

COMPOUND

Methane

Cite

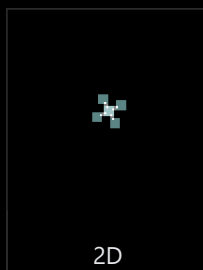


Download

PubChem CID

297

Structure



Primary Hazards



Flammable



Compressed Gas

[Laboratory Chemical Safety Summary \(LCSS\) Datasheet](#)

Molecular Formula

CH₄

Synonyms

methane
Marsh gas
Methyl hydride
Fire Damp
Biogas

[View More...](#)

Molecular Weight

16.043 g/mol

Computed by PubChem 2.2 (PubChem release 2025.04.14)

Dates

Create:

2004-09-16

Modify:

2026-08-22

Description

Methane is a colorless odorless gas. It is also known as marsh gas or methyl hydride. It is easily ignited. The vapors

are lighter than air. Under prolonged exposure to fire or intense heat the containers may rupture violently and rocket. It is used in making other chemicals and as a constituent of the fuel, natural gas.

► [CAMEO Chemicals](#)

Methane, refrigerated liquid (cryogenic liquid) is a colorless odorless liquid. Flammable. [Water](#) insoluble.

► [CAMEO Chemicals](#)

Natural gas, [compressed] appears as a flammable gaseous mixture of straight chain hydrocarbons, predominately compressed methane.

► [CAMEO Chemicals](#)

[View More...](#)

See also:  Methanide (None); Toxagent Detox 6035 (FDA NDC: 63083-6035)

(component of); (C10-C30)Alkyl methacrylate ester (monomer of) ... [View More ...](#)

Contents

Title and Summary

1 Structures



2 Names and Identifiers



3 Chemical and Physical Properties



4 Spectral Information



5 Related Records



6 Chemical Vendors

7 Pharmacology and Biochemistry



8 Use and Manufacturing



9 Identification

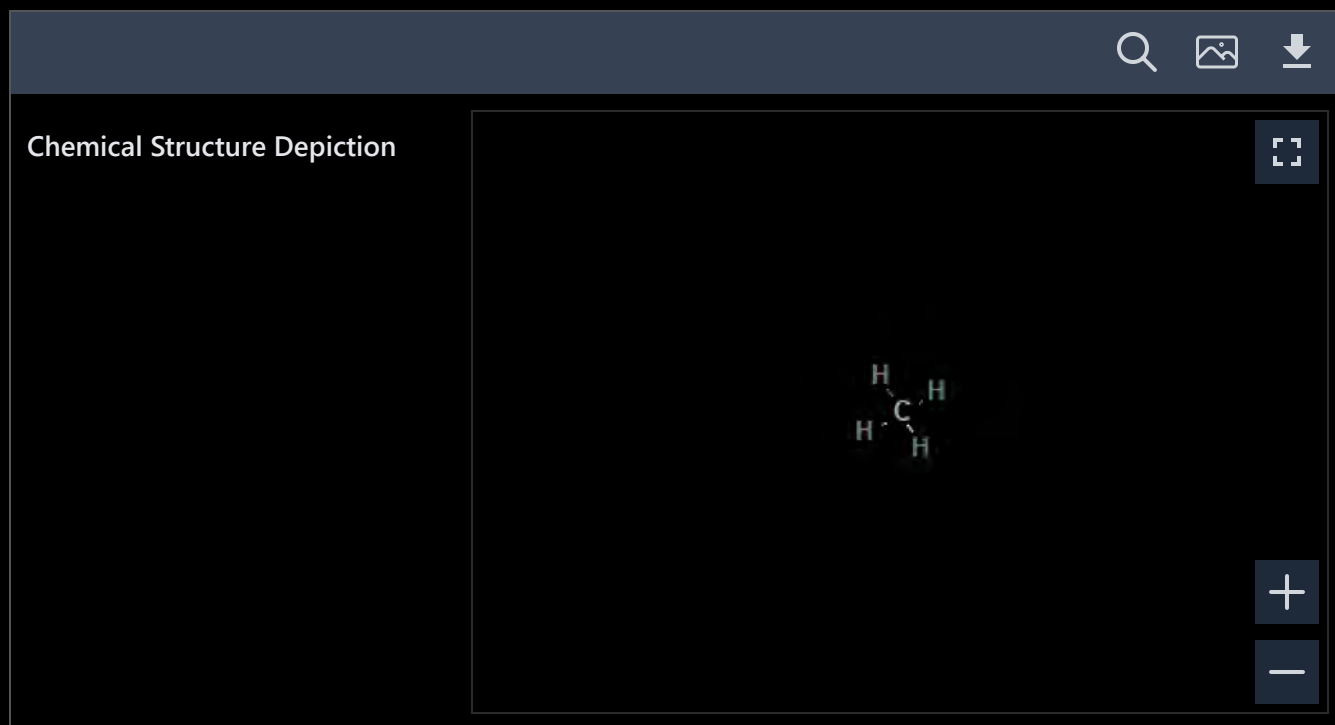


10 Safety and Hazards	▼
11 Toxicity	▼
12 Associated Disorders and Diseases	
13 Literature	▼
14 Patents	▼
15 Interactions and Pathways	▼
16 Biological Test Results	▼
17 Taxonomy	
18 Classification	▼
19 Information Sources	

1 Structures



1.1 2D Structure



▼ PubChem

Source

PubChem

URL	https://pubchem.ncbi.nlm.nih.gov
Description	Data deposited in or computed by PubChem

2 Names and Identifiers



2.1 Computed Descriptors



2.1.1 IUPAC Name



methane

Computed by Lexichem TK 2.7.0 (PubChem release 2025.04.14)

► [PubChem](#)

2.1.2 InChI



InChI=1S/CH4/h1H4

Computed by InChI 1.07.2 (PubChem release 2025.04.14)

► [PubChem](#)

2.1.3 InChIKey



VNWK TOKETHGBQD-UHFFFAOYSA-N

Computed by InChI 1.07.2 (PubChem release 2025.04.14)

► [PubChem](#)

2.1.4 SMILES



C

Computed by OEChem 2.3.0 (PubChem release 2025.04.14)

► [PubChem](#)

2.2 Molecular Formula



CH₄

Computed by PubChem 2.2 (PubChem release 2025.04.14)

▶ Australian Industrial Chemicals Introduction Scheme (AICIS); CAMEO Chemicals; PAC Chemical Data...

CH₄

▶ ILO-WHO International Chemical Safety Cards (ICSCs)

2.3 Other Identifiers



2.3.1 CAS



74-82-8

▶ Australian Industrial Chemicals Introduction Scheme (AICIS); CAMEO Chemicals; CAS Common Che...

8006-14-2

▶ ChemIDplus

2.3.2 Related CAS



27936-85-2

Compound: Methane polymer

▶ CAS Common Chemistry

58760-46-6

Compound: Methane, dimer

▶ CAS Common Chemistry

2.3.3 Deprecated CAS



131452-56-7

- ▶ ChemIDplus; EPA Chemicals under the TSCA

2.3.4 European Community (EC) Number



200-812-7

- ▶ European Chemicals Agency (ECHA)

922-749-0

- ▶ European Chemicals Agency (ECHA)

927-905-1

- ▶ European Chemicals Agency (ECHA)

942-699-3

- ▶ European Chemicals Agency (ECHA)

2.3.5 UNII



OP0UW79H66

- ▶ FDA Global Substance Registration System (GSRS)

2.3.6 UN Number



1972

- ▶ CAMEO Chemicals; Emergency Response Guidebook (ERG); US Code of Federal Regulations, Hazard...

1971

- ▶ CAMEO Chemicals; Emergency Response Guidebook (ERG); ILO-WHO International Chemical Safety ...

