-04. Local PEC in agricultural soil (30-day average): 0.00514 mg/kgww. Risk characterisation ratio: 3.72E-03. Local PEC in grassland (180-day average): 0.00522 mg/kgww. Risk characterisation ratio: 3.78E-03. Risk from environmental exposure is driven by soil [TCR1f].
Health: Inhalation (vapour).	exposure resulting from contributing scenario ES3-CS1: 8-hour average 0.01 ppm - Risk characterisation ratio: <0.01. 15-minute average 0.04 ppm - Risk characterisation ratio: <0.01.
	exposure resulting from contributing scenario ES3-CS2: 8-hour average 18 ppm - Risk characterisation ratio: 0.35. 15-minute average 35 ppm - Risk characterisation ratio: 0.35.
	exposure resulting from contributing scenario ES3-CS3: 8-hour average 5 ppm - Risk characterisation ratio: 0.1. 15-minute average 20 ppm - Risk characterisation ratio: 0.2.
	exposure resulting from contributing scenario ES3-CS4: 8-hour average 10 ppm - Risk characterisation ratio: 0.2. 15-minute average 40 ppm - Risk characterisation ratio: 0.4.
	exposure resulting from contributing scenario ES3-CS5: 8-hour average 1.5 ppm - Risk characterisation ratio: 0.03. 15-minute average 30 ppm - Risk characterisation ratio: 0.3.
	exposure resulting from contributing scenario ES3-CS6: 8-hour average 5 ppm - Risk characterisation ratio: 0.1. 15-minute average 20 ppm - Risk characterisation ratio: 0.2.
	exposure resulting from contributing scenario ES3-CS7: 8-hour average 27 ppm - Risk characterisation ratio: 0.54. 15-minute average 49 ppm - Risk characterisation ratio: 0.49
	exposure resulting from contributing scenario ES3-CS8: 8-hour average 15 ppm - Risk characterisation ratio: 0.3. 15-minute average 50 ppm - Risk characterisation ratio: 0.5.
	exposure resulting from contributing scenario ES3-CS9: 8-hour average 0.01 ppm - Risk characterisation ratio: <0.01. 15-minute average 0.04 ppm - Risk characterisation ratio: <0.01.
	exposure resulting from contributing scenario ES3-CS10: 8-hour average 15 ppm - Risk characterisation ratio: 0.3. 15-minute average 50 ppm - Risk characterisation ratio: 0.5.
	Risk management measures described will protect against acute exposure.
Health: Dermal:	exposure resulting from contributing scenario ES3-CS1: 0.03 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES3-CS2: 0.27 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES3-CS3: 0.013 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES3-CS4: 0.13 mg/kg/day. Risk characterisation ratio: <0.001.

	exposure resulting from contributing scenario ES3-CS5: 0.13 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES3-CS6: 0.0068 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES3-CS7: 1.6 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES3-CS8: 1.6 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES3-CS9: 0.03 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES3-CS10: 0.16 mg/kg/day. Risk characterisation ratio: <0.001.
	Available hazard data do not enable the derivation of a DNEL for dermal irritant effects [G32]. Risk Management Measures are based on qualitative risk characterisation [G37].
Section 4:	Guidance to check compliance with the exposure scenario:
Environment:	Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures [DSU1]. If scaling reveals a condition of unsafe use (i.e., RCRs > 1), additional RMMs or a site-specific chemical safety assessment is required [DSU8]. Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html) [DSU4].
Health:	No data

Notes on exposure scenario and exposure estimation, including deviations and additions to ECETOC TRA defaults:

The situations leading to exposure include the use of neat MTBE as intermediate. When modeling resulted in risk characterization ratios above 1 exposure data was used to estimate exposure (tier-2). Only tier-2 data as presented in the EU RAR for MTBE (European Commission, 2002) was used (see Annex B1.2, containing a summary of data from the EU RAR of MTBE).

The workers' exposure to MTBE may principally occur only during incidental leaks and spills from pipeline and valve connections (fugitive emissions) and maintenance operations. Sampling and laboratory work, handling products containing MTBE for analyses, lead to exposure of laboratory assistants. The mechanics are daily exposed during removal of pumps and repairing impellers. They are also doing maintenance on pipelines and vapour recovery equipment. The maintenance tasks are such that the workers are exposed to MTBE vapours and their hands are in contact with petrol products

Deviations due to availability of measured data:

Measured data is available for the following contributing scenarios (see annex B)

Contributing scenario	Measured data available	Modification justification
CS2 and CS10 PROC 2 (sampling)	Sampling of neat MTBE; sampling vessel (n=5), sampling pipeline (n=3) and sampling rail car (n=5): highest short-term value: 63 mg/m ³ = 17 ppm (see table 4.4 of EU risk assessment report, 2002).	The default approach in the ECETOC TRA tool of estimating the short-term exposure as 4x the long-term exposure estimate seems excessive. The available measured data is used to justify reducing this factor to 2x
CS7 PROC 8b(bulk loading and unloading)	Full-shift exposure: Tier 2 estimation of long-term inhalatory exposure: transportation of neat MTBE long-term inhalatory exposure: 100 mg/m ³ = 27 ppm (RWC OC:	The measured data is used in place of estimated data.

	4 hours OC: 4hr; conclusion adopted from EU risk assessment report, 2002 section 4.1.1.1.4.). Short-term exposure: transportation of neat MTBE short-term inhalatory exposure: 180 mg/m³ = 49 ppm (maximum exposure level during transportation of neat MTBE); see table 4.8 of risk assessment report, 2002.	Measured data is used in place of estimated data.
CS8 PROC 8a (Equipment maintenance)	Maintenance neat MTBE emptying operations (n=14), start up (n=6), tank roof (n=7), highest short-term exposure 57 mg/m³ (16 ppm) - see table 4.4 of risk assessment report, 2002.	The default approach in the ECETOC TRA tool of estimating the short-term exposure as 4x the long-term exposure estimate seems excessive. The available measured data is used to justify reducing this factor to 2x

Other justified deviations

Contributing scenario	Additional RMM	Justification for exposure reduction
CS8 PROC 8a (Equipment maintenance)	Drain down and flush system prior to equipment break-in or maintenance [E55])	Draining prior to maintenance is assumed to deliver a reduction of 90% of the inhalation exposure estimates in industrial settings. Reduction is based on comparison of CONCAWE data on exposures resulting from spills and those arising from same/similar task when Standard Operating Procedures invoked.

9.4 Exposure scenario 4. Use as a process chemical or extraction solvent. - Industrial.

Although MTBE is used almost exclusively as an additive to petrol, limited amounts (0.1-0.2%) of produced very pure substance (97.5%) is used as solvent. MTBE is used as a solvent in different situations. The following activities are covered by this exposure scenario:

- The pharmaceutical industry uses MTBE as a solvent for extraction and crystallisation of substances instead of other ethers (Little et al., 1979 as referred in European Commission, 2002).
- In laboratories, MTBE is used to some extent as a solvent for chemical analyses (Little et al. 1979; Mount et al., 1991 as referred in European Commission, 2002).
- For research and development purposes MTBE has been used for dissolution of gallstones in patients and laboratory animals (Adam et al., 1990; Allen et al., 1985; Ponchon et al., 1988; Teplick et al., 1987 as referred in European Commission, 2002).

The main advantage of MTBE in comparison with other solvents is the stability against oxidation processes and nearly no formation of peroxides. So, MTBE is used as a specialist solvent for closed special processes. The extraction solvent is recycled after usage. Only a small amount of the overall amount of MTBE is disposed to wastewater or burned in waste incineration plants. Exhaust air is typically treated in exhaust air burning facilities.

Air, water, and soil emission factors were adopted without modification from ESVOC SpERC 4.24.v1 (#39). This SpERC covers the industrial use of a substance in laboratory settings on a limited basis. The SpERC emission factors are identical to the default values established for ERC2 (formulation of mixtures). As a result, a separate SpERC factsheet is not available and the applicable emission factors that have been taken directly from Chapter R.16.

Exposure scenario

Based on ECHA Template CSA&IR Part D June 08 combined with the GES Narrative Format.

Section 1	
Title:	MTBE. Use as a process chemical or extraction solvent. CAS:1634-04-4.
Sector(s) of Use:	Industrial (SU3).
Environmental Release Category(ies):	ERC4. ESVOC SpERC 4.24.v1
Process Category(ies):	PROC1, PROC2, PROC3, PROC4, PROC8a, PROC8b, PROC15.
Processes, tasks, activities covered:	Covers the use a process chemical or extraction solvent, including exposures during use (including product transfer, mixing and preparation plus manual and automated application) and equipment cleaning.
Assessment method:	Health: Used ECETOC TRA model [EE1]. (v3). Environment: Used EUSES model [EE4]. Used ESIG SpERC #38.
Section 2:	
Operational conditions and risk management measures.	
Section 2.1	
Control of environmental exposure:	
Product Characteristics:	Substance is a unique structure [PrC1]. Predominantly hydrophobic [PrC4a]. Readily biodegradable [PrC5a].

Regional tonnage of MTBE (tonne per year).	2,010 tpa (6,692 kg/day).
Fraction of EU production volume for region	0.25
Fraction of tonnage for application	0.003
Fraction of chemical in formulation	1
Frequency and duration of use:	Continuous process [CS54]. 20 days per year of operation.
Environmental factors not influenced by risk management:	Local freshwater dilution factor [EF1]: 10. Local marine water dilution factor [EF2]: 100.
Other operational conditions of use affecting environmental exposure.	No specific measures required.
Technical onsite conditions and measures to reduce or limit discharges, air emissions.	Conditions given in SPERC fact sheet give rise to following releases fractions [OOC29]. ES4-E1: ERC4. ESVOC SpERC 38. Release fraction to air from process (initial release prior to RMM) [OOC4]: 0.025. Release fraction to wastewater from process (initial release prior to RMM) [OOC5]: 0.02. Release fraction to soil from process (initial release prior to RMM) [OOC6]: 0.0001. Fraction of main source: 0.3 No air emission controls required; required removal efficiency is 0% [TCR5]. Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency of $\geq$ (%) [TCR8]: 99. Assumed industrial waste water treatment plant flow (m³/d): 2000.
Organisation measures to prevent/limit release from site.	Prevent discharge of undissolved substance to or recover from onsite wastewater [TCR14].
Conditions and measures related to municipal sewage treatment plant.	Estimated substance removal from wastewater via domestic sewage treatment (%) [STP3]: 99. Assumed domestic sewage treatment plant flow (m ³ /d) [STP5]: 2000.
Conditions and measures related to external treatment of waste for disposal.	External treatment and disposal of waste should comply with applicable local and/or national regulations [ETW3].
Conditions and measures related to external recovery of waste.	External recovery and recycling of waste should comply with applicable local and/or national regulations [ERW1].
Other environmental control measures additional to above:	none.
Section 2.2: Control of worker exposure.	
Product Characteristics:	
Physical form of product:	Liquid, vapour pressure > 10 kPa at STP [OC5].
Concentration of substance in product:	Covers percentage substance in the product up to 100 % (unless stated differently) [G13].
Amounts used:	Not applicable.
Frequency and duration of use:	Covers daily exposures up to 8-hours (unless stated differently) [G2]. Continuous process [CS54].
Human factors not influenced by risk management:	none.

