

Components	CAS No	Type of Valor	Control parameters (Concentration)	Bases
Butane	106-97-8	LMPE-PPT	800 ppm 1.900 mg/m ³	MX OEL
		VLE-PPT	1.000 ppm	NOM - 010-STPS- 2014
		STEL	1.000 ppm	ACGIH

Exposure controls:

Appropriate engineering controls:

Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

Personal protective equipment:

- **Eye and face protection:**
Sufficient eye protection should be worn. When handling compressed gas, at least glasses with side protection should be worn. When handling liquid gas, chemical safety goggles must be used as well as a protective shield.
- **Skin protection:**
Body protection:
Use protective boots while handling gas cylinders.
Hand protection: Wear leather gloves to prevent frostbite injuries from rapidly expanding gas when handling pressurized gas bottles.
- **Respiratory protection:** In an emergency (e.g.: unintentional release of the substance, exceeding the occupational exposure limit value) respiratory protection must be worn. Consider the maximum period for wear. Wear self-contained breathing apparatus. Do not use filter respirator.

Environmental exposure controls:

Do not allow material to be released to the environment without the proper governmental permits.

Industrial hygiene:

Handle in accordance with good industrial hygiene and safety practice.
Wash hands before breaks and at the end of workday. Avoid contact with skin and eyes.
Avoid inhalation of vapor or mist.

9. Physical and chemical properties

Information on basic physical and chemical properties.

Appearance:	Compressed liquefied gas.
Color:	Colorless, no turbid.
Odor:	slight, ether-like
Melting Point:	No data available
Boiling Point:	-43° C at 1013 hPa
Glide temperature at 1,013 bar	6.25 K
Saturated liquid density at 25 ° C	1180 kg/m ³
Saturated vapor density at boiling point	5.390 kg/m ³
Vapor pressure:	11.24 bar at 25 °C
Density:	1.14 g/cm ³ at 25°C
Vapor Density:	3.5 At bubble point temperature. (Air = 1)
Critical Density:	522 kg/m ³
Critical Temperature:	83.74°C
Critical Pressure:	42.16 bar
Flammability:	Not Fammable
ODP	0
GWP	2265

10. Stability and Reactivity

- Stability: Stable. Not classified as a reactivity hazard.
- Incompatible materials: Oxidizers.
- This substance is not flammable in air at temperatures up to 100 °C (212 °F) at atmospheric pressure. However, mixtures of this substance with high concentrations of air at elevated pressure and/or temperature can become combustible in the presence of an ignition source. This substance can also become combustible in an oxygen enriched environment (oxygen concentrations greater than that in air). Whether a mixture containing this substance and air, or this substance in an oxygen enriched atmosphere become combustible depends on the inter-relationship of 1) the temperature 2) the pressure, and 3) the proportion of oxygen in the mixture. In general, this substance should not be allowed to exist with air above atmospheric pressure or at high temperatures; or in an oxygen enriched environment. For example this substance should NOT be mixed with air under pressure for leak testing or other purposes. Heat, flames and sparks.
- No hazardous decomposition products are known.

11. Toxicological information

Inhalation		
Pentafluoroethane:	Acute inhalation toxicity	CL0 (Rat): > 800000 ppm Exposure Time: 4 h Test atmosphere: gas Method: OECD Test Guideline 403
1,1,1,2-Tetrafluoroethane	Acute inhalation toxicity	CL50 (Rat): > 567000 ppm Exposure Time: 4 h Test Atmosphere: gas
		No observed adverse effect concentration (Dog): 40000 ppm Test Atmosphere: gas Remarks: Cardiac sensitization
		Lowest observed adverse effect concentration (Dog): 80000 ppm Test atmosphere: gas Symptoms: May cause cardiac arrhythmia
		Cardiac sensitization threshold limit (Dog): 334,000 mg/m ³ Test atmosphere: gas Symptoms: May cause cardiac arrhythmia.
Difluoromethane	Acute inhalation toxicity	CL50 (Rat): > 520000 ppm Exposure Time: 4 h Test atmosphere: gas
		No observed adverse effect concentration (Dog): 350000 ppm Test atmosphere: gas Remarks: Cardiac sensitization
		Lowest observed adverse effect concentration (Dog): > 350000 ppm. Test atmosphere: gas Remarks: Cardiac sensitization
		Cardiac sensitization threshold limit (Dog): > 735,000 mg/m ³ Test atmosphere: gas Remarks: Cardiac sensitization
Butane	Acute inhalation toxicity	CL50 (Rat): 658 mg/l Exposure Time: 4 h Test Atmosphere: Vapor
Skin corrosion/irritation		
1,1,1,2-Tetrafluoroethane	No skin irritation	
Difluoromethane	No skin irritation	