2.3.7 ChEBI ID



CHEBI:16183

▶ ChEBI

2.3.8 ChEMBL ID



CHEMBL17564

▶ ChEMBL; Open Targets

2.3.9 DrugBank ID



DB15994

▶ DrugBank

2.3.10 DSSTox Substance ID



DTXSID8025545

▶ EPA DSSTox

2.3.11 HMDB ID



HMDB0002714

▶ Human Metabolome Database (HMDB)

2.3.12 ICSC Number



0291

▶ ILO-WHO International Chemical Safety Cards (ICSCs)

2.3.13 KEGG ID



C01438

▶ KEGG

2.3.14 Metabolomics Workbench ID



50410

- ▶ Metabolomics Workbench

2.3.15 Nikkaji Number



J2.380I

- ▶ Japan Chemical Substance Dictionary (Nikkaji)

J593B

- ▶ Japan Chemical Substance Dictionary (Nikkaji)

J2.228.533E

- ▶ Japan Chemical Substance Dictionary (Nikkaji)

J68.119I

- ▶ Japan Chemical Substance Dictionary (Nikkaji)

J3.470.363I

- ▶ Japan Chemical Substance Dictionary (Nikkaji)

2.3.16 Wikidata



Q37129

- ▶ Wikidata

2.3.17 Wikipedia



Methane

- ▶ Wikipedia

Methylidyne_radical

[▶ Wikipedia](#)

2.4 Synonyms

2.4.1 MeSH Entry Terms

MeSH Entry Terms for Methane

Methane

[▶ Medical Subject Headings \(MeSH\)](#)

MeSH Entry Terms for Biogas

Biogas

[▶ Medical Subject Headings \(MeSH\)](#)

2.4.2 Depositor-Supplied Synonyms

methane	Methane in gaseous state	Methane-12C	OCB689EE-132E-4559-A597
Marsh gas	UN1972	RefChem:6654	200-812-7
Methyl hydride	BRN 1718732	methane;tetrahydridocarbon	02329_FLUKA
Fire Damp	OP0UW79H66	AC1L18XA	14493-06-2
Biogas	UN1971	CHEMBL17564	150036-83-2
74-82-8	CH ₄	DTXCID705545	295477_ALDRICH
R 50 (refrigerant)	DTXSID8025545	CTK2H7747	3B4-2254
metano	UNII-OP0UW79H66	AC1Q2825	463035_ALDRICH
tetrahydridocarbon	CHEBI:16183	AKOS005166816	490210_ALDRICH
HSDB 167	R 50	C01438	8006-14-2

[▶ PubChem](#)

3 Chemical and Physical Properties

3.1 Computed Properties

Property Name	Property Value	Reference
---------------	----------------	-----------

Molecular Weight	16.043 g/mol	Computed by PubChem 2.2 (PubChem release 2025.04.14)
XLogP3-AA	0.6	Computed by XLogP3 3.0 (PubChem release 2025.04.14)
Hydrogen Bond Donor Count	0	Computed by Cactvs 3.4.8.18 (PubChem release 2025.04.14)
Hydrogen Bond Acceptor Count	0	Computed by Cactvs 3.4.8.18 (PubChem release 2025.04.14)
Rotatable Bond Count	0	Computed by Cactvs 3.4.8.18 (PubChem release 2025.04.14)
Exact Mass	16.0313001276 Da	Computed by PubChem 2.2 (PubChem release 2025.04.14)
Monoisotopic Mass	16.0313001276 Da	Computed by PubChem 2.2 (PubChem release 2025.04.14)
Topological Polar Surface Area	0 Å ²	Computed by Cactvs 3.4.8.18 (PubChem release 2025.04.14)
Heavy Atom Count	1	Computed by PubChem
Formal Charge	0	Computed by PubChem
Complexity	0	Computed by Cactvs 3.4.8.18 (PubChem release 2025.04.14)
Isotope Atom Count	0	Computed by PubChem
Defined Atom Stereocenter Count	0	Computed by PubChem
Undefined Atom Stereocenter Count	0	Computed by PubChem
Defined Bond Stereocenter Count	0	Computed by PubChem
Undefined Bond Stereocenter Count	0	Computed by PubChem
Covalently-Bonded Unit Count	1	Computed by PubChem
Compound Is Canonicalized	Yes	Computed by PubChem (release 2025.04.14)

[▶ PubChem](#)

3.2 Experimental Properties



3.2.1 Physical Description



Methane is a colorless odorless gas. It is also known as marsh gas or methyl hydride. It is easily ignited. The vapors are lighter than air. Under prolonged exposure to fire or intense heat the containers may rupture violently and rocket. It is used in making other chemicals and as a constituent of the fuel, natural gas.

[▶ CAMEO Chemicals](#)

Methane, refrigerated liquid (cryogenic liquid) is a colorless odorless liquid. Flammable. [Water](#) insoluble.

[▶ CAMEO Chemicals](#)

Natural gas, [compressed] appears as a flammable gaseous mixture of straight chain hydrocarbons, predominately compressed methane.

[▶ CAMEO Chemicals](#)

Liquid; CBI; Gas Vapor

[▶ EPA Chemical Data Reporting \(CDR\)](#)

Colorless, odorless gas; [Merck Index] Vapor density = 0.554 (lighter than air); [HSDB]

[▶ Haz-Map, Information on Hazardous Chemicals and Occupational Diseases](#)

Liquid

[▶ Human Metabolome Database \(HMDB\)](#)

COLOURLESS ODOURLESS COMPRESSED OR LIQUEFIED GAS.

[▶ ILO-WHO International Chemical Safety Cards \(ICSCs\)](#)

3.2.2 Color / Form



Colorless gas

O'Neil, M.J. (ed.). *The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals*. Cambridge, UK: Royal Society of Chemistry, 2013., p. 1105

► [Hazardous Substances Data Bank \(HSDB\)](#)

3.2.3 Odor



Odorless

O'Neil, M.J. (ed.). *The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals*. Cambridge, UK: Royal Society of Chemistry, 2013., p. 1105

► [Hazardous Substances Data Bank \(HSDB\)](#)

Weak odor

U.S. Coast Guard, Department of Transportation. *CHRIS - Hazardous Chemical Data. Volume II*. Washington, D.C.: U.S. Government Printing Office, 1984-5.

► [Hazardous Substances Data Bank \(HSDB\)](#)

3.2.4 Taste



Tasteless

Lewis, R.J. Sr.; *Hawley's Condensed Chemical Dictionary 15th Edition*. John Wiley & Sons, Inc. New York, NY 2007., p. 810

► [Hazardous Substances Data Bank \(HSDB\)](#)

3.2.5 Boiling Point



-258 °F at 760 mmHg (USCG, 1999)

U.S. Coast Guard. 1999. *Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data. Commandant Instruction 16465.12C*. Washington, D.C.: U.S. Government Printing Office.

► [CAMEO Chemicals](#)

-258.7 °F at 760 mmHg (NTP, 1992)

National Toxicology Program, Institute of Environmental Health Sciences, National Institutes of Health (NTP). 1992. *National Toxicology Program Chemical Repository Database*. Research Triangle Park, North Carolina.

► [CAMEO Chemicals](#)

-161.50 °C

Haynes, W.M. (ed.). *CRC Handbook of Chemistry and Physics*. 94th Edition. CRC Press LLC, Boca Raton: FL 2013-2014, p. 3-344

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

-161 °C

▶ [ILO-WHO International Chemical Safety Cards \(ICSCs\)](#)

-161.48 °C @760 [mm Hg]

▶ [PAC Chemical Database, U.S. Department of Energy](#)

3.2.6 Melting Point



-296 °F (USCG, 1999)

U.S. Coast Guard. 1999. *Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data*. Commandant Instruction 16465.12C. Washington, D.C.: U.S. Government Printing Office.

▶ [CAMEO Chemicals](#)

-296.5 °F (NTP, 1992)

National Toxicology Program, Institute of Environmental Health Sciences, National Institutes of Health (NTP). 1992. *National Toxicology Program Chemical Repository Database*. Research Triangle Park, North Carolina.

▶ [CAMEO Chemicals](#)

-182.566 °C

Haynes, W.M. (ed.). *CRC Handbook of Chemistry and Physics*. 94th Edition. CRC Press LLC, Boca Raton: FL 2013-2014, p. 3-344

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

-182.4 °C

▶ [Human Metabolome Database \(HMDB\)](#)

-183 °C

▶ [ILO-WHO International Chemical Safety Cards \(ICSCs\)](#)

-182.47 °C

► PAC Chemical Database, U.S. Department of Energy

3.2.7 Flash Point



-306 °F (NTP, 1992)

National Toxicology Program, Institute of Environmental Health Sciences, National Institutes of Health (NTP). 1992. National Toxicology Program Chemical Repository Database. Research Triangle Park, North Carolina.

► CAMEO Chemicals

-306 °F

► Haz-Map, Information on Hazardous Chemicals and Occupational Diseases

-188 °C (-306 °F) - closed cup

Sigma-Aldrich Material Safety Data Sheet for methane. Product number 295477. Version 3.3. (December 5, 2012). Available from, as of November 6, 2013.