Other operational conditions affecting worker exposure:	Assumes a good basic standard of occupational hygiene is implemented [G1]. Assumes use at not more than 20°C above ambient temperature, unless stated differently [G15]. Outdoor use [OOC1].
Technical conditions and measures at a process level to prevent release and technical conditions and measures to control dispersion from source towards workers:	Common practices vary across sites thus conservative process release estimates used [TCS1].
Contributing Scenarios:	Risk Management Measures: Note: list RMM standard phrases according to the control hierarchy indicated in the ECHA template: 1. Technical measures to prevent release, 2. Technical measures to prevent dispersion, 3. Organisational measures, 4. Personal protection.
General measures (skin irritants) [G19]:	Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin problems that may develop [E3].
ES4-CS1: PROC1. General exposures (closed systems) [CS15].	No specific measures identified [EI18].
ES4-CS2: PROC2. General exposures (closed systems) [CS15]. with sample collection [CS56].	Ensure operation is undertaken outdoors [E69].
ES4-CS3: PROC3. General exposures (closed systems) [CS15]. Use in contained batch processes [CS37]. with sample collection [CS56].	Provide extract ventilation to points where emissions occur [E54].
ES4-CS4: PROC4. General exposures (open systems) [CS16]. Batch process [CS55]. with sample collection [CS56]. Filling / preparation of equipment from drums or containers. [CS45].	Ensure material transfers are under containment or extract ventilation [E66].
ES4-CS5: PROC8b. Process sampling [CS2]. Dedicated facility [CS81].	Provide extract ventilation to points where emissions occur [E54]. Avoid carrying out activities involving exposure for more than 1-hour [OC27].
ES4-CS6: PROC15. Laboratory activities [CS36]. Cleaning [CS47]. Wiping [CS50]. Rolling, Brushing [CS51].	Handle in a fume cupboard or under extract ventilation [E83].
ES4-CS7: PROC8b. Bulk closed loading and unloading [CS501]. Dedicated facility [CS81].	Avoid carrying out activities involving exposure for more than 4 hours [OC28], or wear a respirator conforming to EN140 with Type A filter or better [PPE22].
ES4-CS8: PROC8a. Equipment cleaning and maintenance [CS39]. Non-dedicated facility [CS82].	Drain down and flush system prior to equipment break-in or maintenance [E55]. Avoid carrying out activities involving exposure for more than 4 hours [OC28], or wear a respirator conforming to EN140 with Type A filter or better [PPE22].
ES4-CS9: PROC1. Storage [CS67]. General exposures (closed systems) [CS15].	No specific measures identified [EI18].

ES4-CS10: PROC2. Storage [CS67]. General exposures (closed systems) [CS15]. with sample collection [CS56].	Avoid carrying out activities involving exposure for more than 4 hours [OC28], or wear a respirator conforming to EN140 with Type A filter or better [PPE22].
Section 3:	Exposure estimation:
Environment:	Maximum exposure resulting from contributing scenarios described.
	ES4-E1: PEC for microorganisms in STP: 0.0101 mg/l. Risk characterisation ratio: 1.42E-04. Local PEC in surface water: 0.00185 mg/l. Risk characterisation ratio: 3.63E-04. Local PEC in fresh water sediment: 0.00177 mg/kgww. Risk characterisation ratio: 3.54E-04. Local PEC in sea water during emission episode: 0.00021 mg/l. Risk characterisation ratio: 8.08E-04. Local PEC in marine sediment: 0.0002 mg/kgww. Risk characterisation ratio: 8.00E-04. Local PEC in agricultural soil (30-day average): 0.00199 mg/kgww. Risk characterisation ratio: 1.44E-03. Local PEC in grassland (180-day average): 0.00198 mg/kgww. Risk characterisation ratio: 1.43E-03. Risk from environmental exposure is driven by soil [TCR1f].
Health: Inhalation (vapour).	exposure resulting from contributing scenario ES4-CS1: 8-hour average 0.01 ppm - Risk characterisation ratio: <0.01. 15-minute average 0.04 ppm - Risk characterisation ratio: <0.01.
	exposure resulting from contributing scenario ES4-CS2: 8-hour average 18 ppm - Risk characterisation ratio: 0.35. 15-minute average 35 ppm - Risk characterisation ratio: 0.35.
	exposure resulting from contributing scenario ES4-CS3: 8-hour average 5 ppm - Risk characterisation ratio: 0.1. 15-minute average 20 ppm - Risk characterisation ratio: 0.2.
	exposure resulting from contributing scenario ES4-CS4: 8-hour average 10 ppm - Risk characterisation ratio: 0.2. 15-minute average 40 ppm - Risk characterisation ratio: 0.4.
	exposure resulting from contributing scenario ES4-CS5: 8-hour average 1.5 ppm - Risk characterisation ratio: 0.03. 15-minute average 30 ppm - Risk characterisation ratio: 0.3.
	exposure resulting from contributing scenario ES4-CS6: 8-hour average 5 ppm - Risk characterisation ratio: 0.1. 15-minute average 20 ppm - Risk characterisation ratio: 0.2.
	exposure resulting from contributing scenario ES4-CS7: 8-hour average 27 ppm - Risk characterisation ratio: 0.54. 15-minute average 49 ppm - Risk characterisation ratio: 0.49.
	exposure resulting from contributing scenario ES4-CS8: 8-hour average 15 ppm - Risk characterisation ratio: 0.3. 15-minute average 50 ppm - Risk characterisation ratio: 0.5.
	exposure resulting from contributing scenario ES4-CS9: 8-hour average 0.01 ppm - Risk characterisation ratio: <0.01. 15-minute average 0.04 ppm - Risk characterisation ratio: <0.01.
	exposure resulting from contributing scenario ES4-CS10: 8-hour average 15 ppm - Risk characterisation ratio: 0.3. 15-minute average 50 ppm - Risk characterisation ratio: 0.5.
	Risk management measures described will protect against acute exposure.

Health: Dermal:	exposure resulting from contributing scenario ES4-CS1: 0.03 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES4-CS2: 0.27 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES4-CS3: 0.013 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES4-CS4: 0.13 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES4-CS5: 0.13 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES4-CS6: 0.0068 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES4-CS7: 1.6 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES4-CS8: 8.2 mg/kg/day. Risk characterisation ratio: 0.002.
	exposure resulting from contributing scenario ES4-CS9: 0.006 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES4-CS10: 0.82 mg/kg/day. Risk characterisation ratio: <0.001.
	Available hazard data do not enable the derivation of a DNEL for dermal irritant effects [G32]. Risk Management Measures are based on qualitative risk characterisation [G37].
Section 4:	Guidance to check compliance with the exposure scenario:
Environment:	Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures [DSU1]. If scaling reveals a condition of unsafe use (i.e., RCRs > 1), additional RMMs or a site-specific chemical safety assessment is required [DSU8]. Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html) [DSU4].
Health:	No data

Notes on exposure scenario and exposure estimation, including deviations and additions to ECETOC TRA defaults:

The situations leading to exposure include the use of neat MTBE as process solvent for the extraction and crystallisation of substances, as a solvent in chemical analyses and in research and development activities. No exposure data for this ES was available in the EU RAR for MTBE (European Commission, 2002).

Deviations due to availability of measured data:

Measured data is available for the following contributing scenarios (see annex B)

Contributing scenario	Measured data available	Modification justification
CS2 and CS10 PROC 2 (sampling)	Sampling of neat MTBE; sampling vessel (n=5), sampling pipeline (n=3) and sampling rail car (n=5): highest short-term value: 63 mg/m ³ = 17 ppm (see table 4.4 of EU risk assessment report, 2002).	The default approach in the ECETOC TRA tool of estimating the short-term exposure as 4x the long-term exposure estimate seems excessive. The available measured data is used to justify reducing this factor to 2x
CS7 PROC 8b(bulk loading and unloading)	Full-shift exposure: Tier 2 estimation of long-term inhalatory exposure: transportation of neat MTBE	The measured data is used in place of estimated data.

	long-term inhalatory exposure: 100 mg/m³ = 27 ppm (RWC OC: 4 hours OC: 4hr; conclusion adopted from EU risk assessment report, 2002 section 4.1.1.4.). Short-term exposure: transportation of neat MTBE short-term inhalatory exposure: 180 mg/m³ = 49 ppm (maximum exposure level during transportation of neat MTBE); see table 4.8 of risk assessment report, 2002.	The measured data is used in place of estimated data.
CS8 PROC 8a (Equipment maintenance)	Maintenance neat MTBE emptying operations (n=14), start up (n=6), tank roof (n=7), highest short-term exposure 57 mg/m³ (16 ppm) - see table 4.4 of risk assessment report, 2002.	The default approach in the ECETOC TRA tool of estimating the short-term exposure as 4x the long-term exposure estimate seems excessive. The available measured data is used to justify reducing this factor to 2x

Other justified deviations

Contributing scenario	Additional RMM	Justification for exposure reduction
CS8 PROC 8a (Equipment maintenance)	Drain down and flush system prior to equipment break-in or maintenance [E55])	Draining prior to maintenance is assumed to deliver a reduction of 90% of the inhalation exposure estimate in industrial settings. Reduction is based on comparison of CONCAWE data on exposures resulting from spills and those arising from same/similar task when Standard Operating Procedures invoked.