Serious eye damage/eye irritation	
1,1,1,2-Tetrafluoroethane	No eye irritation
Difluoromethane	No eye irritation

Germ cell mutagenicity		
Pentafluoroethane	Genotoxicity in vitro	Test Type: Chromosome aberration test in vitro Method: OECD Test Guideline 473 Result: negative
		Test Type: Mammalian erythrocyte micronucleus test (in vivo cytogenetic assay) Species: Mouse Application Route: inhalation (gas) Method: OECD Test Guideline 474 Result: negative
1,1,1,2-Tetrafluoroethane	Germ cell mutagenicity - Assessment	Weight of evidence does not support classification as a germ cell mutagen.
Difluoromethane	Germ cell mutagenicity - Assessment	Weight of evidence does not support classification as a germ cell mutagen.
Butane	Genotoxicity in vitro	Test Type: Bacterial reverse mutation assay (AMES) Method: OECD Test Guideline 471 Result: negative
		Test Type: Mammalian erythrocyte micronucleus test (in vivo cytogenetic assay) Species: Rat Application Route: inhalation (gas) Method: OECD Test Guideline 474 Result: negative Remarks: Based on data from similar materials

Reproductive toxicity		
Pentafluoroethane	Effects on fertility	Test Type: One-generation reproduction toxicity study Species: Rat Application Route: inhalation (vapor) Result: negative Remarks: Based on data from similar materials

	Effects on fetal development	Test Type: Embryo-fetal development Species: Rat Application Route: inhalation (gas) Method: OECD Test Guideline 414 Result: negative
1,1,1,2-Tetrafluoroethane	Reproductive toxicity - Assessment	Weight of evidence does not support classification for reproductive toxicity
Difluoromethane	Reproductive toxicity - Assessment	Weight of evidence does not support classification for reproductive toxicity
Butane	Effects on fertility	Test Type: Combined repeated dose toxicity study with the reproduction/developmental toxicity screening test Species: Rat Application Route: inhalation (gas) Method: OECD Test Guideline 422 Result: negative
	Effects on fetal development	Test Type: Combined repeated dose toxicity study with the reproduction/developmental toxicity screening test Species: Rat Application Route: inhalation (gas) Method: OECD Test Guideline 422 Result: negative

12. Ecological Information

Toxicity	Toxicity to fish
Pentafluoroethane	CL50 (Oncorhynchus mykiss (trucha irisada)): 450 mg/l Tiempo de exposición: 96 h Método: Directiva 67/548/CEE, Anexo V, C.1. Observaciones: Basado en datos de materiales similares
1,1,1,2-Tetrafluoroethane	LC50 (Oncorhynchus mykiss (rainbow trout)): 450 mg/l Exposure time: 96 h Method: Regulation (EC) No. 440/2008, Annex, C.1
Difluoromethane	LC50 (Fish): 1,507 mg/l Exposure time: 96 h Method: ECOSAR (Ecological Structure Activity Relationships)

Toxicity	Toxicity to daphnia and other aquatic invertebrates
Pentafluoroethane	EC50 (Daphnia magna (Water flea)): > 100 mg/l Exposure time: 48 h Remarks: Based on data from similar materials

1,1,1,2-Tetrafluoroethane	EC50 (Daphnia magna (Water flea)): 980 mg/l Exposure time: 48 h Method: Regulation (EC) No. 440/2008, Annex, C.2
Difluoromethane	EC50 (Daphnia): 652 mg/l Exposure time: 48 h Method: ECOSAR (Ecological Structure Activity Relationships)