<https://www.sigmaaldrich.com/catalog/product/aldrich/295477?lang=en®ion=US>

► Hazardous Substances Data Bank (HSDB)

Flammable gas

► ILO-WHO International Chemical Safety Cards (ICSCs)

3.2.8 Solubility



3.5 mL/100 mL at 63 °F (NTP, 1992)

National Toxicology Program, Institute of Environmental Health Sciences, National Institutes of Health (NTP). 1992. National Toxicology Program Chemical Repository Database. Research Triangle Park, North Carolina.

► CAMEO Chemicals

In water, 22 mg/L at 25 °C

Yalkowsky, S.H., He, Yan, Jain, P. Handbook of Aqueous Solubility Data Second Edition. CRC Press, Boca Raton, FL 2010, p. 8

► Hazardous Substances Data Bank (HSDB)

Slightly soluble in acetone; soluble in ethanol, ethyl ether, benzene, toluene, methanol

Haynes, W.M. (ed.). *CRC Handbook of Chemistry and Physics*. 94th Edition. CRC Press LLC, Boca Raton: FL 2013-2014, p. 3-344

► [Hazardous Substances Data Bank \(HSDB\)](#)

0.91 mL in 1 g ether at 20 °C; 0.60 mL in 1 g ethyl alcohol at 20 °C

Patty, F. (ed.). *Industrial Hygiene and Toxicology: Volume II: Toxicology*. 2nd ed. New York: Interscience Publishers, 1963., p. 1197

► [Hazardous Substances Data Bank \(HSDB\)](#)

0.022 mg/mL at 25 °C

► [Human Metabolome Database \(HMDB\)](#)

Solubility in water, ml/100ml at 20 °C: 3.3

► [ILO-WHO International Chemical Safety Cards \(ICSCs\)](#)

3.2.9 Density



0.415 to 0.45 at -259.6 °F (USCG, 1999)

U.S. Coast Guard. 1999. *Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data*. Commandant Instruction 16465.12C. Washington, D.C.: U.S. Government Printing Office.

► [CAMEO Chemicals](#)

0.422 at -256 °F (USCG, 1999) - Less dense than water; will float

U.S. Coast Guard. 1999. *Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data*. Commandant Instruction 16465.12C. Washington, D.C.: U.S. Government Printing Office.

► [CAMEO Chemicals](#)

0.554 at 0 °C/4 °C (air = 1) or 0.7168 g/liter

O'Neil, M.J. (ed.). *The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals*. Cambridge, UK: Royal Society of Chemistry, 2013., p. 1105

► [Hazardous Substances Data Bank \(HSDB\)](#)

0.4228 @ -162°C

► [PAC Chemical Database, U.S. Department of Energy](#)



3.2.10 Vapor Density

0.55 (NTP, 1992) - Lighter than air; will rise (Relative to Air)

National Toxicology Program, Institute of Environmental Health Sciences, National Institutes of Health (NTP). 1992. National Toxicology Program Chemical Repository Database. Research Triangle Park, North Carolina.

► [CAMEO Chemicals](#)

0.554 at 0 °C (Air = 1)

Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 810

► [Hazardous Substances Data Bank \(HSDB\)](#)

Relative vapor density (air = 1): 0.6

► [ILO-WHO International Chemical Safety Cards \(ICSCs\)](#)



3.2.11 Vapor Pressure

258574 mmHg at 100 °F ; 760 mmHg at -258.7 °F (NTP, 1992)

National Toxicology Program, Institute of Environmental Health Sciences, National Institutes of Health (NTP). 1992. National Toxicology Program Chemical Repository Database. Research Triangle Park, North Carolina.

► [CAMEO Chemicals](#)

VP: 1 Pa at -220 °C (solid); -10 Pa at 214.2 °C (solid); 100 Pa at -206.8 °C (solid); 1 kPa at -197 °C (solid); 10 kPa at -183.6 °C (solid); 100 kPa at -161.7 °C

Haynes, W.M. (ed.). CRC Handbook of Chemistry and Physics. 94th Edition. CRC Press LLC, Boca Raton: FL 2013-2014, p. 6-94

► [Hazardous Substances Data Bank \(HSDB\)](#)

4.66X10+5 mm Hg at 25 °C

Daubert, T.E., R.P. Danner. Physical and Thermodynamic Properties of Pure Chemicals Data Compilation. Washington, D.C.: Taylor and Francis, 1989.

► [Hazardous Substances Data Bank \(HSDB\)](#)

750 [mm Hg] @-161.69999999999999 °C

▶ [PAC Chemical Database, U.S. Department of Energy](#)

3.2.12 LogP



log Kow = 1.09

Hansch, C., Leo, A., D. Hoekman. Exploring QSAR - Hydrophobic, Electronic, and Steric Constants. Washington, DC: American Chemical Society, 1995., p. 3

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

1.09

HANSCH,C ET AL. (1995)

▶ [Human Metabolome Database \(HMDB\)](#); [ILO-WHO International Chemical Safety Cards \(ICSCs\)](#)

3.2.13 Autoignition Temperature



999 °F (USCG, 1999)

U.S. Coast Guard. 1999. Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data. Commandant Instruction 16465.12C. Washington, D.C.: U.S. Government Printing Office.

▶ [CAMEO Chemicals](#)

1004 °F (USCG, 1999)

U.S. Coast Guard. 1999. Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data. Commandant Instruction 16465.12C. Washington, D.C.: U.S. Government Printing Office.

▶ [CAMEO Chemicals](#)

999 °F (537 °C)

National Fire Protection Association; Fire Protection Guide to Hazardous Materials. 14TH Edition, Quincy, MA 2010, p. 49-106

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

537 °C

▶ [ILO-WHO International Chemical Safety Cards \(ICSCs\)](#)

3.2.14 Viscosity



34.8 uP at -181.6 °C; 76.0 uP at -78.5 °C; 102.6 uP at 0 °C; 108.7 uP at 20 °C; 133.1 uP at 100.0 °C; 160.5 uP at 200.5 °C; 181.3 uP at 284 °C; 202.6 uP at 380 °C; 226.4 uP at 499 °C

Weast, R.C. (ed.) *Handbook of Chemistry and Physics*. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989., p. F-46

► [Hazardous Substances Data Bank \(HSDB\)](#)

3.2.15 Heat of Combustion



-890.8 kJ/mol

Haynes, W.M. (ed.). *CRC Handbook of Chemistry and Physics*. 94th Edition. CRC Press LLC, Boca Raton: FL 2013-2014, p. 5-68

► [Hazardous Substances Data Bank \(HSDB\)](#)

3.2.16 Heat of Vaporization



8.19 kJ/mol

Haynes, W.M. (ed.). *CRC Handbook of Chemistry and Physics*. 94th Edition. CRC Press LLC, Boca Raton: FL 2013-2014, p. 6-140

► [Hazardous Substances Data Bank \(HSDB\)](#)

3.2.17 Surface Tension



14 dynes/cm = 0.014 N/m at -161 °C

U.S. Coast Guard, Department of Transportation. *CHRIS - Hazardous Chemical Data. Volume II*. Washington, D.C.: U.S. Government Printing Office, 1984-5.

► [Hazardous Substances Data Bank \(HSDB\)](#)

3.2.18 Kovats Retention Index



All column types	100
------------------	-----

► [NIST Mass Spectrometry Data Center](#)



3.2.19 Other Experimental Properties

Burns with a pale, faintly luminous flame; air containing more than 14% methane burns without noise

O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Cambridge, UK: Royal Society of Chemistry, 2013., p. 1105

► [Hazardous Substances Data Bank \(HSDB\)](#)

Practically inert toward sulfuric acid, nitric acid, alkalies, and salts but reacts with chlorine and bromine in light (explosively in direct sunlight)

Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 810

► [Hazardous Substances Data Bank \(HSDB\)](#)

Liquid water interfacial tension: 50 dynes/cm = 0.050 N/m at -161 °C; Ratio of specific heats of vapor: 1.306

U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5.

► [Hazardous Substances Data Bank \(HSDB\)](#)

Enthalpy of fusion: 0.94 kJ/mol

Haynes, W.M. (ed.). CRC Handbook of Chemistry and Physics. 94th Edition. CRC Press LLC, Boca Raton: FL 2013-2014, p. 6-153

► [Hazardous Substances Data Bank \(HSDB\)](#)

For more Other Experimental Properties (Complete) data for METHANE (7 total), please visit the [HSDB record page](#).

