KorPTG	Material Safety Data Sheet	Doc. No.	MSDS-003
		Initial Issue Date	June. 1996.
		Revision Date	Jul. 2019.

Substance name	Tetrahydrofuran		
CAS NO	KE NO	UN NO	EC NO
109-99-9	KE-33454	2056	203-726-8

1. Identification of the substance/mixture and of the company:

1.1 Substance name	Tetrahydrofuran
1.2 Intended Use and Use Limitations	
Intended Use	Resin solvent, Reaction solvent, PTMEG
Use Limitations	No Data Available
1.3 Company identification	
Company	Korea PTG Co., Ltd.
Address	15, Yongyeon-ro 179beon-gil, Nam-gu, Ulsan,
Tel, Number	Tel 82-52-257-5240 Fax 82-52-257-5246
Emergency number	82-52-257-5240
Team	Safety & Environment Team

2. Hazard-Risk:

2.1 Hazard-Risk classification

Flammable liquids : cat2
Serious eyes damages or irritation substance : cat.1
Carcinogenicity : cat2
Specific target organ toxicity substance(single exposure) : cat3

2.2 Label element, including and precautionary statements

Pictogram

Signal word	Danger
Hazard-Risk statement	H225 High flammable liquids or vapors
	H318 Cause serious eye damage
	H335 May cause respiratory irritation
	H351 Suspected of causing cancer
precautionary statement	P201 Obtain special instructions before use.
Prevention	P202 Do not handle until all safety precautions have been read and understo
	P210 Keep away from heat/sparks/open flames/hot surfaces. - No
	P233 Keep container tightly closed.
	P240 Ground/bond container and receiving equipment.

	P241 Use explosion-proof electrical/ventilating/lighting/.../equipment. P242 Use only non-sparking tools. P243 Take precautionary measures against static discharge. P261 Avoid breating dust/fume/gas/vapours/spray. P280 Wear protective gloves/protective clothing/eye protection/face P271 Use only outdoors or in a well-ventilated area.
Response	P303+P361+P353 IF ON SKIN (or hair): Take off immediately all contaminated P370+P378 In case of fire: Use ... for extinction. P305+P351+P338 IF IN EYES: Rinse cautiously with water for several Remove minutes. contact lenses, if present and easy to do. Continue rinsing. P308+P313 IF exposed or concerned: Get medical advice/ attention P304+P340 IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. P310 Immediately call a POISON CENTER/doctor. P312 Call a POISON CENTER or doctor/physician if you feel unwell.
Storage	P403+P235 Store in a well-ventilated place. Keep cool. P405 Store locked up. P403+P233 Store in a well-ventilated place. Keep container tightly closed.
Disposal	P501 Dispose of contents/container to ...

2.3 Other hazard-Risk which are not included in the classification(NFPA)

Health	4
Fire	3
Reactivity	1

3. Composition/Information on Ingredients:

Substance name	Trivial name	CAS No	Content(%)
Tetrahydrofuran	Tetramethylene Oxide	109-99-9	> 99.9%

4. First aid measures:

4.1 In case of intrusion into eye	Wash eyes for at least 15 minutes with plenty of water. Consult with a doctor.
4.2 In case of skin contamination	Wash eyes for at least 15 minutes with soap and water. If irritation or symptoms occur, consult with a Rinse contaminated clothing before reuse. Remove contaminated clothing and shoes.
4.3 In case of respiratory	Avoid exposure from sources. Do artificial respiration if needed. Get medical attention.

4.4 In case of ingestion	Contact local poision control center or physician immediately. Never make an unconscious person vomit or drink fluids. When vomiting occurs, keep head lower than hips to help prevent aspiration. If person is unconscious, turn head to side. Get medical attention immediately.
4.5 Notices to physicians	Medical team are aware this substance and take protective measures.
4.6 The most important accute/delaed symptom.	
Inhale	
Short time explosure.	Irritation, blood pressure, vomit, headache, sleepiness, function loss suffocation, insensibility.
Long time explosure.	Irritation, nosebleed, liner trouble, genital influence, brain trouble, insesibility.
Intake	
Short time explosure.	Irritation, nausa, vomit, diarrhea, stomachache.
Long time explosure.	kidney trouble, liner trouble.
Skin contact	
Short time explosure.	Irritation
Long time explosure.	Irritation
Eyes contact	
Short time explosure.	Irritation, tearjacker.
Long time explosure.	Visual impairment.
4.7 Indication of immediate medical attention and Doctor directions	When person intakes, consider stomach pump and acitate carbon slury inject.

5. Explosion,fire measures:

5.1 Suitable(Inappropriate) extinguishing media	
Suitable extinguishing media	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Inappropriate extinguishing media	-
Major fire	Use alcohol formal or big water sprinke by fine spray.
5.2. Specific hazards arising from the chemical	
Heat decomposition product	Carbon oxide
Fire and explosion risk	Serious fire risk. The mixture of vapour and air is can exlosive. Vapour is havier than air. Vapour or gas ignite from distant fire source and spread rapidly. During burning, pyrolysis or combustion may produce irritating and highly toxic gases.