9.5 Exposure scenario 5. Distribution of substance. - Industrial.

MTBE is used in transportation and distribution as fuel additive in fuels BY transfer of substance or preparation. Neat MTBE and the blended petrol products are transported from the refinery to the depot-terminals and distributed from the depot area (bulk station) to service stations. The products can be transported in an airplane, railcar, truck and ship. Emissions during transport and distribution are mainly atmospheric, even if emission to all environmental compartments are possible during storage, loading/reloading, transportation and delivery of petrol at service stations. Release to the aquatic environment may occur during transportation of petrol/MTBE through waterways and refuelling of watercrafts. This scenario also covers the storage element of this process in particular storage in floating roof tanks. This type of storage tank is now effectively obsolete and is not used anymore for the storage of fuels containing MTBE or MTBE itself and is maintained in the exposure assessment for historical purposes only and to provide a worse case assessment.

Air, water, and soil emission factors were adopted without modification from ESVOC SpERC 1.1b.v1 (#3) for the transport scenario, whereas the emissions of to wastewater from MTBE storage were calculated as described in Annex C. This transportation SpERC covers the loading (including marine vessel/barge, rail/road car and IBC loading) and repacking (including drums and small packs) of substance, including its sampling, storage, unloading and associated laboratory activities. These emission factors are applicable to petroleum substances (e.g., aliphatic and aromatic hydrocarbons) and petrochemicals. Further details on the creation and suitability of this SpERC can be found in the ESVOC factsheet located Annex D.

Exposure scenario

Based on ECHA Template CSA&IR Part D June 08 combined with the GES Narrative Format.

Section 1	
Title:	MTBE. Distribution of substance. CAS:1634-04-4.
Sector(s) of Use:	Industrial (SU3).
Environmental Release Category(ies):	ERC1, ERC2. ESVOC SpERC 1.1b.v1
Process Category(ies):	PROC1, PROC2, PROC3, PROC4, PROC8a, PROC8b, PROC9, PROC15.
Processes, tasks, activities covered:	Loading (including marine vessel/barge, rail/road car and IBC loading) and repacking (including drums and small packs) of substance, including its sampling, storage, unloading distribution and associated laboratory activities [GES1A_I].
Assessment method:	Health: Used ECETOC TRA model [EE1]. (v3). Environment: Used EUSES model [EE4]. Used ESVOC SpERC #3.
Section 2:	Operational conditions and risk management measures.

Section 2.1	
Product Characteristics:	Substance is a unique structure [PrC1]. Predominantly hydrophobic [PrC4a]. Readily biodegradable [PrC5a].
Regional tonnage of MTBE (tonne per year) – transport	659,000 tpa (2,197,125 kg/day).
Fraction of EU production volume for region – transport	0.25
Fraction of tonnage for application – transport	0.985
Fraction of chemical in formulation – transport	0.15

Regional tonnage of MTBE (kg per day) – storage (see Annex C)	8.4
Frequency and duration of use:	Continuous process [CS54]. 300 days per year of operation.
Environmental factors not influenced by risk management:	Local freshwater dilution factor [EF1]: 10. Local marine water dilution factor [EF2]: 100.
Other operational conditions of use affecting environmental exposure.	No specific measures required.
Technical onsite conditions and measures to reduce or limit discharges, air emissions.	<u>Transport [CS58]</u> Conditions given in SPERC fact sheet give rise to following releases fractions [OOC29]. ES5-E1: ERC1, ERC2. ESVOC SpERC 3. Release fraction to air from process (initial release prior to RMM) [OOC4]: 0.0001. Release fraction to wastewater from process (initial release prior to RMM) [OOC5]: 0.00001. Release fraction to soil from process (initial release prior to RMM) [OOC6]: 0. Fraction of main source: 0.05 <u>Bulk Product Storage [CS85]</u> Assessment of storage conditions give rise to the following release estimates. See annex C for details. ES5-E2: ERC1, ERC2. Local release to air: 0 kg/day. Local release to water: 8.4 kg/day. Local release to soil: 0 kg/day. Fraction of main source: 1.0 No air emission controls required; required removal efficiency is 0% [TCR5]. Soil emission controls are not applicable as there is no direct release to soil [TCR4]. Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency of $\geq$ (%) [TCR8]: Transport: 95. Storage: 99. Assumed industrial waste water treatment plant flow (m³/d): 2000.
Organisation measures to prevent/limit release from site.	Prevent discharge of undissolved substance to or recover from onsite wastewater [TCR14].
Conditions and measures related to municipal sewage treatment plant.	Estimated substance removal from wastewater via domestic sewage treatment (%) [STP3]: Transport: 95%. Storage: 99%. Assumed domestic sewage treatment plant flow (m ³ /d) [STP5]: 2000.
Conditions and measures related to external treatment of waste for disposal.	External treatment and disposal of waste should comply with applicable local and/or national regulations [ETW3].
Conditions and measures related to external recovery of waste.	External recovery and recycling of waste should comply with applicable local and/or national regulations [ERW1].
Other environmental control measures additional to above:	none.
Section 2.2: Control of worker exposure.	
Product Characteristics:	
Physical form of product:	Liquid, vapour pressure > 10 kPa at STP [OC5].
Concentration of substance in product:	Covers percentage substance in the product up to 100 % (unless stated differently) [G13].
Amounts used:	Not applicable.
Frequency and duration of use:	Covers daily exposures up to 8-hours (unless stated differently) [G2]. Continuous process [CS54].
Human factors not influenced by risk management:	none.

Other operational conditions affecting worker exposure:	Assumes a good basic standard of occupational hygiene is implemented [G1]. Assumes use at not more than 20°C above ambient temperature, unless stated differently [G15]. Outdoor use [OOC1].
Technical conditions and measures at a process level to prevent release and technical conditions and measures to control dispersion from source towards workers:	Common practices vary across sites thus conservative process release estimates used [TCS1].
Contributing Scenarios:	Risk Management Measures: Note: list RMM standard phrases according to the control hierarchy indicated in the ECHA template: 1. Technical measures to prevent release, 2. Technical measures to prevent dispersion, 3. Organisational measures, 4. Personal protection.
General measures (skin irritants) [G19]:	Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin problems that may develop [E3].
ES5-CS1: PROC1. General exposures (closed systems) [CS15].	No specific measures identified [EI18].
ES5-CS2: PROC2. General exposures (closed systems) [CS15]. with sample collection [CS56].	Ensure operation is undertaken outdoors [E69].
ES5-CS3: PROC3. General exposures (closed systems) [CS15]. Use in contained batch processes [CS37]. with sample collection [CS56].	Ensure operation is undertaken outdoors [E69]. Avoid carrying out activities involving exposure for more than 4 hours [OC28], or wear a respirator conforming to EN140 with Type A filter or better [PPE22].
ES5-CS4: PROC4. General exposures (open systems) [CS16]. Batch process [CS55]. with sample collection [CS56]. Filling / preparation of equipment from drums or containers. [CS45].	Provide extract ventilation to points where emissions occur [E54]. Ensure samples are obtained under containment or extract ventilation [E76].
ES5-CS5: PROC3. Process sampling [CS2].	Ensure operation is undertaken outdoors [E69]. Avoid carrying out activities involving exposure for more than 15-minutes [OC26], or wear a respirator conforming to EN140 with Type A filter or better [PPE22].
ES5-CS6: PROC15. Laboratory activities [CS36]. Cleaning [CS47]. Wiping [CS50]. Rolling, Brushing [CS51].	Handle in a fume cupboard or under extract ventilation [E83].
ES5-CS7: PROC8b. Bulk closed loading and unloading [CS501]. Dedicated facility [CS81].	Ensure operation is undertaken outdoors [E69]. Avoid carrying out activities involving exposure for more than 1-hour [OC27], or wear a respirator conforming to EN140 with Type A filter or better [PPE22].
ES5-CS8: PROC8a. Bulk open loading and unloading [CS503]. Non-dedicated facility [CS82].	Ensure material transfers are under containment or extract ventilation [E66], or wear a respirator conforming to EN140 with Type A filter or better [PPE22].

ES5-CS9: PROC9. Drum and small package filling [CS6]. Dedicated facility [CS81].	Use drum pumps [E53]. Fill containers/cans at dedicated fill points supplied with local extract ventilation [E51].
ES5-CS10: PROC8a. Equipment cleaning and maintenance [CS39]. Non-dedicated facility [CS82].	Drain down and flush system prior to equipment break-in or maintenance [E55].
ES5-CS11: PROC1. Storage [CS67]. General exposures (closed systems) [CS15].	No specific measures identified [EI18].
ES5-CS12: PROC2. Storage [CS67]. General exposures (closed systems) [CS15]. with sample collection [CS56].	Ensure operation is undertaken outdoors [E69].
Section 3:	Exposure estimation:
Environment:	Maximum exposure resulting from contributing scenarios described.
	ES5-E1 (transport [CS58]): PEC for microorganisms in STP: 0.00964 mg/l. Risk characterisation ratio: 1.36E-04. Local PEC in surface water: 0.00181 mg/l. Risk characterisation ratio: 3.55E-04. Local PEC in fresh water sediment: 0.00173 mg/kgww. Risk characterisation ratio: 3.46E-04. Local PEC in sea water during emission episode: 0.00542 mg/l. Risk characterisation ratio: 2.08E-02. Local PEC in marine sediment: 0.00531 mg/kgww. Risk characterisation ratio: 2.12E-02. Local PEC in agricultural soil (30-day average): 0.00164 mg/kgww. Risk characterisation ratio: 1.19E-03. Local PEC in grassland (180-day average): 0.000520 mg/kgww. Risk characterisation ratio: 3.77E-04. Risk from environmental exposure is driven by marine sediment [TCR1d]. ES5-E2 (bulk product storage [CS85]): PEC for microorganisms in STP: 0.00978 mg/l. Risk characterisation ratio: 1.38E-04. Local PEC in surface water: 0.00182 mg/l. Risk characterisation ratio: 3.57E-04. Local PEC in fresh water sediment: 0.00174mg/kgdw. Risk characterisation ratio: 3.48E-04. Local PEC in sea water during emission episode: 0.000208 mg/l. Risk characterisation ratio: 8.00E-04. Local PEC in marine sediment: 0.000198mg/kgdw. Risk characterisation ratio: 7.92E-04. Local PEC in agricultural soil (30-day average): 0.00902mg/kgdw. Risk characterisation ratio: 6.54E-03. Local PEC in grassland (180-day average): 0.00062mg/kgdw. Risk characterisation ratio: 4.49E-04 Risk from environmental exposure is driven by soil [TCR1f].
Health: Inhalation (vapour).	exposure resulting from contributing scenario ES5-CS1: 8-hour average 0.01 ppm - Risk characterisation ratio: <0.01. 15-minute average 0.04 ppm - Risk characterisation ratio: <0.01.
	exposure resulting from contributing scenario ES5-CS2: 8-hour average 18 ppm - Risk characterisation ratio: 0.35. 15-minute average 35 ppm - Risk characterisation ratio: 0.35.