► [Hazardous Substances Data Bank \(HSDB\)](#)



3.3 SpringerMaterials Properties

Dunham energy parameter	Composition	Diamagnetic susceptibility	Electronic structure
Gibbs energy	Compressibility	Dielectric constant	Electrooptical properties
Schoenflies notation	Core level transition	Dielectricity	Emissivity
Acentric factor	Corrosion	Diffusion	Enthalpy
Activation energy	Creep	Diffusion of impurities	Enthalpy of formation

Band structure	Critical point	Diffusive flux	Entropy
Boiling point	Crystal structure	Elasticity	Excess enthalpy
Centrifugal distortion	Crystal structure type	Elasto-optic coefficient	Fluorescence
Chemical bond	Crystallographic point group	Electric dipole moment	Formation enthalpy
Chemical diffusion	Density	Electron conductivity	Formation enthalpy

► [SpringerMaterials](#)

3.4 Chemical Classes



◀ Toxic Gases & Vapors -> Simple Asphyxiants ▶

► [Haz-Map, Information on Hazardous Chemicals and Occupational Diseases](#)

Flammable agents - 4th degree

► [NJDOH RTK Hazardous Substance List](#)

4 Spectral Information



4.1 1D NMR Spectra



1D NMR Spectra	NMRShiftDB Link
----------------	---------------------------------

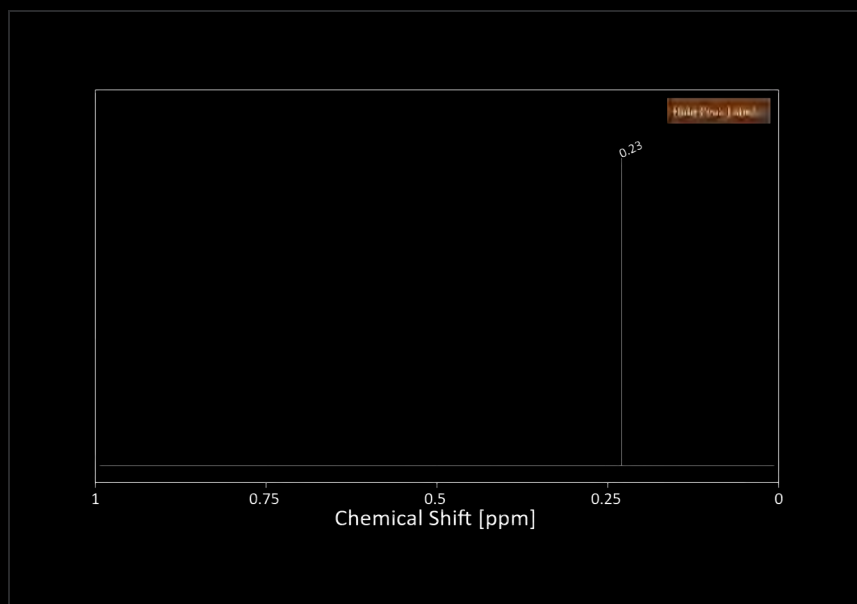
► [NMRShiftDB](#)

4.1.1 1H NMR Spectra



Spectra ID	2602
Instrument Type	JEOL
Frequency	300 MHz
Solvent	CCl4
Shifts [ppm]:Intensity	0.23:1000.00

Thumbnail



► [Human Metabolome Database \(HMDB\)](#)

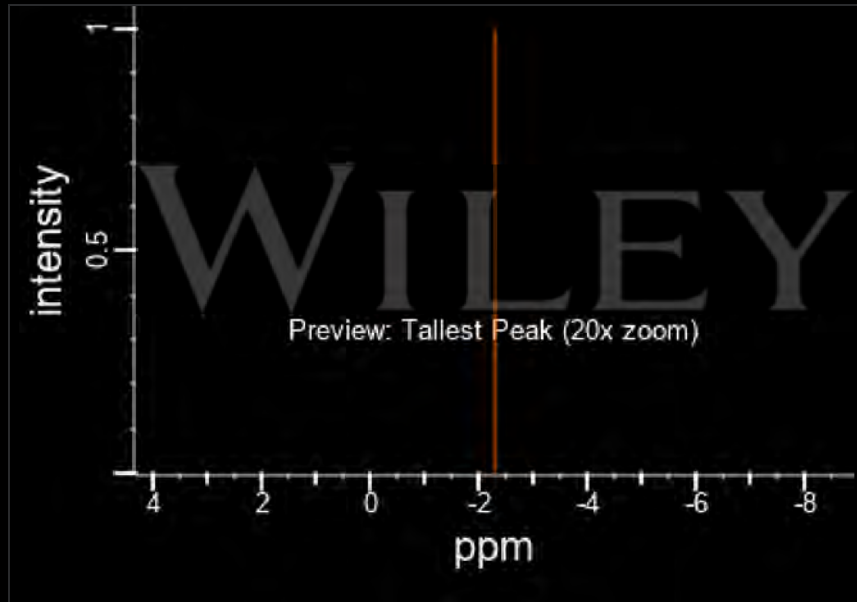
4.1.2 13C NMR Spectra



Copyright

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Thumbnail



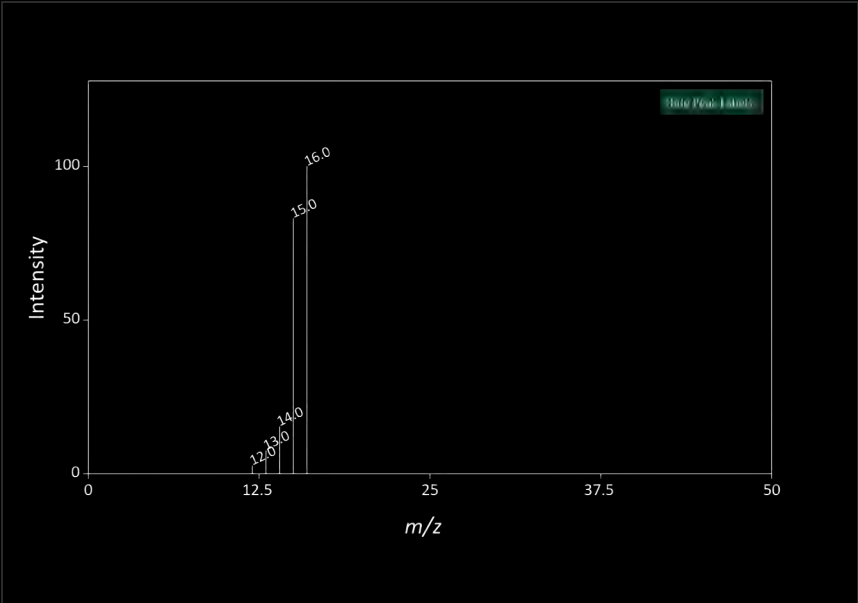
► [SpectraBase](#)

4.2 Mass Spectrometry



4.2.1 GC-MS



1 of 7 items		View All 
Spectra ID	27078	
Instrument Type	EI-B	
Ionization Mode	positive	
SPLASH	splash10-014i-9000000000-42e2bf163f3e1178d2b7	
Top 5 Peaks	16.0 99.99 15.0 83.07 14.0 15.36 13.0 7.57 12.0 2.66	
Thumbnail		
Notes	instrument=HITACHI RMU-5B	

► [Human Metabolome Database \(HMDB\)](#)

2 of 7 items		View All 
MoNA ID	JP001582	
MS Category	Experimental	
MS Type	GC-MS	
MS Level	MS1	
Instrument	HITACHI RMU-5B	

Instrument Type	EI-B
Ionization Mode	positive
Top 5 Peaks	16 99.99 15 83.07 14 15.36 13 7.57 12 2.66
SPLASH	splash10-014i-9000000000-42e2bf163f3e1178d2b7
Thumbnail	
License	CC BY-NC-SA

► [MassBank of North America \(MoNA\)](#)

4.2.2 Other MS

1 of 2 items	
Other MS	MASS: 61313 (NIST/EPA/MSDC Mass Spectral Database 1990 version)
► Hazardous Substances Data Bank (HSDB)	
2 of 2 items	
Accession ID	MSBNK-Fac_Eng_Univ_Tokyo-JP001582
Authors	MASS SPECTROSCOPY SOC. OF JAPAN (MSSJ)

Instrument	HITACHI RMU-5B
Instrument Type	EI-B
MS Level	MS
Ionization Mode	POSITIVE
Ionization	ENERGY 80 eV
Top 5 Peaks	16 999 15 831 14 154 13 76 12 27
SPLASH	splash10-014i-9000000000-42e2bf163f3e1178d2b7
Thumbnail	
License	CC BY-NC-SA

► [MassBank Europe](#)