5.3. Protective equipment and precaution for fire-fighters

Move container from fire area if it can be done without risk. Cool Containers with water spray until well after the fire is out. Stay away from the ends of tanks. For fires in cargo or storage area: Cool Containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck: Evacuation radius: 800 meters (1/2 mile). Water may be ineffective.

6. Accidental release measures:

6.1 Personal precautions, protective equipment

Use personal protective equipment.
Avoid breathing vapors, mist or gas. Ensure adequate ventilation.
Remove all sources of ignition. Evacuate personnel to safe areas.
Beware of vapours accumulating to form explosive concentrations.
Vapours can accumulate in low areas.

6.2 Environmental precautions

Prevent further leakage or spillage if safe to do

6.3 Methods and materials for containment and

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

7. Handling and storage:

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
Use explosion-proof equipment. Keep away from sources of ignition - No smoking.
Take measures to prevent the build up of electrostatic charge.

7.2 Conditions for safe storage	Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

8 Exposure controls/personal protection:

8.1 exposure limits of chemical substance,	
Biological exposure limits	
Domestic regulation	TWA - 50ppm STEL - 100ppm
ACGIH regulation	TWA - 200 ppm STEL - 250 ppm
Biological exposure limits	-
8.2 Appropriate engineering controls	Install ventilation equipment. Ensure compliance with applicable exposure Ventilation equipment should be explosion-resistant type if explosive concentration of
8.3 Conditions for safe storage	
Respiratory Protection	Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).
Eye protection	Tightly fitting safety goggles. Faceshield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU). Provide an emergency eye wash foundation and quick drench shower in the immediate work area.
Hands protection	Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Body protection	Complete suit protecting against chemicals, Flame retardant antistatic protective clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.
Hygiene measures	Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

9. Physical and chemical properties:

9.1 Appearance	
Physical state	Liquid.
Colour	Achromatic color.
9.2 Odour	Sweet Smell
9.3 Odour threshold	No Data Available
9.4 pH	No Data Available
9.5 Melting point/freezing point	-108.44 ℃
9.6 Initial boiling point and boiling range	65 ℃
9.7 Flash point	-14.5 ℃
9.8 Evaporation rate	No Data Available
9.9 Flammability (solid, gas)	No Data Available
9.10 Upper/lower flammability or explosive limits	11.8/2%
9.11 Vapour pressure	162mmHg
9.12 Solubility	30%(25℃, Water)
9.13 Vapour density	2.5 (Air = 1, Calculation)
9.14 Specific gravity	0.8833(25℃)
9.15 N-octanol/water partition coefficient	0.46(= log Pow (Measurements))
9.16 Auto-ignition temperature	321℃
9.17 Decomposition temperature	No Data Available
9.18 Viscosity	0.53cP(20 ℃)
9.19 Molecular weight	72.1
9.20 Molecular formula	C4H8O

10. Stability and reactivity:

10.1 Chemical stability	Explosive peroxides can be produced. - Avoid with Long-term storage/air and light contact or storage and use above room temperature.
10.2 Possibility of hazardous reactions	Polymerization: Polymerizes with exothermic reation. Avoid contact with heat or acids or amines.

10.3 Conditions to avoid	Avoid contact with heat, flames, sparks and other sources of ignition sparks. If container is expose to heat, containers may rupture or explode.
10.4 Substance to avoid	Acids, bases, halogens, metals, oxidizing materials, combustible materials, metal oxide
10.5 Hazardous decomposition products	During burning, pyrolysis or combustion may produce irritating and highly toxic gases.

11. Toxicological information:

11.1 Information on the likely route of exposure	No Data Available
11.2 Delayed and immediate effects and also chronic effects from short and long term exposure	
Acute toxicity	
Oral	LD50 2.3 ~ 3.6 ㎖/kg Rat
Dermal	LD50 > 2000 mg/kg Rat (OECD TG 402)
Inhalation	LC50 > 14.7 mg/ℓ 6Hr Rat (US EPA, GLP)
Skin corrosion or irritation	Skin corrosion / irritation test results in rabbits, not irritating. (PIID : 1.93)
Serious eyes damages or irritation	Severe eye damage / irritation test results in rabbits, causing corrosive effects.
Respiratory sensitization	No Data Available
Skin sensitization	Skin sensitization test results in rats do not cause sensitization. (OECD TG 429, GLP)
Carcinogenicity	
IARC	No Data Available
OSHA	No Data Available
ACGIH	A3
NTP	No Data Available
EU CLP	2
Germ cell mutagenicity	Chromosome aberration test using mammalian cultured cells revealed negative, regardless of metabolic activity. (OECD Guideline 473) Results of micronucleus test using in vivo mammalian red blood cells, negative. (OECD Guideline 474)