	exposure resulting from contributing scenario ES5-CS3: 8-hour average 21 ppm - Risk characterisation ratio: 0.42. 15-minute average 35 ppm - Risk characterisation ratio: 0.35. exposure resulting from contributing scenario ES5-CS4: 8-hour average 10 ppm - Risk characterisation ratio: 0.2. 15-minute average 40 ppm - Risk characterisation ratio: 0.4. exposure resulting from contributing scenario ES5-CS5: 8-hour average 3.4 ppm - Risk characterisation ratio: 0.07. 15-minute average 35 ppm - Risk characterisation ratio: 0.35. exposure resulting from contributing scenario ES5-CS6: 8-hour average 5 ppm - Risk characterisation ratio: 0.1. 15-minute average 20 ppm - Risk characterisation ratio: 0.2. exposure resulting from contributing scenario ES5-CS7: 8-hour average 21 ppm - Risk characterisation ratio: 0.42. 15-minute average 49 ppm - Risk characterisation ratio: 0.49. exposure resulting from contributing scenario ES5-CS8: 8-hour average 25 ppm - Risk characterisation ratio: 0.5. 15-minute average 50 ppm - Risk characterisation ratio: 0.5. exposure resulting from contributing scenario ES5-CS9: 8-hour average 4 ppm - Risk characterisation ratio: 0.08. 15-minute average 16 ppm - Risk characterisation ratio: 0.16. exposure resulting from contributing scenario ES5-CS10: 8-hour average 25 ppm - Risk characterisation ratio: 0.5. 15-minute average 50 ppm - Risk characterisation ratio: 0.5. exposure resulting from contributing scenario ES5-CS11: 8-hour average 0.01 ppm - Risk characterisation ratio: <0.01. 15-minute average 0.04 ppm - Risk characterisation ratio: <0.01. exposure resulting from contributing scenario ES5-CS12: 8-hour average 18 ppm - Risk characterisation ratio: 0.35. 15-minute average 35 ppm - Risk characterisation ratio: 0.35.
	Risk management measures described will protect against acute exposure.
Health: Dermal:	exposure resulting from contributing scenario ES5-CS1: 0.03 mg/kg/day. Risk characterisation ratio: <0.001. exposure resulting from contributing scenario ES5-CS2: 0.27 mg/kg/day. Risk characterisation ratio: <0.001. exposure resulting from contributing scenario ES5-CS3: 0.082 mg/kg/day. Risk characterisation ratio: <0.001. exposure resulting from contributing scenario ES5-CS4: 0.13 mg/kg/day. Risk characterisation ratio: <0.001. exposure resulting from contributing scenario ES5-CS5: 0.013 mg/kg/day. Risk characterisation ratio: <0.001. exposure resulting from contributing scenario ES5-CS6: 0.0068 mg/kg/day. Risk characterisation ratio: <0.001. exposure resulting from contributing scenario ES5-CS7: 0.54 mg/kg/day. Risk characterisation ratio: <0.001. exposure resulting from contributing scenario ES5-CS8: 0.27 mg/kg/day. Risk characterisation ratio: <0.001. exposure resulting from contributing scenario ES5-CS9: 0.13 mg/kg/day. Risk characterisation ratio: <0.001. exposure resulting from contributing scenario ES5-CS10: 2.7 mg/kg/day. Risk characterisation ratio: <0.001. exposure resulting from contributing scenario ES5-CS11: 0.03 mg/kg/day. Risk characterisation ratio: <0.001.

	exposure resulting from contributing scenario ES5-CS12: 0.27 mg/kg/day. Risk characterisation ratio: <0.001.
	Available hazard data do not enable the derivation of a DNEL for dermal irritant effects [G32]. Risk Management Measures are based on qualitative risk characterisation [G37].
Section 4:	Guidance to check compliance with the exposure scenario:
Environment:	Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures [DSU1]. If scaling reveals a condition of unsafe use (i.e., RCRs > 1), additional RMMs or a site-specific chemical safety assessment is required [DSU8]. Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html) [DSU4].
Health:	No data

Notes on exposure scenario and exposure estimation, including deviations and additions to ECETOC TRA defaults:

The situations leading to exposure include loading and unloading railroad car, ship etc. and distribution of petrol containing MTBE to service stations (loading and unloading tank trucks). When modeling resulted in risk characterization ratios above 1 exposure data was used to estimate exposure (tier-2). Only tier-2 data as presented in the EU RAR for MTBE (European Commission, 2002) was used (see Annex B1.2, containing a summary of data from the EU RAR of MTBE).

Transporting operations concerns both neat MTBE and mixed fuel. The exposed workers are bulk terminal, railcar, truck and marine employees. Leaks from the fittings and dry break mating surfaces contribute to the operators' exposure during the loading/unloading operations. The severity of drivers' exposure to petrol vapours depends on the method of loading (top loading or bottom loading), and how the vapours from the empty tanks are displaced, recovered or vented.

Exposure can be the result of the following loading/unloading activities (as described in the RAR, European Commission, 2002):

Unloading of a railroad car (disconnecting the bottom cap from the rail car, connecting a male unloading elbow, and connecting a female unloading dry break to the male elbow for product transfer to a storage tank)

Loading and delivery operations (The major part of exposure of road tanker drivers takes place during loading and delivery operations. The principal source for workers' exposure at depot area is created by the flow of petrol into the truck tank. The petrol flow displaces petrol vapours from the truck tank into the atmosphere or into a vapour recovery system. Leaking from the filling lines or spillage of petrol may also produce vapours through evaporation)

disconnecting the bottom cap from the truck (at service stations for product transfer to the storing tank), connecting a male unloading elbow, and connecting a female unloading dry break to the male elbow. Spills and leaks from the fittings and dry break mating surfaces contribute to the driver's exposure. The highest short-term exposures may occur during the connecting and disconnecting the dry break valves. Saturated petrol vapours escaping from the tanks when the tanks are filled with new liquid likely causes the main exposure.

Taking samples: During transportation, also samplings for laboratory analyses are required by removal an unloading valve cap located underneath the car, installing a sample valve, and filling a glass bottle for sampling. The operators' exposures increase especially while handling the wetted valves. After finishing the sampling, the valves become plugged and then cleaned. The bucket used to drain the overflow of the sampling increases the exposure. Mechanics are daily exposed during removal of pumps and repairing repellers, during replacement of railroad car dry break couplings, and while repairing and calibrating fuel meters at transport loading racks and at service stations. They are also doing maintenance on pipelines and vapour recovery equipment. The maintenance tasks are such that the workers are exposed to MTBE vapours and their hands are in contact with petrol products.

Deviations due to availability of measured data:

Measured data is available for the following contributing scenarios (see annex B)

Contributing scenario	Measured data available	Modification justification
CS2, CS3, CS5 and CS12 PROC 2, PROC 3 (sampling)	Sampling of neat MTBE; sampling vessel (n=5), sampling pipeline (n=3) and sampling rail car (n=5): highest short-term value: $63 \text{ mg/m}^3 = 17 \text{ ppm}$ (see table 4.4 of EU risk assessment report, 2002).	The default approach in the ECETOC TRA tool of estimating the short-term exposure as 4x the long-term exposure estimate seems excessive. The available measured data is used to justify reducing this factor to 2x for PROC 2 (CS2 and CS12) and to 1 (for PROC 3 (CS3 and CS5).
CS7 PROC 8b(bulk loading and unloading)	Short-term exposure: transportation of neat MTBE short-term inhalatory exposure: $180 \text{ mg/m}^3 = 49 \text{ ppm}$ (maximum exposure level during transportation of neat MTBE); see table 4.8 of risk assessment report, 2002.	The measured data are used in place of estimated data
CS8 PROC 8a, (bulk loading and unloading)	Short-term exposure: transportation of neat MTBE short-term inhalatory exposure: $180 \text{ mg/m}^3 = 49 \text{ ppm}$ (maximum exposure level during transportation of neat MTBE); see table 4.8 of risk assessment report, 2002.	The default approach in the ECETOC TRA tool of estimating the short-term exposure as 4x the long-term exposure estimate seems excessive. The available measured data is used to justify reducing this factor to 2x
CS10 PROC 8a (Equipment maintenance)	Maintenance neat MTBE emptying operations (n=14), start up (n=6), tank roof (n=7), highest short-term exposure 57 mg/m^3 (16 ppm) - see table 4.4 of risk assessment report, 2002.	The default approach in the ECETOC TRA tool of estimating the short-term exposure as 4x the long-term exposure estimate seems excessive. The available measured data is used to justify reducing this factor to 2x

Other justified deviations

Contributing scenario	Additional RMM	Justification for exposure reduction
CS9 Drum and small package filling, Dedicated facility	Use drum pumps [E53].	Use of drum pumps was shown to deliver an exposure reduction of 80% in CONCAWE report 11/12, 2012.
CS10 PROC 8a (Equipment cleaning and maintenance)	Drain down and flush system prior to equipment break-in or maintenance [E55])	Draining prior to maintenance is assumed to deliver a reduction of 90% of the inhalation exposure estimate in industrial settings. Reduction is based on comparison of CONCAWE data on exposures resulting from spills and those arising from same/similar task when Standard Operating Procedures invoked.

9.6 Exposure scenario 6. Use as a fuel. - Industrial.

MTBE use as a fuel additive in industrial use of fuel. Industrial uses cover emissions from the use of petrol as a fuel in spark ignition engines. In addition, this scenario covers use as a fuel (or fuel additive) and includes activities associated with its transfer, use, equipment maintenance and handling of waste). Emissions to all environmental compartments are possible although emissions into environment are mainly atmospheric. Emissions to air from the use of petrol are the main source of MTBE released to the environment. It covers the majority of the total emitted mass volume. Emissions are divided into two main categories: evaporative emissions and exhaust emissions

Air, water, and soil emission factors were adopted without modification from ESVOC SpERC 7.12a.v1 (#28). This SpERC covers the industrial use MTBE as a fuel (or fuel additive) and includes activities associated with its transfer, use, equipment maintenance and handling of waste. These emission factors are applicable to petroleum substances (e.g., aliphatic and aromatic hydrocarbons) and petrochemicals. Further details on the creation and suitability of this SpERC can be found in the ESVOC factsheet located Annex D.