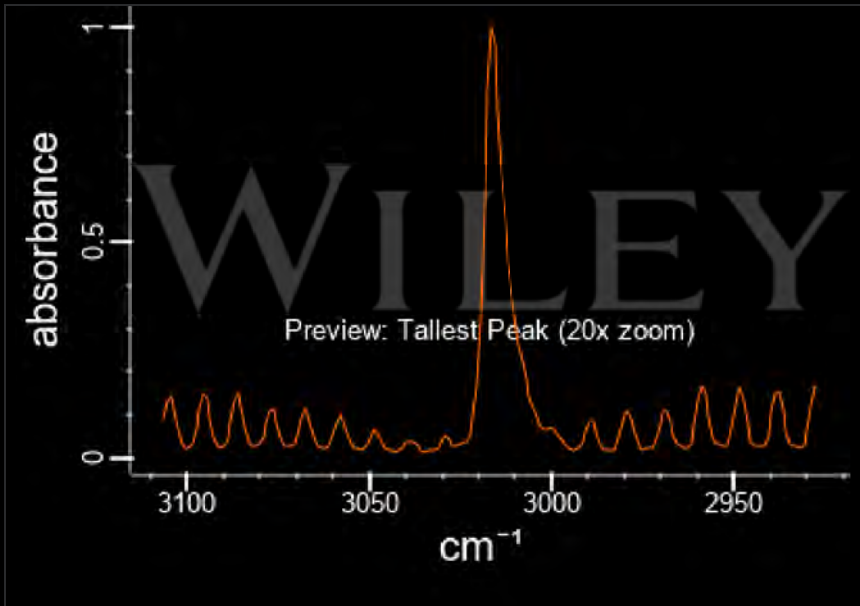
4.3 IR Spectra

IR Spectra	IR: 4063 u- SADP (Sadtlter Research Laboratories Prism Collection)
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► [Hazardous Substances Data Bank \(HSDB\)](#)

4.3.1 Vapor Phase IR Spectra



Instrument Name	DIGILAB FTS-14
Technique	Vapor Phase
Copyright	Copyright © 1980, 1981-2025 John Wiley & Sons, Inc. All Rights Reserved.
Thumbnail	

► SpectraBase

5 Related Records



5.1 Related Compounds with Annotation



Follow these links to [do a live 2D search](#) or [do a live 3D search](#) for this compound, sorted by annotation score. This section is deprecated (see [the neighbor discontinuation help page](#) for details), but these live search links provide equivalent functionality to the table that was previously shown here.

► PubChem

5.2 Related Compounds



Same Connectivity Count	34
-------------------------	----

Same Parent, Connectivity Count	376
Same Parent, Exact Count	317
Mixtures, Components, and Neutralized Forms Count	566890
Similar Compounds (2D)	View in PubChem Search
Similar Conformers (3D)	View in PubChem Search

► [PubChem](#)

5.3 Substances



5.3.1 PubChem Reference Collection SID



481107993

► [PubChem](#)

5.3.2 Related Substances



All Count	596268
Same Count	1942
Mixture Count	594326

► [PubChem](#)

5.3.3 Substances by Category



▶ PubChem



5.4 Other Relationships



Methanide (None)

Toxagent Detox 6035 (FDA NDC: 63083-6035) (component of)
(C10-C30)Alkyl methacrylate ester (monomer of)
Natural gas, [compressed] (related)
Methane, refrigerated liquid (cryogenic liquid) (narrower)
Activated Charcoal (annotation moved to)
Natural Gas (annotation moved to)

- Carbon (annotation moved to)



Methyl (annotation moved to)

Natural gas, refrigerated liquid (cryogenic liquid) (annotation moved to)

▶ PubChem



5.5 Entrez Crosslinks

PubMed Count	64
Protein Structures Count	30
Taxonomy Count	4
OMIM Count	30
Gene Count	99

[▶ PubChem](#)

5.6 NCBI LinkOut

[▶ NCBI](#)

6 Chemical Vendors

[▶ PubChem](#)

7 Pharmacology and Biochemistry



7.1 Absorption, Distribution and Excretion



The pharmacokinetics of methane ... would probably be similar to that reported for [ethane](#).

Snyder, R. (ed.) Ethel Browning's Toxicity and Metabolism of Industrial Solvents. 2nd ed. Volume 1: Hydrocarbons. Amsterdam - New York - Oxford: Elsevier, 1987., p. 257

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

Methane has been demonstrated to be absorbed through the lungs in mammals.

Snyder, R. (ed.) Ethel Browning's Toxicity and Metabolism of Industrial Solvents. 2nd ed. Volume 1: Hydrocarbons. Amsterdam - New York - Oxford: Elsevier, 1987., p. 256

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

7.2 Metabolism / Metabolites



Methane is absorbed through the lungs in mammals. when inhaled, the majority of the absorbed dose is exhaled unchanged. A small amount of methane is converted to [methanol](#) and ultimately to [carbon dioxide](#). Uptake in humans is less rapid than in the rat.

Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V4 6

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

Small amt of methane undergoes metabolism to [methanol](#) and ultimately to [carbon dioxide](#).

Snyder, R. (ed.) Ethel Browning's Toxicity and Metabolism of Industrial Solvents. 2nd ed. Volume 1: Hydrocarbons. Amsterdam - New York - Oxford: Elsevier, 1987., p. 257

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

Methane is biologically inactive. (L172)

▶ [Toxin and Toxin Target Database \(T3DB\)](#)

7.3 Human Metabolite Information



7.3.1 Tissue Locations



Adipose Tissue
Fibroblasts
Intestine
Kidney
Liver
Platelet
Skeletal Muscle

► [Human Metabolome Database \(HMDB\)](#)

7.3.2 Cellular Locations



Cytoplasm

► [Human Metabolome Database \(HMDB\)](#)

7.4 Biochemical Reactions



► [Rhea - Annotated Reactions Database](#)

► PubChem

7.5 Transformations



► NORMAN Suspect List Exchange

8 Use and Manufacturing



8.1 Uses



CPDat Product Use Categories (PUCs)



- ▶ [EPA Chemical and Products Database \(CPDat\)](#)

Sources/Uses

In the USA 85% of natural gas is methane. [Merck Index] Produced by decaying matter in swamps and marshes; [Hawley]

Merck Index - O'Neil MJ, Heckelman PE, Dobbelaar PH, Roman KJ (eds). The Merck Index, An Encyclopedia of Chemicals, Drugs, and Biologicals, 15th Ed. Cambridge, UK: The Royal Society of Chemistry, 2013.

Hawley - Lewis RJ. _Hawley's Condensed Chemical Dictionary, _15th Ed. New York: John Wiley & Sons, 2007.

- ▶ [Haz-Map, Information on Hazardous Chemicals and Occupational Diseases](#)

Industrial Processes with risk of exposure

Mining [Category: Industry]

Sewer and Wastewater Treatment [Category: Industry]

Farming (Respiratory Hazards) [Category: Industry]

- ▶ [Haz-Map, Information on Hazardous Chemicals and Occupational Diseases](#)

Activities with risk of exposure

Smoking cigarettes [Category: Food & Drugs]

- ▶ [Haz-Map, Information on Hazardous Chemicals and Occupational Diseases](#)

In the production of [methanol](#)

Snyder, R. (ed.) Ethel Browning's Toxicity and Metabolism of Industrial Solvents. 2nd ed. Volume 1: Hydrocarbons. Amsterdam - New York - Oxford: Elsevier, 1987., p. 256

- ▶ [Hazardous Substances Data Bank \(HSDB\)](#)

Constituent of illuminating and cooking gas; in manufacture of [hydrogen](#), [hydrogen cyanide](#), [ammonia](#), [acetylene](#), [formaldehyde](#), in organic syntheses.

O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Cambridge, UK: Royal Society of Chemistry, 2013., p. 1105

► [Hazardous Substances Data Bank \(HSDB\)](#)

Chemical intermediate (excluding fuel use); constituent of natural gas (about 85% methane); ... halogenated methanes, [carbon disulfide](#), [sodium hydrosulfide](#), [carbon black](#)

SRI

► [Hazardous Substances Data Bank \(HSDB\)](#)

The largest /SRP: industrial/ use of methane is for synthesis gas, a mixture of [hydrogen](#) and [carbon monoxide](#). Synthesis gas, in turn, is the primary feed for the production of [ammonia](#) and [methanol](#). Synthesis gas is produced by steam reforming of methane over a [nickel catalyst](#).