Reproductive toxicity	As a result of the second generation reproductive toxicity test, general toxic symptoms such as weight / weight gain / reduction of food intake were observed in rats and physiological developmental delay such as weight / weight increase rate of F2 offspring of high concentration individuals was observed. (NOAEL F0&F1 parental=9000ppm(nominal), NOAEL FO, F1 parental&FI,F2 litters) (OECD TG 416, GLP). As a result of fetal developmental toxicity test in rats, weight loss of maternal and fetus was observed at 5000 ppm concentration group. (NOAECmaternal toxicity&developmental toxicity=1800ppm (nominal)) (GLP, OECD Guideline 414)
Specific target organ toxicity - single exposure	Dyspnea, convulsions, anesthesia, and nervous system effects were observed. Target organ: central nervous system
Specific target organ toxicity - repeated exposure	Toxicity test result on rats: small histological changes in liver, kidney and thyroid were observed, but there is not any apparent evidence that the changes are caused by the dosage. NOAEL = 1000㎎/L drinking water Inhalation toxicity test result on rats: ataxia was observed in 5000ppm concentration group and slight changes in blood and serum were observed. And also absolute/relative weight of the thymus and spleen was reduced much lower than comparison-group, but it may be caused by stress. NOAEC = 1800ppm
11.3 Aspiration hazard	No Data Available

12. Ecological information:

12.1 Aquatic·terrestrial ecotoxicity

Fish	LC50 2160mg/ℓ - 96Hr Pimephales promelas (OECD Guideline 203)
Alage	LC50 3,485mg/ℓ - 48Hr Daphnia magna (OECD TG 203)

Bird	No Data Available
12.2 Persistence and degradability	
Persistence	0.45 log Kow (25℃, OECD TG 107)
degradability	No Data Available
12.3 Bioaccumulative potential	
Accumulation	No Data Available
Biodegradation	39% 28day (OECD TG 301 D)
12.4 Mobility in soil	23.32 Koc ~ 18.33 Koc
12.5 Other hazardous effects	Pimephales promelas : NOEC33d = 216mg/ℓ

13. Disposal considerations:

13.1 Disposal methods	Dispose in accordance with all applicable regulations. Waste disposal regulation in the United States : U.S.EPA 40 CFR 262. Hazardous waste number(s): U213.
13.2 Disposal attention	Consider notices of regulations in case that it is indicated in waste disposal regulation.

14. Transport information:

14.1 U.S. Department of Transportation(DOT)	Hazard Class : 3 Packing group : Ⅱ ID number : UN 2056 Hazard label : 3 Proper shipping name : Tetrahydrofuran
14.2 International Maritime Organization(IMDG)	Hazard Class : 3 Packing group : Ⅱ ID number : UN 2056 Hazard label : 3 Proper shipping name : Tetrahydrofuran
14.3 International Air Transport Association(IATA) / International Civil Aviation Organization(ICAO)	Hazard Class : 3 Packing group : Ⅱ ID number : UN 2056 Hazard label : 3 Proper shipping name : Tetrahydrofuran

15. Regulatory information:

15.1 Industrial Safety and Health Act	Follow the laws of your country
15.2 Toxic Chemicals Control Act	No Data Available
15.3 Safety Control of Dangerous Substances Act	Follow the laws of your country
15.4 Waste management Act.	No Data Available
15.5 Other requirements in domestic and other	
Domestic regulation	
Persistent Organic Pollutants Management Act	Not Applicable
Foreign regulation	
American Management Information (OSHA Regulation)	Not Applicable
American Management Information (CERCLA Regulation)	453.599 kg 1000 lb
American Management Information (EPCRA 302 Regulation)	Not Applicable
American Management Information (EPCRA 304 Regulation)	Not Applicable
American Management Information (EPCRA 313 Regulation)	Not Applicable
American Management Information (Rotterdam Convention material)	Not Applicable
American Management Information (Stockholm Convention material)	Not Applicable
American Management Information (Montreal Protocol material)	Not Applicable
EU classification Information (Final classification results)	Flam. Liq. 2 Carc. 2 STOT SE 3 Eye Irrit. 2
EU classification Information (Risk statement)	H225, H351, H335, H339
EU classification Information (Safety statement)	Not Applicable

16. Other information:

16.1 Reference	9.1 Physical state(HSDB)
	9.2 Odour(HSDB)
	9.5 Melting point/freezing point(HSDB)
	9.6 Initial boiling point and boiling range(HSDB)
	9.7 Flash point(ICSC)

9.11 Vapour pressure(HSDB)

9.12 Solubility(HSDB)

9.13 Vapour density((HSDB)

9.14 Specific gravity(HSDB)

9.15 N-octanol/water partition coefficient(HSDB)

9.18 Viscosity(HSDB)

9.19 Molecular weight(HSDB)

11.2 Oral(ECHA)
Dermal(ECHA)
Inhalation(ECHA)
Skin corrosion or irritation(ECHA)
Skin sensitization(ECHA)
Germ cell mutagenicity(ECHA)

Reproductive toxicity(ECHA)
Specific target organ toxicity-single exposure (CERI, ICSC)

12.1 Fish(ECHA), Alage(ECHA)

12.2 Persistence(ECHA)

12.3 Biodegradation(ECHA)

12.4 Mobility in soil(ECHA)

12.5 Other hazardous effects(ECHA)

16.2 Initial Issue Date	June. 1996
16.3 Revision number and date	
- Revision Number	Rev. 9
- Revision Date	Jul. 2019.
16.4 Others	No Data Available