Exposure scenario

Based on ECHA Template CSA&IR Part D June 08 combined with the GES Narrative Format.

Section 1	
Title.	MTBE. Use as a fuel. CAS:1634-04-4.
Sector(s) of Use:	Industrial (SU3).
Environmental Release Category(ies):	ERC6b. ESVOC SpERC 7.12a.v1
Process Category(ies):	PROC1, PROC2, PROC3, PROC8a, PROC8b, PROC16.
Processes, tasks, activities covered:	Covers the use as a fuel (or fuel additive) and includes activities associated with its transfer, use, equipment maintenance and handling of waste [GES12_I].
Assessment method:	Health: Used ECETOC TRA model [EE1]. (v3). Environment: Used EUSES model [EE4]. Used ESVOC SpERC #28.
Section 2: Operational conditions and risk management measures.	

Section 2.1	
Control of environmental exposure:	
Product Characteristics:	Substance is a unique structure [PrC1]. Predominantly hydrophobic [PrC4a]. Readily biodegradable [PrC5a].
Regional tonnage of MTBE (tonne per year).	659,000 tpa (2,197,125 kg/day).
Fraction of EU production volume for region	0.25
Fraction of tonnage for application	0.985
Fraction of chemical in formulation	0.15
Frequency and duration of use:	Continuous process [CS54]. 365 days per year of operation.
Environmental factors not influenced by risk management:	Local freshwater dilution factor [EF1]: 10. Local marine water dilution factor [EF2]: 100.

Other operational conditions of use affecting environmental exposure.	No specific measures required.
Technical onsite conditions and measures to reduce or limit discharges, air emissions.	Conditions given in SPERC fact sheet give rise to following releases fractions [OOC29]. ES6-E1: ERC7. ESVOC SpERC 28. Release fraction to air from process (initial release prior to RMM) [OOC4]: 0.0025. Release fraction to wastewater from process (initial release prior to RMM) [OOC5]: 0.00001. Release fraction to soil from process (initial release prior to RMM) [OOC6]: 0. Fraction of main source: 0.02 No air emission controls required; required removal efficiency is 0% [TCR5]. Soil emission controls are not applicable as there is no direct release to soil [TCR4]. Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency of $\geq$ (%) [TCR8]: 95. Assumed industrial waste water treatment plant flow (m³/d): 2000.
Organisation measures to prevent/limit release from site.	Prevent discharge of undissolved substance to or recover from onsite wastewater [TCR14].
Conditions and measures related to municipal sewage treatment plant.	Estimated substance removal from wastewater via domestic sewage treatment (%) [STP3]: 95. Assumed domestic sewage treatment plant flow (m ³ /d) [STP5]: 2000.
Conditions and measures related to external treatment of waste for disposal.	External treatment and disposal of waste should comply with applicable local and/or national regulations [ETW3].
Conditions and measures related to external recovery of waste.	External recovery and recycling of waste should comply with applicable local and/or national regulations [ERW1].
Other environmental control measures additional to above:	none.
Section 2.2: Control of worker exposure.	
Product Characteristics:	
Physical form of product:	Liquid, vapour pressure > 10 kPa at STP [OC5].
Concentration of substance in product:	See contributing scenarios below.
Amounts used:	Not applicable.
Frequency and duration of use:	Covers daily exposures up to 8-hours (unless stated differently) [G2]. Continuous process [CS54].
Human factors not influenced by risk management:	none.
Other operational conditions affecting worker exposure:	Assumes a good basic standard of occupational hygiene is implemented [G1]. Assumes use at not more than 20°C above ambient temperature, unless stated differently [G15]. Outdoor use [OOC1].
Technical conditions and measures at a process level to prevent release and technical conditions and measures to control dispersion from source towards workers:	Common practices vary across sites thus conservative process release estimates used [TCS1].
Contributing Scenarios:	Risk Management Measures: Note: list RMM standard phrases according to the control hierarchy indicated in the ECHA template: 1. Technical measures to prevent release, 2. Technical measures to prevent dispersion, 3. Organisational measures, 4. Personal protection.

Risk management measures common to all contributing scenarios.	Limit the substance in product to 15 % [OC20].
General measures (skin irritants) [G19]:	Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin problems that may develop [E3].
ES6-CS1: PROC8b. Bulk transfers [CS14]. Batch process [CS55]. with sample collection [CS56]. Filling / preparation of equipment from drums or containers. [CS45].	Use vapour recovery units when necessary [A7]. Ensure material transfers are under containment or extract ventilation [E66].
ES6-CS2: PROC8b. Drum/batch transfers [CS8]. Filling / preparation of equipment from drums or containers. [CS45]. Bulk transfers [CS14]. Dedicated facility [CS81].	Use drum pumps [E53].
ES6-CS3: PROC1. General exposures (closed systems) [CS15].	No other specific measures identified [EI20].
ES6-CS4: PROC2. General exposures (closed systems) [CS15]. with sample collection [CS56].	No other specific measures identified [EI20].
ES6-CS5: PROC3. General exposures (closed systems) [CS15]. Use in contained batch processes [CS37]. with sample collection [CS56].	Avoid carrying out activities involving exposure for more than 4 hours [OC28], or wear a respirator conforming to EN140 with Type A filter or better [PPE22].
ES6-CS6: PROC16. Use as a fuel. (closed systems) [CS107].	No other specific measures identified [EI20].
ES6-CS7: PROC3. Batch process [CS55]. (closed systems) [CS107].	Avoid carrying out activities involving exposure for more than 4 hours [OC28], or wear a respirator conforming to EN140 with Type A filter or better [PPE22].
ES6-CS8: PROC8a. Equipment cleaning and maintenance [CS39]. Non-dedicated facility [CS82]. for example: fuel pump repair. Indoor [OC8].	Avoid carrying out activities involving exposure for more than 4 hours [OC28], or wear a respirator conforming to EN140 with Type A filter or better [PPE22]. Drain down and flush system prior to equipment break-in or maintenance [E55]
ES6-CS9: PROC1. Storage [CS67]. General exposures (closed systems) [CS15].	No other specific measures identified [EI20].
ES6-CS10: PROC2. Storage [CS67]. General exposures (closed systems) [CS15]. with sample collection [CS56].	Ensure operation is undertaken outdoors [E69].
Section 3:	Exposure estimation:
Environment:	Maximum exposure resulting from contributing scenarios described.

	ES6-E1: PEC for microorganisms in STP: 0.00943 mg/l. Risk characterisation ratio: 1.33E-04. Local PEC in surface water: 0.00178 mg/l. Risk characterisation ratio: 3.49E-04. Local PEC in fresh water sediment: 0.00171 mg/kgww. Risk characterisation ratio: 3.42E-04. Local PEC in sea water during emission episode: 0.000204 mg/l. Risk characterisation ratio: 7.85E-04. Local PEC in marine sediment: 0.000194 mg/kgww. Risk characterisation ratio: 7.76E-04. Local PEC in agricultural soil (30-day average): 0.00442 mg/kgww. Risk characterisation ratio: 3.20E-03. Local PEC in grassland (180-day average): 0.00418 mg/kgww. Risk characterisation ratio: 3.03E-03 Risk from environmental exposure is driven by soil [TCR1f].
Health: Inhalation (vapour).	exposure resulting from contributing scenario ES6-CS1: 8-hour average 18 ppm - Risk characterisation ratio: 0.36. 15-minute average 50 ppm - Risk characterisation ratio: 0.5.
	exposure resulting from contributing scenario ES6-CS2: 8-hour average 18 ppm - Risk characterisation ratio: 0.36. 15-minute average 50 ppm - Risk characterisation ratio: 0.5.
	exposure resulting from contributing scenario ES6-CS3: 8-hour average 0.006 ppm - Risk characterisation ratio: <0.01. 15-minute average 0.024 ppm - Risk characterisation ratio: <0.01.
	exposure resulting from contributing scenario ES6-CS4: 8-hour average 15 ppm - Risk characterisation ratio: 0.3. 15-minute average 15 ppm - Risk characterisation ratio: 0.15.
	exposure resulting from contributing scenario ES6-CS5: 8-hour average 18 ppm - Risk characterisation ratio: 0.36. 15-minute average 15 ppm - Risk characterisation ratio: 0.15.
	exposure resulting from contributing scenario ES6-CS6: 8-hour average 15 ppm - Risk characterisation ratio: 0.3. 15-minute average 15 ppm - Risk characterisation ratio: 0.15.
	exposure resulting from contributing scenario ES6-CS7: 8-hour average 18 ppm - Risk characterisation ratio: 0.36. 15-minute average 15 ppm - Risk characterisation ratio: 0.15.
	exposure resulting from contributing scenario ES6-CS8: 8-hour average 18 ppm - Risk characterisation ratio: 0.36. 15-minute average 30 ppm - Risk characterisation ratio: 0.30.
	exposure resulting from contributing scenario ES6-CS9: 8-hour average 0.006 ppm - Risk characterisation ratio: <0.01. 15-minute average 0.024 ppm - Risk characterisation ratio: <0.01.
	exposure resulting from contributing scenario ES6-CS10: 8-hour average 11 ppm - Risk characterisation ratio: 0.21. 15-minute average 42 ppm - Risk characterisation ratio: 0.42.
	Risk management measures described will protect against acute exposure.
Health: Dermal:	exposure resulting from contributing scenario ES6-CS1: 1.6 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES6-CS2: 1.6 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES6-CS3: 0.018 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES6-CS4: 0.16 mg/kg/day. Risk characterisation ratio: <0.001.

	exposure resulting from contributing scenario ES6-CS5: 0.082 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES6-CS6: 0.04 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES6-CS7: 0.082 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES6-CS8: 1.6 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES6-CS9: 0.018 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES6-CS10: 0.16 mg/kg/day. Risk characterisation ratio: <0.001.
	Available hazard data do not enable the derivation of a DNEL for dermal irritant effects [G32]. Risk Management Measures are based on qualitative risk characterisation [G37].
Section 4:	Guidance to check compliance with the exposure scenario:
Environment:	Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures [DSU1]. If scaling reveals a condition of unsafe use (i.e., RCRs > 1), additional RMMs or a site-specific chemical safety assessment is required [DSU8]. Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html) [DSU4].
Health:	No data

Notes on exposure scenario and exposure estimation, including deviations and additions to ECETOC TRA defaults:

The release includes handling of blended fuels containing a variety of percentage of MTBE (up to 15%). When modelling resulted in risk characterization ratios above 1 exposure data was used to estimate exposure (tier-2). Only tier-2 data as presented in the EU RAR for MTBE (European Commission, 2002) was used (see Annex B2.2 and B3.2, containing a summary of data from the EU RAR of MTBE).