Eastman Ad, Mears D; Hydrocarbons, C1-C6. Kirk-Othmer Encyclopedia of Chemical Technology (1999-2013). John Wiley & Sons, Inc. Online Posting Date: December 4, 2000

► [Hazardous Substances Data Bank \(HSDB\)](#)

Source of petrochemicals by conversion to [hydrogen](#) and [carbon monoxide](#) by steam cracking or partial oxidation. Important products are [methanol](#), [acetylene](#), /and/ [hydrogen cyanide](#) ... Chlorination gives [carbon tetrachloride](#), [chloroform](#), [methylene chloride](#), and [methyl chloride](#). In the form of natural gas, methane is used as a fuel, as a source of [carbon black](#), and as the starting material for manufacture of synthetic proteins.

Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 810

► [Hazardous Substances Data Bank \(HSDB\)](#)

Methane is the major component of natural gas, which is found in geological deposits known as natural gas fields and used as vehicle fuel in its compressed form. Methane may be burned to produce electricity and is often piped into homes for domestic heating and cooking purposes. Methane is also used in industrial processes to produce chemicals such as [hydrogen](#), [methanol](#), [acetic acid](#), and [acetic anhydride](#). (L171)

► [Toxin and Toxin Target Database \(T3DB\)](#)

8.1.1 Industry Uses



Not Known or Reasonably Ascertainable
Intermediate
X-ray absorber
Monomers
Fuel

<https://www.epa.gov/chemical-data-reporting>

▶ [EPA Chemical Data Reporting \(CDR\)](#)

8.1.2 Consumer Uses



Fuel
Abrasives
Intermediate

<https://www.epa.gov/chemical-data-reporting>

▶ [EPA Chemical Data Reporting \(CDR\)](#)

8.2 Methods of Manufacturing



Prepared commercially from natural gas or by fermentation of cellulose and sewage sludge.

O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Cambridge, UK: Royal Society of Chemistry, 2013., p. 1105

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

Pure carbon combines directly with pure hydrogen at temperatures above 1100 °C forming methane. Above 1500 °C amount of methane formed increases with temperature.

O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Cambridge, UK: Royal Society of Chemistry, 2013., p. 1105

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

From natural gas by absorption or adsorption

Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 810

► [Hazardous Substances Data Bank \(HSDB\)](#)

From coal mines for use as fuel gas.

Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 810

► [Hazardous Substances Data Bank \(HSDB\)](#)

For more Methods of Manufacturing (Complete) data for METHANE (8 total), please visit the [HSDB record page](#).

► [Hazardous Substances Data Bank \(HSDB\)](#)

8.3 Impurities



Methanol and carbon monoxide

CHEM ENG NEWS 63 (25): 25 1985

► [Hazardous Substances Data Bank \(HSDB\)](#)

8.4 Formulations / Preparations



Grades: Research 99.99%; CP /chemically pure/ 99%; technical 95%; Btu grade, which must have heating value of 1000 BTU/cu ft at 15.5 °C and a pressure of 30 inches of [mercury](#).

Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 810

► [Hazardous Substances Data Bank \(HSDB\)](#)

8.5 U.S. Production



Aggregated Product Volume

2023: 4,000,000,000 - <5,500,000,000 lb

2022: 4,000,000,000 - <5,500,000,000 lb

2021: 4,000,000,000 - <5,500,000,000 lb

2020: 4,000,000,000 - <5,500,000,000 lb

<https://www.epa.gov/chemical-data-reporting>

► [EPA Chemical Data Reporting \(CDR\)](#)

(1972) 2.25X10+13 CU FT (NATURAL GAS)

SRI

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

(1975) 2.01X10+13 CU FT (NATURAL GAS)

SRI

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

(1982) 509.1 MILLION BARRELS

BUREAU OF THE CENSUS. CENSUS OF MINERAL INDUSTRIES 1982: NATURAL GAS LIQUIDS

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

Methane is listed as a High Production Volume (HPV) chemical (65FR81686). Chemicals listed as HPV were produced in or imported into the U.S. in >1 million pounds in 1990 and/or 1994. The HPV list is based on the 1990 Inventory Update Rule. (IUR) (40 CFR part 710 subpart B; 51FR21438).

EPA/Office of Pollution Prevention and Toxics; High Production Volume (HPV) Challenge Program. Methane (74-82-8). Available from, as of November 4, 2013: <https://www.epa.gov/hpv/pubs/general/opptsrch.htm>

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

For more U.S. Production (Complete) data for METHANE (7 total), please visit the [HSDB record page](#).

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

8.6 U.S. Imports



(1972) 1.02X10+12 CU FT (NATURAL GAS)

SRI

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

(1975) 9.7X10+11 CU FT (NATURAL GAS)

SRI

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

(1984) 3.80X10+11 g /NATURAL GAS, METHANE AND MIXTURES THEREOF INCLUDING SYNTHETIC NATURAL GAS/

BUREAU OF THE CENSUS. FOREIGN TRADE DIVISION - TRADE INFORMATION OFFICE

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

(1986) 7.26X10+8 mcf /Natural gas, methane and mixtures thereof including synthetic natural gas/

BUREAU OF THE CENSUS. US IMPORTS FOR CONSUMPTION AND GENERAL IMPORTS 1986 P.1-554

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

8.7 U.S. Exports



(1972) 7.8X10+10 CU FT (NATURAL GAS)

SRI

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

(1975) 7.0X10+10 CU FT (NATURAL GAS)

SRI

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

(1984) 1.70X10+11 g /NATURAL GAS, METHANE AND MIXTURES THERE OF INCLUDING SYNTHETIC NATURAL GAS/

BUREAU OF THE CENSUS. FOREIGN TRADE DIVISION - TRADE INFORMATION OFFICE

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

8.8 General Manufacturing Information



Industry Processing Sectors

Utilities
Plastics Product Manufacturing
Wholesale and Retail Trade
Plastics Material and Resin Manufacturing
Petroleum Refineries
Not Known or Reasonably Ascertainable
All Other Chemical Product and Preparation Manufacturing
Petrochemical Manufacturing
Industrial Gas Manufacturing

All Other Basic Organic Chemical Manufacturing

▶ [EPA Chemical Data Reporting \(CDR\)](#)

EPA TSCA Commercial Activity Status

Methane: ACTIVE

▶ [EPA Chemicals under the TSCA](#)

American natural gas is about 85% methane.

O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Cambridge, UK: Royal Society of Chemistry, 2013., p. 1105

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

Due to environmental pressures, the use of methane in the production of several halogenated products is decreasing rapidly

Eastman AD, Mears D; Hydrocarbons, C1-C6. Kirk-Othmer Encyclopedia of Chemical Technology. (1999-2013). New York, NY: John Wiley & Sons. Online Posting Date: 4 Dec 2000

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

9 Identification



9.1 Analytic Laboratory Methods



Headspace gas chromatography (GC) has been used to determine the concn of methane in the atmosphere. Detector tubes using a colorimetric assay and direct reading instruments (eg flame ionization detection, catalytic combustion, and thermal conductivity detection) have also been used to determine methane concn in the air.

Snyder, R. (ed.) Ethel Browning's Toxicity and Metabolism of Industrial Solvents. 2nd ed. Volume 1: Hydrocarbons. Amsterdam - New York - Oxford: Elsevier, 1987., p. 256

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

9.2 Clinical Laboratory Methods



Because of its volatility, methane concn are easily determined /in blood and tissues/ using headspace GC (gas chromatography) techniques.

Snyder, R. (ed.) Ethel Browning's Toxicity and Metabolism of Industrial Solvents. 2nd ed. Volume 1: Hydrocarbons. Amsterdam - New York - Oxford: Elsevier, 1987., p. 256

► Hazardous Substances Data Bank (HSDB)

10 Safety and Hazards



10.1 Hazards Identification



10.1.1 GHS Classification



1 of 6 items		View All
Pictogram(s)	 Flammable Compressed Gas	
Signal	<u>Danger</u>	
GHS Hazard Statements	H220: Extremely flammable gas [<u>Danger</u> Flammable gases]	
Precautionary Statement Codes	P203, P210, P222, P280, P377, P381, and P403 (click each P-code to see the statement)	

► Regulation (EC) No 1272/2008 of the European Parliament and of the Council

10.1.2 Hazard Classes and Categories



Aquatic Chronic 2 (100%)

► European Chemicals Agency (ECHA)

View More...