Toxicity	Toxicity to algae/aquatic plants
Pentafluoroethane	ErC50 (Pseudokirchneriella subcapitata (green algae)): > 100 mg/l Exposure time: 72 h Method: OECD Test Guideline 201 Remarks: Based on data from similar materials NOEC (Pseudokirchneriella subcapitata (green algae)): > 1 mg/l Exposure time: 72 h Method: OECD Test Guideline 201 Remarks: Based on data from similar materials
1,1,1,2-Tetrafluoroethane	ErC50 (green algae): > 100 mg/l Exposure time: 96 h Remarks: Based on data from similar materials
Difluoromethane	EC50 (green algae): 142 mg/l Exposure time: 96 h Method: ECOSAR (Ecological Structure Activity Relationships)

Toxicity	Persistence and degradability
Pentafluoroethane	Result: Not readily biodegradable. Biodegradation: 5 % Exposure time: 28 d Method: OECD Test Guideline 301D
1,1,1,2-Tetrafluoroethane	Result: Not readily biodegradable. Method: OECD Test Guideline 301D
Difluoromethane	Result: Not readily biodegradable. Method: OECD Test Guideline 301D
Butane	Result: Readily biodegradable.

13. Transport Information

Land Transport (ADR/RID/GGVSE)

UN-No.:	1078
Official transport designation:	Gas R438A
Class:	2.2
Classification Code:	2A
Packing group:	-
Hazard label:	2.2

Sea Transport (IMDG-Code/GGVSee)	
Proper Shipping Name:	Gas R438A
Class:	2.2
UN-No.:	1078
Packing group:	-

Air Transport (ICAO-TI/IATA-DGR)	
Proper Shipping Name:	Gas R438A
Class:	2.2
UN-No.:	1078
Packing group:	-

14. Disposal Considerations

Disposal methods

Waste from residues: Dispose of in accordance with local regulations.

Contaminated packaging: Empty containers should be taken to an approved waste handling site for recycling or disposal. Empty pressure vessels should be returned to the supplier. If not otherwise specified: Dispose of as unused product.

15. Regulatory Information (México)

Regulations and legislation on safety, health and environment specific for the substance or mixture: NOM-165-SEMARNAT-2013, which establishes the list of substances subject to report for the record of emissions and transfer of pollutants

Components	CAS No.	MPU (kg/year)	Emission (kg/year)
Pentafluoroethane	354-33-6	2500 kg/year	100 kg/year
1,1,1,2-Tetrafluoroethane	811-97-2	2500 kg/year	100 kg/year
Difluoromethane	75-10-5	2500 kg/year	100 kg/year

16. Other Information

Abbreviations y acronyms	
CLP	EU regulation (EC) No 1272/2008 on classification, labelling and packaging of chemical substances and mixture.
CAS	Chemical Abstracts Service (division of the American Chemical Society).
EINECS	European Inventory of Existing Commercial Chemical Substances.
IARC	International agency for research on cancer.
RID	European Rail Transport.
IMDG	International Maritime Code for Dangerous Goods.
IATA	International Air Transport Association.
DSD	Dangerous Substance Directive (67/548/EEC).
TSCA	Toxic Substances Control Act, The American chemical inventory.
DSL	Domestic Substances List, The Canadian chemical inventory.
AICS	The Australian Inventory of Chemical Substances.
ECL	Existing Chemicals List, the Korean chemical inventory.
ENCS	Japanese Existing and New Chemical Substances.
IECSC	Inventory of existing chemical substances in China.

KEY LITERATURE REFERENCES AND SOURCES FOR DATA	
ESIS IUCLID Dataset:	European chemical Substances Information System.
HSDB:	Hazardous Substances Data Bank.

ICSC:	International Chemical Safety Cards.
NLM Dataset:	United States National library of medicine.
GESTIS Substance database.	

TRAINING ADVICE:

Provide adequate information, instructions and training for operators.

DECLARE TO READER:

The information in this Safety Data Sheet (SDS) was obtained from sources which we believe are reliable. However, the information is provided without any warranty, express or implied, regarding its correctness. The conditions or methods of handling, storage, use or disposal of the product are beyond our control and may be beyond our knowledge. For this and other reasons, we do not assume responsibility and expressly disclaim liability for loss, damage or expense arising out of or in any way connected with the handling, storage, use or disposal of the product. This SDS was prepared and is to be used only for this product. If the product is used as a component in another product, this SDS information may not be applicable. According to REACH Article 31(5), the SDS shall be supplied in an official language of the Member State(s) where the substance or mixture is placed on the market, unless the recipient Member State(s) concerned provide otherwise. It should also be noted that this SDS is applicable to the countries with English as an official language.