Deviations due to availability of measured data – Short-term exposures:

Measured data is available for the following contributing scenarios and is used (see annex B)

Contributing scenario	Measured data available	Modification justification
CS1, CS2 PROC 8b: Bulk and drum/batch transfer at dedicated facilities	Short-term exposure data available: Loading and unloading of truck with gasoline with MTBE - no vapour recovery system: 3 studies on short-term exposure (n=54): highest 90th-percentile values: 181 mg/m ³ = 49 ppm.	The default approach in the ECETOC TRA tool of estimating the short-term exposure as 4x the long-term exposure estimate seems excessive. The available measured data is used to justify reducing this factor to 2.75 x
CS4, CS5 PROC 2, PROC 3 (sampling)	Sampling of neat MTBE; sampling vessel (n=5), sampling pipeline (n=3) and sampling rail car (n=5): highest short-term value: 63 mg/m ³ = 17 ppm (see table 4.4 of RAR, 2002).	The default approach in the ECETOC TRA tool of estimating the short-term exposure as 4x the long-term exposure estimate seems excessive. The available measured data is used to justify reducing this factor to 1 (PROC 2: CS4) and to 0.5 (PROC 3:CS5)
CS6 PROC 16: Refuelling a car	Short-term exposure: Refuel of car with gasoline with MTBE - consumer - stage 1 vapour recovery system: short-term	The default approach in the ECETOC TRA tool of estimating the short-term exposure as 4x the long-term exposure estimate

	exposure (n=20): 90th-percentile value: 60 mg/m ³ = 16 ppm.	seems excessive. The available measured data is used to justify reducing this factor to 1
CS7, CS8 PROC 3: Closed batch processes PROC8a: Equipment cleaning and maintenance.	Short-term exposure: Activities of refinery off-site operator with gasoline with MTBE (measured activities: e.g. dipping, sampling, valve operation, dewatering, loading rail cars) - short-term exposure (n=29): 90th- percentile value: 61 mg/m ³ = 16.7 ppm.	The default approach in the ECETOC TRA tool of estimating the short-term exposure as 4x the long-term exposure estimate seems excessive. The available measured data is used to justify reducing this factor to 0.5 for PROC 3 and 1 for PROC 8a

Other justified deviations

Contributing scenario	Additional RMM	Justification for exposure reduction
CS1 Bulk transfers, dedicated facilities.	Use vapour recovery units when necessary [A7].	Vapour recovery systems on road and rail tanker loading and unloading operations are assumed to have an efficiency of 80% (CONCAWE report 11/12 – 2-012)
CS2 Drum and small package filling, Dedicated facility	Use drum pumps [E53].	Use of drum pumps was shown to deliver an exposure reduction of 80% in CONCAWE report 11/12, 2012.
CS8: PROC8a. Equipment cleaning and maintenance	Drain down and flush system prior to equipment break-in or maintenance [E55])	Draining prior to maintenance is assumed to deliver a reduction of 80% of the inhalation exposure estimate in industrial settings. Reduction is based on comparison of CONCAWE data on exposures resulting from spills and those arising from same/similar task when Standard Operating Procedures invoked. (CONCAWE report 11/12, 2012)

9.7 Exposure scenario 7. Use as a fuel. - Professional.

MTBE used in as fuel additive in fuels in professional applications of fuels. Emissions to all environmental compartments are possible although emissions into environment are mainly atmospheric. Emissions to air from the use of petrol are the main source of MTBE released to the environment. It covers the majority of the total emitted mass volume. Emissions are divided into two main categories: evaporative emissions and exhaust emissions.

Air, water, and soil emission factors were adopted without modification from ESVOC SpERC 9.12b.v1 (#29). This SpERC covers the professional and consumer use of a substance as a fuel or fuel additive and includes activities associated with its transfer, use, equipment maintenance and handling of waste. These emission factors are applicable to petroleum substances (e.g., aliphatic and aromatic hydrocarbons) and petrochemicals. Further details on the creation and suitability of this SpERC can be found in the ESVOC factsheet located Annex D.

Exposure scenario

Based on ECHA Template CSA&IR Part D June 08 combined with the GES Narrative Format.

Section 1	
Title.	MTBE. Use as a fuel. CAS:1634-04-4.
Sector(s) of Use:	Professional (SU22).
Environmental Release Category(ies):	ERC8b, ERC8e. ESVOC SpERC 29
Process Category(ies):	PROC1, PROC2, PROC3, PROC8a, PROC8b, PROC9, PROC16.
Processes, tasks, activities covered:	Covers the use as a fuel (or fuel additive) and includes activities associated with its transfer, use, equipment maintenance and handling of waste [GES12_P].
Assessment method:	Health: Used ECETOC TRA model [EE1]. (v3). Environment: Used EUSES model [EE4]. Used ESIG SpERCs.
Section 2: Operational conditions and risk management measures.	

Section 2.1	
Control of environmental exposure:	
Product Characteristics:	Substance is a unique structure [PrC1]. Predominantly hydrophobic [PrC4a]. Readily biodegradable [PrC5a].
Regional tonnage of MTBE (tonne per year).	659,000 tpa (2,197,125 kg/day).
Fraction of EU production volume for region	0.25
Fraction of tonnage for application	0.985
Fraction of chemical in formulation	0.15
Frequency and duration of use:	Continuous process [CS54]. 365days per year of operation.
Environmental factors not influenced by risk management:	Local freshwater dilution factor [EF1]: 10. Local marine water dilution factor [EF2]: 100.
Other operational conditions of use affecting environmental	No specific measures required.

exposure.	
Technical onsite conditions and measures to reduce or limit discharges, air emissions.	Conditions given in SPERC fact sheet give rise to following releases fractions [OOC29]. ES7-E1: ERC8b, ERC8e. ESVOC SpERC 29. Release fraction to air from wide dispersive use (regional only) [OOC7]: 0.01. Release fraction to wastewater from wide dispersive use [OOC8]: 0.00005. Release fraction to soil from wide dispersive use (regional only) [OOC9]: 0.00005. Fraction of main source: 6.24E-04 No air emission controls required; required removal efficiency is 0% [TCR5]. Soil emission controls are not applicable as there is no direct release to soil [TCR4]. Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency of $\geq$ (%) [TCR8]: 37. Assumed industrial waste water treatment plant flow (m³/d): 2000.
Organisation measures to prevent/limit release from site.	Prevent discharge of undissolved substance to or recover from onsite wastewater [TCR14].
Conditions and measures related to municipal sewage treatment plant.	Estimated substance removal from wastewater via domestic sewage treatment (%) [STP3]: 37. Assumed domestic sewage treatment plant flow (m ³ /d) [STP5]: 2000.
Conditions and measures related to external treatment of waste for disposal.	External treatment and disposal of waste should comply with applicable local and/or national regulations [ETW3].
Conditions and measures related to external recovery of waste.	External recovery and recycling of waste should comply with applicable local and/or national regulations [ERW1].
Other environmental control measures additional to above:	none.
Section 2.2: Control of worker exposure.	
Product Characteristics:	
Physical form of product:	Liquid, vapour pressure > 10 kPa at STP [OC5].
Concentration of substance in product:	Limit the substance in product to 15 % [OC20].
Amounts used:	Not applicable.
Frequency and duration of use:	Covers daily exposures up to 8-hours (unless stated differently) [G2]. Continuous process [CS54].
Human factors not influenced by risk management:	none.
Other operational conditions affecting worker exposure:	Assumes a good basic standard of occupational hygiene is implemented [G1]. Assumes use at not more than 20°C above ambient temperature, unless stated differently [G15]. Outdoor use [OOC1].
Technical conditions and measures at a process level to prevent release and technical conditions and measures to control dispersion from source towards workers:	Common practices vary across sites thus conservative process release estimates used [TCS1].
Contributing Scenarios:	Risk Management Measures: Note: list RMM standard phrases according to the control hierarchy indicated in the ECHA template: 1. Technical measures to prevent release, 2. Technical measures to prevent dispersion, 3. Organisational measures, 4. Personal protection.

General measures (skin irritants) [G19]:	Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin problems that may develop [E3].
ES7-CS1: PROC8b. Bulk transfers [CS14]. Batch process [CS55]. Filling / preparation of equipment from drums or containers. [CS45].	Use vapour recovery units when necessary [A7]. Ensure material transfers are under containment or extract ventilation [E66].
ES7-CS2: PROC8b. Drum/batch transfers [CS8]. Filling / preparation of equipment from drums or containers. [CS45]. Bulk transfers [CS14]. Dedicated facility [CS81].	Use vapour recovery units when necessary [A7]. Ensure material transfers are under containment or extract ventilation [E66].
ES7-CS3: PROC8b. refuelling vehicles.	Ensure operation is undertaken outdoors [E69].
ES7-CS4: PROC2. General exposures (closed systems) [CS15]. with sample collection [CS56].	No specific measures identified [EI18].
ES7-CS5: PROC3. General exposures (closed systems) [CS15]. Use in contained batch processes [CS37]. with sample collection [CS56].	Ensure operation is undertaken outdoors [E69].
ES7-CS6: PROC9. Drum and small package filling [CS6]. Dedicated facility [CS81].	Avoid carrying out activities involving exposure for more than 1-hour [OC27], or wear a respirator conforming to EN140 with Type A filter or better [PPE22]. Use drum pumps or carefully pour from container [E64].
ES7-CS7: PROC16. Use as a fuel. (closed systems) [CS107].	Ensure operation is undertaken outdoors [E69].
ES7-CS8: PROC8a. Equipment cleaning and maintenance [CS39]. Non-dedicated facility [CS82]. for example: fuel pump repair. Indoor [OC8].	Avoid carrying out activities involving exposure for more than 4 hours [OC28], or wear a respirator conforming to EN140 with Type A filter or better [PPE22]. Drain down system prior to equipment break-in or maintenance [E65].
ES7-CS9: PROC8a. Equipment cleaning and maintenance [CS39]. Non-dedicated facility [CS82]. for example: fuel pump repair. Outdoor [OC9].	Avoid carrying out activities involving exposure for more than 4 hours [OC28], or wear a respirator conforming to EN140 with Type A filter or better [PPE22]. Drain down system prior to equipment break-in or maintenance [E65].
ES7-CS10: PROC1. Storage [CS67]. General exposures (closed systems) [CS15].	No specific measures identified [EI18].
Section 3:	Exposure estimation:
Environment:	Maximum exposure resulting from contributing scenarios described.