10.1.3 NFPA Hazard Classification



NFPA 704 Diamond	
	2-4-0

NFPA Health Rating	2 - Materials that, under emergency conditions, can cause temporary incapacitation or residual injury.
NFPA Fire Rating	4 - Materials that rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air and burn readily.
NFPA Instability Rating	0 - Materials that in themselves are normally stable, even under fire conditions.

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.1.4 DOT Hazard Classification



1 of 2 items		View All
Substance (Descriptions/Shipping Name)	Methane, compressed or Natural gas, compressed (with high methane content)	
DOT ID (UN/NA Number)	UN1971	
Hazard Class/Label Code(s)	Div 2.1 Flammable gas (49 eCFR § 173.115)	
Placard/Label(s)		

► [US Code of Federal Regulations, Hazardous Materials, 49 CFR Part 172](#)

10.1.5 Health Hazards



If concentration of gas is high enough, may cause asphyxiation. No detectable systemic effects, even at 5% concentration in air. (USCG, 1999)

U.S. Coast Guard. 1999. Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data. Commandant Instruction 16465.12C. Washington, D.C.: U.S. Government Printing Office.

► [CAMEO Chemicals](#)

High concentrations may cause asphyxiation. No systemic effects, even at 5% concentration in air. (USCG, 1999)

U.S. Coast Guard. 1999. *Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data. Commandant Instruction 16465.12C. Washington, D.C.: U.S. Government Printing Office.*

► CAMEO Chemicals

Excerpt from ERG Guide 115 [Gases - Flammable (Including Refrigerated Liquids)]:

Vapors may cause dizziness or asphyxiation without warning, especially when in closed or confined areas. Some may be irritating if inhaled at high concentrations. Contact with gas, liquefied gas or cryogenic liquids may cause burns, severe injury and/or frostbite. Fire may produce irritating and/or toxic gases. (ERG, 2024)

2024 Emergency Response Guidebook, <https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg>

2024 Emergency Response Guidebook, <https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg>

► CAMEO Chemicals

ERG2024, Guide 115 (Methane, refrigerated liquid (cryogenic liquid); Methane, compressed)

- Vapors may cause dizziness or asphyxiation without warning, especially when in closed or confined areas.
- Some may be irritating if inhaled at high concentrations.
- Contact with gas, liquefied gas or cryogenic liquids may cause burns, severe injury and/or frostbite.
- Fire may produce irritating and/or toxic gases.

► Emergency Response Guidebook (ERG)



10.1.6 Fire Hazards

Excerpt from ERG Guide 115 [Gases - Flammable (Including Refrigerated Liquids)]:

EXTREMELY FLAMMABLE. Will be easily ignited by heat, sparks or flames. Will form explosive mixtures with air. Vapors from liquefied gas are initially heavier than air and spread along ground. CAUTION: Hydrogen (UN1049), Deuterium (UN1957), Hydrogen, refrigerated liquid (UN1966), Methane (UN1971) and Hydrogen and Methane mixture, compressed (UN2034) are lighter than air and will rise. Hydrogen and Deuterium fires are difficult to detect since they burn with an invisible flame. Use an alternate method of detection (thermal camera, broom handle, etc.) Vapors may travel to source of ignition and flash back. Cylinders exposed to fire may vent and release flammable gas through pressure relief devices. Containers may explode when heated. Ruptured cylinders may rocket. CAUTION: When LNG - Liquefied natural gas (UN1972) is released on or near water, product may vaporize explosively. (ERG, 2024)

2024 Emergency Response Guidebook, <https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg>

2024 Emergency Response Guidebook, <https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg>

2024 Emergency Response Guidebook, <https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg>

► CAMEO Chemicals

Special Hazards of Combustion Products: None (USCG, 1999)

U.S. Coast Guard. 1999. *Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data. Commandant Instruction 16465.12C*. Washington, D.C.: U.S. Government Printing Office.

► CAMEO Chemicals

ERG2024, Guide 115 (Methane, refrigerated liquid (cryogenic liquid); Methane, compressed)

· EXTREMELY FLAMMABLE.

· Will be easily ignited by heat, sparks or flames.

· Will form explosive mixtures with air.

· Vapors from liquefied gas are initially heavier than air and spread along ground.

CAUTION: Hydrogen (UN1049), Deuterium (UN1957), Hydrogen, refrigerated liquid (UN1966), Methane (UN1971) and Hydrogen and Methane mixture, compressed (UN2034) are lighter than air and will rise. Hydrogen and Deuterium fires are difficult to detect since they burn with an invisible flame. Use an alternate method of detection (thermal camera, broom handle, etc.)

· Vapors may travel to source of ignition and flash back.

· Cylinders exposed to fire may vent and release flammable gas through pressure relief devices.

· Containers may explode when heated.

· Ruptured cylinders may rocket.

CAUTION: When LNG - Liquefied natural gas (UN1972) is released on or near water, product may vaporize explosively.

► Emergency Response Guidebook (ERG)

Extremely flammable. Gas/air mixtures are explosive.

► ILO-WHO International Chemical Safety Cards (ICSCs)

10.1.7 Hazards Summary



The Critical Effects for aliphatic hydrocarbon gases are CNS depression and cardiac sensitization. From a toxicologic standpoint, methane and ethane are practically inert; however, at very high concentrations, they act as a simple asphyxiant and can cause suffocation by displacement of oxygen from breathing atmosphere, below the critical level of 16% oxygen that is required to sustain life. [ACGIH] Simple asphyxiant; Evaporating liquid can cause frostbite; [ICSC]

ACGIH - Documentation of the TLVs and BEIs, 7th Ed. Cincinnati: ACGIH Worldwide, 2020.

► Haz-Map, Information on Hazardous Chemicals and Occupational Diseases

10.1.8 Fire Potential



Very dangerous fire and explosion hazard when exposed to heat or flame.

Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 2331

► Hazardous Substances Data Bank (HSDB)

Flammable in the presence of an oxidizing gas (eg air), a source of ignition, and when the concentration of the gas is between the lower and upper explosive limits. Keep away from heat/sparks/open flame/hotsurface/oxidizing gas. No smoking.

Sigma-Aldrich Material Safety Data Sheet for methane. Product number 295477. Version 3.3. (December 5, 2012). Available from, as of November 6, 2013.

<https://www.sigmaaldrich.com/catalog/product/aldrich/295477?lang=en®ion=US>

► Hazardous Substances Data Bank (HSDB)

10.2 Safety and Hazard Properties



10.2.1 Flammable Limits



Lower flammable limit: 5.3% by volume; Upper flammable limit: 14.0% by volume.

National Fire Protection Association; Fire Protection Guide to Hazardous Materials. 14TH Edition, Quincy, MA 2010, p. 49-106

► Hazardous Substances Data Bank (HSDB)

10.2.2 Lower Explosive Limit (LEL)



5.3 % (USCG, 1999)

U.S. Coast Guard. 1999. Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data. Commandant Instruction 16465.12C. Washington, D.C.: U.S. Government Printing Office.

► [CAMEO Chemicals](#)

5 % (NTP, 1992)

National Toxicology Program, Institute of Environmental Health Sciences, National Institutes of Health (NTP). 1992. National Toxicology Program Chemical Repository Database. Research Triangle Park, North Carolina.

► [CAMEO Chemicals](#)

50000 [ppm]

► [PAC Chemical Database, U.S. Department of Energy](#)

10.2.3 Upper Explosive Limit (UEL)



14 % (USCG, 1999)

U.S. Coast Guard. 1999. Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data. Commandant Instruction 16465.12C. Washington, D.C.: U.S. Government Printing Office.

► [CAMEO Chemicals](#)

15 % (NTP, 1992)

National Toxicology Program, Institute of Environmental Health Sciences, National Institutes of Health (NTP). 1992. National Toxicology Program Chemical Repository Database. Research Triangle Park, North Carolina.

► [CAMEO Chemicals](#)

10.2.4 Critical Temperature and Pressure



Critical temperature: -82.25 °C; critical pressure: 45.8 atm

O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Cambridge, UK: Royal Society of Chemistry, 2013., p. 1105

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.2.5 Physical Dangers



The gas is lighter than air.

- ▶ ILO-WHO International Chemical Safety Cards (ICSCs)

10.2.6 Explosive Limits and Potential



Severe fire and explosion hazard, forms explosive mixture with air (5-15% by volume).

Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 810

- ▶ Hazardous Substances Data Bank (HSDB)

Very dangerous fire and explosion hazard when exposed to heat or flame.

Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 2331

- ▶ Hazardous Substances Data Bank (HSDB)

Forms explosive mixtures with air, the loudest explosions occur when one volume of methane is mixed with ten volumes of air (or two volumes of **oxygen**). Air containing less than 5.53% methane no longer explodes. Air containing more than 14% methane burns without noise.