	ES7-E1: PEC for microorganisms in STP: 0.00000294 mg/l. Risk characterisation ratio: 4.14E-08. Local PEC in surface water: 0.000844 mg/l. Risk characterisation ratio: 1.65E-04. Local PEC in fresh water sediment: 0.000783 mg/kgww. Risk characterisation ratio: 1.57E-04. Local PEC in sea water during emission episode: 0.000109 mg/l. Risk characterisation ratio: 4.19E-04. Local PEC in marine sediment: 0.000102 mg/kgww. Risk characterisation ratio: 4.08E-04. Local PEC in agricultural soil (30-day average): 0.000121 mg/kgww. Risk characterisation ratio: 8.77E-05. Local PEC in grassland (180-day average): 0.0000357 mg/kgww. Risk characterisation ratio: 2.59E-05. Risk from environmental exposure is driven by marine water [TCR1c].
Health: Inhalation (vapour).	exposure resulting from contributing scenario ES7-CS1: 8-hour average 0.39 ppm - Risk characterisation ratio: <0.01. 15-minute average 16 ppm - Risk characterisation ratio: <0.01.
	exposure resulting from contributing scenario ES7-CS2: 8-hour average 0.39 ppm - Risk characterisation ratio: <0.01. 15-minute average 16 ppm - Risk characterisation ratio: <0.01.
	exposure resulting from contributing scenario ES7-CS3: 8-hour average 0.4 ppm - Risk characterisation ratio: <0.01. 15-minute average 16 ppm - Risk characterisation ratio: <0.01.
	exposure resulting from contributing scenario ES7-CS4: 8-hour average 0.8 ppm - Risk characterisation ratio: 0.02. 15-minute average 17 ppm - Risk characterisation ratio: 0.17.
	exposure resulting from contributing scenario ES7-CS5: 8-hour average 0.8 ppm - Risk characterisation ratio: 0.02. 15-minute average 17 ppm - Risk characterisation ratio: 0.17.
	exposure resulting from contributing scenario ES7-CS6: 8-hour average 6 ppm - Risk characterisation ratio: 0.12. 15-minute average 30 ppm - Risk characterisation ratio: 0.3.
	exposure resulting from contributing scenario ES7-CS7: 8-hour average 21 ppm - Risk characterisation ratio: 0.42. 15-minute average 21 ppm - Risk characterisation ratio: 0.21.
	exposure resulting from contributing scenario ES7-CS8: 8-hour average 12 ppm - Risk characterisation ratio: 0.25. 15-minute average 25 ppm - Risk characterisation ratio: 0.25.
	exposure resulting from contributing scenario ES7-CS9: 8-hour average 6.5 ppm - Risk characterisation ratio: 0.13. 15-minute average 13.2 ppm - Risk characterisation ratio: 0.13.
	exposure resulting from contributing scenario ES7-CS10: 8-hour average 0.006 ppm - Risk characterisation ratio: <0.01. 15-minute average 0.024 ppm - Risk characterisation ratio: <0.01.
	Risk management measures described will protect against acute exposure.
Health: Dermal:	exposure resulting from contributing scenario ES7-CS1: 1.6 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES7-CS2: 1.6 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES7-CS3: 1.6 mg/kg/day. Risk characterisation ratio: <0.001.

	exposure resulting from contributing scenario ES7-CS4: 0.16 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES7-CS5: 0.082 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES7-CS6: 0.16 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES7-CS7: 0.04 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES7-CS8: 0.98 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES7-CS9: 0.98 mg/kg/day. Risk characterisation ratio: <0.001.
	exposure resulting from contributing scenario ES7-CS10: 0.018 mg/kg/day. Risk characterisation ratio: <0.001.
	Available hazard data do not enable the derivation of a DNEL for dermal irritant effects [G32]. Risk Management Measures are based on qualitative risk characterisation [G37].
Section 4:	Guidance to check compliance with the exposure scenario:
Environment:	Not applicable for wide dispersive uses [DSU5].
Health:	no data.

Notes on exposure scenario and exposure estimation, including deviations and additions to ECETOC TRA defaults:

The release includes handling of blended fuels containing a variety of percentage of MTBE (up to 15%). When modelling resulted in risk characterization ratios above 1 exposure data was used to estimate exposure (tier-2). Only tier-2 data as presented in the EU RAR for MTBE (European Commission, 2002) was used (see Annex B2.2 and B3.2, containing a summary of data from the EU RAR of MTBE).

Deviations due to availability of measured data

Measured data is available for the following contributing scenarios and is used (see annex B)

Contributing scenario	Measured data available	Modification justification
CS1, CS2, CS3 PROC 8b: Bulk and drum/batch transfer at dedicated facilities. Refuelling vehicles.	Full-shift Tier 2 - estimate based on measured exposure data for service station attendant with no vapour recovery - full shift: 90th percentile: 1,4 mg/m ³ = 0,4 ppm (n=355) (Concawe, 02/00, 2000). Short-term: Tier 2 estimate refuel of car with gasoline with MTBE - consumer - stage 1 vapour recovery system: short-term exposure (n=20): 90th-percentile value: 60 mg/m ³ = 16 ppm.	90 th percentile values are considered valid to use as an alternative to modelled data for short and long-term exposure values.
CS4, CS5 PROC 2, PROC 3 (general exposures from closed systems)	Full-shift Tier 2 estimate Activities of refinery off-site operator using gasoline with MTBE (measured activities: e.g. dipping, sampling, valve operation, dewatering, loading rail cars) - full shift term	90 th percentile values are considered valid to use as an alternative to modelled data for short and long-term exposure values.

	exposure (n=29): 90th-percentile value: 3,0 mg/m³ = 0,8 ppm (Concawe, 02/00, 2000) Short-term Tier 2 estimate Activities of refinery off-site operator with gasoline with MTBE (measured activities: e.g. dipping, sampling, valve operation, dewatering, loading rail cars) - short-term exposure (n=29): 90th-percentile value: 61 mg/m³ = 16,6 ppm	
CS6 PROC 9. Drum and small package filling, Dedicated facility	Tier 2 estimate: Refuel of car with gasoline with MTBE - consumer - stage 1 vapour recovery system: short-term exposure (n=20): 90th-percentile value: 60 mg/m ³ = 16 ppm	The default approach in the ECETOC TRA tool of estimating the short-term exposure as 4x the long-term exposure estimate seems excessive. The available measured data is used to justify reducing this factor to 1.
CS7 PROC 16. Use as a fuel (closed systems)	Tier 2 estimate: Refuel of car with gasoline with MTBE - consumer - stage 1 vapour recovery system: short-term exposure (n=20): 90th-percentile value: 60 mg/m ³ = 16 ppm	The default approach in the ECETOC TRA tool of estimating the short-term exposure as 4x the long-term exposure estimate seems excessive. The available measured data is used to justify reducing this factor to 1.
CS8 PROC 8a (Equipment cleaning and maintenance) - indoor	Full-shift and short-term estimate: Tier 2 estimate Gasoline pump maintenance, repair (indoor and outdoor) and inspection (n=10; task duration 90-469 min): highest inhalation exposure value during task (indoor repair): 46 mg/m ³ = 12.5 ppm (Vainiotalo et al., 2006).	Highest measured value is used as estimate for both long-term exposure value. Since measurements are by task the standard ECETOC factor of 4 to derive the short-term exposure seems excessive, therefore a factor of 2 is used instead.
CS9 PROC 8a (Equipment cleaning and maintenance) - outdoor	Full-shift and short-term estimate: Tier 2 estimate Gasoline pump maintenance, repair (indoor and outdoor) and inspection (n=10; task duration 90-469 min): highest inhalation exposure value during task (gauge calibration 24.1mg/m ³ = 6.6 ppm (Vainiotalo et al., 2006).	Highest measured value is used as estimate for both long-term exposure value. Since measurements are by task the standard ECETOC factor of 4 to derive the short-term exposure seems excessive, therefore a factor of 2 is used instead.

Other justified deviations

Contributing scenario	Additional RMM	Justification for exposure reduction
CS6 Drum and small package filling, Dedicated facility	Use drum pumps or carefully pour from containers [E64].	Use of drum pumps was shown to deliver an exposure reduction of 80% in CONCAWE report 11/12, 2012. Careful pouring deemed to give equivalent measure of protection.

9.8 Exposure scenario 8. Use as a fuel. - Consumer.

Emissions to all environmental compartments are possible although emissions into environment are mainly atmospheric. Emissions to air from the use of petrol are the main source of MTBE released to the environment. It covers the majority of the total emitted mass volume. Emissions are divided into two main categories: evaporative emissions and exhaust emissions.

Air, water, and soil emission factors were adopted without modification from ESVOC SpERC 9.12c.v1 (#30). This SpERC covers the professional and consumer use of a substance as a fuel or fuel additive and includes activities associated with its transfer, use, equipment maintenance and handling of waste. These emission factors are applicable to petroleum substances (e.g., aliphatic and aromatic hydrocarbons) and petrochemicals. Further details on the creation and suitability of this SpERC can be found in the ESVOC factsheet located Annex D.

Exposure scenario

Based on ECHA Template CSA&IR Part D June 08 combined with the GES Narrative Format.

Section 1 Exposure scenario	
Title.	Use as a fuel. MTBE. CAS: 1634-04-4
Sector(s) of Use:	Consumer (SU21).
Use Descriptor.	PC13
Processes, tasks, activities covered:	Covers consumer uses in liquid fuels [GES12_C].
Environmental Release Category(ies):	ERC8b, ERC8e. ESVOC SpERC 30
Assessment method:	Health: Based on ESIG GES Consumer with refined exposure modifiers from SCEDS. Environment: Used EUSES model [EE4].
Section 2: Operational conditions and risk management measures.	
Section 2.1 Control of consumer exposure.	
Product Characteristics:	
Product Characteristics:	Substance is a unique structure [PrC1]. Predominantly hydrophobic [PrC4a]. Readily biodegradable [PrC5a].
Regional tonnage of MTBE (tonne per year).	659,000 tpa (2,197,125 kg/day).
Fraction of EU production volume for region	0.25
Fraction of tonnage for application	0.985
Fraction of chemical in formulation	0.15
Frequency and duration of use:	Continuous process [CS54]. 365 days per year of operation.
Environmental factors not influenced by risk management:	Local freshwater dilution factor [EF1]: 10. Local marine water dilution factor [EF2]: 100.
Other operational conditions of use affecting environmental exposure.	No specific measures required.

Technical onsite conditions and measures to reduce or limit discharges, air emissions.		Conditions given in SPERC fact sheet give rise to following releases fractions [OOC29]. ES7-E1: ERC8b, ERC8e. ESVOC SpERC 30. Release fraction to air from wide dispersive use (regional only) [OOC7]: 0.01. Release fraction to wastewater from wide dispersive use [OOC8]: 0.00005. Release fraction to soil from wide dispersive use (regional only) [OOC9]: 0.00005. Fraction of main source: 6.24E-04 No air emission controls required; required removal efficiency is 0% [TCR5]. Soil emission controls are not applicable as there is no direct release to soil [TCR4]. Treat onsite wastewater (prior to receiving water discharge) to provide the required removal efficiency of $\geq$ (%) [TCR8]: 37. Assumed industrial waste water treatment plant flow (m³/d): 2000.
Organisation measures to prevent/limit release from site.		Prevent discharge of undissolved substance to or recover from onsite wastewater [TCR14].
Conditions and measures related to municipal sewage treatment plant.		Estimated substance removal from wastewater via domestic sewage treatment (%) [STP3]: 37. Assumed domestic sewage treatment plant flow (m ³ /d) [STP5]: 2000.
Conditions and measures related to external treatment of waste for disposal.		External treatment and disposal of waste should comply with applicable local and/or national regulations [ETW3].
Conditions and measures related to external recovery of waste.		External recovery and recycling of waste should comply with applicable local and/or national regulations [ERW1].
Other environmental control measures additional to above:		none.
Section 2.2: Control of worker exposure.		
Product Characteristics:		
Physical form of product:		Liquid, vapour pressure > 10 kPa at STP [OC5].
Concentration of substance in product:		Limit the substance in product to 15 % [OC20].
Amounts used:		Not applicable.
Contributing Scenarios: Product categories:		
Fuels [PC13]. --Liquid: Automotive Refuelling [PC13_1].	OC	Covers concentrations up to [ConsOC1]: 15%. For each use event, covers use amounts up to [ConsOC2]: 37500 g. Covers use up to [ConsOC3]: 1 time per week [CSL111]. Covers use up to [ConsOC3]: 3 minutes per event [CSL113]. Covers skin contact area up to [ConsOC5]: 210 cm ² . Covers outdoor use [ConsOC12].
	RMM	No specific measures identified [EI18].
Fuels [PC13]. --Liquid: Garden Equipment - Refuelling [PC13_4].	OC	Covers concentrations up to [ConsOC1]: 15%. For each use event, covers use amounts up to [ConsOC2]: 750g. Covers use up to [ConsOC3]: 26 times per year [CSL112]. Covers use up to [ConsOC3]: 2 minutes per event [CSL113]. Covers skin contact area up to [ConsOC5]: 420 cm ² . Covers outdoor use [ConsOC12].
	RMM	No specific measures identified [EI18].
Fuels [PC13]. --Liquid Scooter Refuelling [PC13_2].	OC	Covers concentrations up to [ConsOC1]: 15%. For each use event, covers use amounts up to [ConsOC2]: 3750 g. Covers use up to [ConsOC3]: 1 times per week [CSL111]. Covers use up to [ConsOC3]: 2 minutes per event [CSL113]. Covers skin contact area up to [ConsOC5]: 210 cm ² . Covers outdoor use [ConsOC12].
	RMM	No specific measures identified [EI18].
Fuels [PC13]. --refuelling of boats:	OC	Covers concentrations up to [ConsOC1]: 15%. For each use event, covers use amounts up to [ConsOC2]: 225000 g. Covers use up to [ConsOC3]: 1 times per week [CSL111]. Covers use up to [ConsOC3]: 18 minutes per event [CSL113]. Covers skin contact area up to [ConsOC5]: 210 cm ² . Covers outdoor use [ConsOC12].

	RMM	No specific measures identified [EI18].
Fuels [PC13]. --refuelling of boats:	OC	Covers concentrations up to [ConsOC1]: 15%. For each use event, covers use amounts up to [ConsOC2]: 127500 g. Covers use up to [ConsOC3]: 1 times per week [CSL111]. Covers use up to [ConsOC3]: 12 minutes per event [CSL113]. Covers skin contact area up to [ConsOC5]: 210 cm ² . Covers outdoor use [ConsOC12].
	RMM	No specific measures identified [EI18].
Section 2.2:		Control of environmental exposure:
Product Characteristics:		Substance is a unique structure [PrC1]. Non-hydrophobic [PrC4b]. Readily biodegradable [PrC5a].
Amounts used		See contributing scenarios above
Frequency and duration of use:		See contributing scenarios above
Environmental factors not influenced by risk management:		Local freshwater dilution factor [EF1]: 10. Local marine water dilution factor [EF2]: 100.
Other operational conditions of use affecting environmental exposure.		Assumes use at not more than 20°C above ambient temperature, unless stated differently [G15].
Conditions and measures related to municipal sewage treatment plant.		Assumed domestic sewage treatment plant flow (m ³ /d) [STP5]. 2000 Estimated substance removal from wastewater via domestic sewage treatment (%) [STP3]. 95
Conditions and measures related to external treatment of waste for disposal.		This substance is consumed during use and no waste of the substance is generated [ERW3]
Conditions and measures related to external recovery of waste.		none.
Section 3:		Exposure estimation:
Health: Inhalation (vapour).		Maximum exposure resulting from contributing scenarios described:
		Fuels [PC13]. Liquid: Automotive Refuelling [PC13_1]. Short-term concentration during exposure event (mg/m ³) 32.6 mg/m ³ . Risk characterisation ratio: 0.152.
		Fuels [PC13]. Liquid: Garden Equipment - Refuelling [PC13_4]. Short-term concentration during exposure event (mg/m ³) 28.6 mg/m ³ . Risk characterisation ratio: 0.133.
		Fuels [PC13]. Liquid Scooter Refuelling [PC13_2]. Short-term concentration during exposure event (mg/m ³) 32.8 mg/m ³ . Risk characterisation ratio: 0.153.
		Fuels [PC13]. refuelling of boats: Short-term concentration during exposure event (mg/m ³) 182 mg/m ³ . Risk characterisation ratio: 0.85.
		Fuels [PC13]. refuelling of boats: Short-term concentration during exposure event (mg/m ³) 107 mg/m ³ . Risk characterisation ratio: 0.5.
Health: Dermal:		Maximum exposure resulting from contributing scenarios described:
		Fuels [PC13]. Liquid: Automotive Refuelling [PC13_1]. Chronic systemic dermal exposure: 0.0105 mg/kg/day. Risk characterisation ratio: 0.00000294.
		Fuels [PC13]. Liquid: Garden Equipment - Refuelling [PC13_4]. Chronic systemic dermal exposure: 10.5 mg/kg/day. Risk characterisation ratio: 0.00294.
		Fuels [PC13]. Liquid Scooter Refuelling [PC13_2]. Chronic systemic dermal exposure: 5.25 mg/kg/day. Risk characterisation ratio: 0.00147.
		Fuels [PC13]. refuelling of boats: Chronic systemic dermal exposure: 0.0105 mg/kg/day. Risk characterisation ratio: 0.00000294.

	Fuels [PC13]. refuelling of boats: Chronic systemic dermal exposure: 0.0105 mg/kg/day. Risk characterisation ratio: 0.00000294.
Health: Oral:	Maximum exposure resulting from contributing scenarios described:
	Fuels [PC13]. Liquid: Automotive Refuelling [PC13_1]. Not applicable.
	Fuels [PC13]. Liquid: Garden Equipment - Refuelling [PC13_4]. Not applicable.
	Fuels [PC13]. Liquid Scooter Refuelling [PC13_2]. Not applicable.
	Fuels [PC13]. refuelling of boats: Not applicable.
	Fuels [PC13]. refuelling of boats: Not applicable.
Environment:	Maximum exposure resulting from contributing scenarios described:
	ES8-E1: EC for microorganisms in STP: 0.00000294 mg/l. Risk characterisation ratio: 4.14E-08. Local PEC in surface water: 0.000844 mg/l. Risk characterisation ratio: 1.65E-04. Local PEC in fresh water sediment: 0.000783 mg/kgww. Risk characterisation ratio: 1.57E-04. Local PEC in sea water during emission episode: 0.000109 mg/l. Risk characterisation ratio: 4.19E-04. Local PEC in marine sediment: 0.000102 mg/kgww. Risk characterisation ratio: 4.08E-04. Local PEC in agricultural soil (30-day average): 0.000121 mg/kgww. Risk characterisation ratio: 8.77E-05. Local PEC in grassland (180-day average): 0.0000357 mg/kgww. Risk characterisation ratio: 2.59E-05. Risk from environmental exposure is driven by marine water [TCR1c].
Section 4:	Guidance to check compliance with the exposure scenario:
Health	
	Not applicable.
Environment	
	Not applicable for wide dispersive uses [DSU5].

Notes on exposure scenario and exposure estimation, including deviations and additions to ECETOC TRA defaults:

It is assumed that when refuelling other vehicles than cars (boats, motor bikes, jet skis or other two or four stroke engines) or fuel tanks, the exposure is comparable or lower. The reason is that these activities take place less frequently and/or involve lower quantities. If the situation is safe for refuelling cars, the situation is also safe for refuelling in other situations. Even if the RCRs for refuelling other engines would be comparable to the RCR for refuelling of cars, the risk would still be negligible (RCR for car fuelling is <<1). Annex A contains the summary of results of consumer exposure as presented in the EU RAR for MTBE.