O'Neil, M.J. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Cambridge, UK: Royal Society of Chemistry, 2013., p. 1105

- ▶ Hazardous Substances Data Bank (HSDB)

Explosive limits , vol% in air: 5-15

- ▶ ILO-WHO International Chemical Safety Cards (ICSCs)

10.2.7 OSHA Standards



Permissible Exposure Limit: Simple asphyxiant. The limiting factor is the available **oxygen** which shall be at least 18% and be within the requirement addressing explosion in subpart B of part 1915.

29 CFR 1915.1000 (USDOL); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of October 18, 2013: <https://www.ecfr.gov/cgi-bin/ECFR?page=browse>

- ▶ Hazardous Substances Data Bank (HSDB)



10.3 First Aid Measures

Inhalation First Aid

Fresh air, rest. Artificial respiration may be needed. Refer for medical attention.

- ▶ [ILO-WHO International Chemical Safety Cards \(ICSCs\)](#)

Skin First Aid

ON FROSTBITE: rinse with plenty of [water](#), do NOT remove clothes. Refer for medical attention

- ▶ [ILO-WHO International Chemical Safety Cards \(ICSCs\)](#)

Eye First Aid

First rinse with plenty of [water](#) for several minutes (remove contact lenses if easily possible), then refer for medical attention.

- ▶ [ILO-WHO International Chemical Safety Cards \(ICSCs\)](#)



10.3.1 First Aid

Remove victim to open air. If he is overcome by gas, apply artificial resuscitation. (USCG, 1999)

U.S. Coast Guard. 1999. Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data. Commandant Instruction 16465.12C. Washington, D.C.: U.S. Government Printing Office.

- ▶ [CAMEO Chemicals](#)

EYES: First check the victim for contact lenses and remove if present. Flush victim's eyes with [water](#) or [normal saline](#) solution for 20 to 30 minutes while simultaneously calling a hospital or poison control center. Do not put any ointments, oils, or medication in the victim's eyes without specific instructions from a physician. IMMEDIATELY transport the victim after flushing eyes to a hospital even if no symptoms (such as redness or irritation) develop.

SKIN: CAUTION: Exposure of skin to compressed gases may result in freezing of the skin. Treatment for frostbite may be necessary. Remove the victim from the source of contamination. IMMEDIATELY wash affected areas gently with COLD [water](#) (and soap, if necessary) while removing and isolating all contaminated clothing. Dry carefully with clean, soft towels. If symptoms such as inflammation or irritation develop, IMMEDIATELY call a physician or go to a hospital for treatment.

INHALATION: IMMEDIATELY leave the contaminated area; take deep breaths of fresh air. If symptoms (such as wheezing, coughing, shortness of breath, or burning in the mouth, throat,

or chest) develop, call a physician and be prepared to transport the victim to a hospital. Provide proper respiratory protection to rescuers entering an unknown atmosphere. Whenever possible, Self-Contained Breathing Apparatus (SCBA) should be used; if not available, use a level of protection greater than or equal to that advised under Protective Clothing.

INGESTION: This compound is a gas, therefore inhalation is the first route of exposure. (NTP, 1992)

National Toxicology Program, Institute of Environmental Health Sciences, National Institutes of Health (NTP). 1992. National Toxicology Program Chemical Repository Database. Research Triangle Park, North Carolina.

► CAMEO Chemicals

Excerpt from ERG Guide 115 [Gases - Flammable (Including Refrigerated Liquids)]:

Refer to the "General First Aid" section. Specific First Aid: Clothing frozen to the skin should be thawed before being removed. In case of contact with liquefied gas, only medical personnel should attempt thawing frosted parts. In case of burns, immediately cool affected skin for as long as possible with cold water. Do not remove clothing if adhering to skin. (ERG, 2024)

2024 Emergency Response Guidebook, <https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg>

2024 Emergency Response Guidebook, <https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg>

► CAMEO Chemicals

ERG2024, Guide 115 (Methane, refrigerated liquid (cryogenic liquid); Methane, compressed)

General First Aid:

- Call 911 or emergency medical service.
- Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and avoid contamination.
- Move victim to fresh air if it can be done safely.
- Administer oxygen if breathing is difficult.
- If victim is not breathing:
 - DO NOT perform mouth-to-mouth resuscitation; the victim may have ingested or inhaled the substance.
 - If equipped and pulse detected, wash face and mouth, then give artificial respiration using a proper respiratory medical device (bag-valve mask, pocket mask equipped with a one-way valve or other device).
 - If no pulse detected or no respiratory medical device available, provide continuous compressions. Conduct a pulse check every two minutes or monitor for any signs of spontaneous respirations.

- Remove and isolate contaminated clothing and shoes.
- For minor skin contact, avoid spreading material on unaffected skin.
- In case of contact with substance, remove immediately by flushing skin or eyes with running water for at least 20 minutes.
- For severe burns, immediate medical attention is required.
- Effects of exposure (inhalation, ingestion, or skin contact) to substance may be delayed.
- Keep victim calm and warm.
- Keep victim under observation.
- For further assistance, contact your local Poison Control Center.
- Note: Basic Life Support (BLS) and Advanced Life Support (ALS) should be done by trained professionals.

Specific First Aid:

- Clothing frozen to the skin should be thawed before being removed.
- In case of contact with liquefied gas, only medical personnel should attempt thawing frosted parts.
- In case of burns, immediately cool affected skin for as long as possible with cold water. Do not remove clothing if adhering to skin.

In Canada, an Emergency Response Assistance Plan (ERAP) may be required for this product. Please consult the shipping paper and/or the "ERAP" section.

▶ [Emergency Response Guidebook \(ERG\)](#)

10.4 Fire Fighting



Excerpt from ERG Guide 115 [Gases - Flammable (Including Refrigerated Liquids)]:

DO NOT EXTINGUISH A LEAKING GAS FIRE UNLESS LEAK CAN BE STOPPED. CAUTION:

Hydrogen (UN1049), Deuterium (UN1957), Hydrogen, refrigerated liquid (UN1966) and Hydrogen and Methane mixture, compressed (UN2034) will burn with an invisible flame. Use an alternate method of detection (thermal camera, broom handle, etc.).

SMALL FIRE: Dry chemical or CO2.

LARGE FIRE: Water spray or fog. If it can be done safely, move undamaged containers away from the area around the fire. CAUTION: For LNG - Liquefied natural gas (UN1972) pool fires, DO NOT USE water. Use dry chemical or high-expansion foam.

FIRE INVOLVING TANKS: Fight fire from maximum distance or use unmanned master stream devices or monitor nozzles. Cool containers with flooding quantities of water until well after fire is out. Do not direct water at source of leak or safety devices; icing may occur. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.

ALWAYS stay away from tanks in direct contact with flames. For massive fire, use unmanned master stream devices or monitor nozzles; if this is impossible, withdraw from area and let fire burn. (ERG, 2024)

2024 Emergency Response Guidebook, <https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg>

2024 Emergency Response Guidebook, <https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg>

2024 Emergency Response Guidebook, <https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg>

2024 Emergency Response Guidebook, <https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg>

► CAMEO Chemicals

Shut off supply; if not possible and no risk to surroundings, let the fire burn itself out. In other cases extinguish with [water](#) spray, powder, [carbon dioxide](#). In case of fire: keep cylinder cool by spraying with [water](#). Combat fire from a sheltered position.

► ILO-WHO International Chemical Safety Cards (ICSCs)

10.4.1 Fire Fighting Procedures



Wear self contained breathing apparatus for fire fighting if necessary.

Sigma-Aldrich Material Safety Data Sheet for methane. Product number 295477. Version 3.3. (December 5, 2012). Available from, as of November 6, 2013.

<https://www.sigmaaldrich.com/catalog/product/aldrich/295477?lang=en®ion=US>

► Hazardous Substances Data Bank (HSDB)

Use [water](#) spray, alcohol-resistant foam, dry chemical or [carbon dioxide](#).

Sigma-Aldrich Material Safety Data Sheet for methane. Product number 295477. Version 3.3. (December 5, 2012). Available from, as of November 6, 2013.

<https://www.sigmaaldrich.com/catalog/product/aldrich/295477?lang=en®ion=US>

► Hazardous Substances Data Bank (HSDB)

10.5 Accidental Release Measures



Public Safety: ERG2024, Guide 115 (Methane, refrigerated liquid (cryogenic liquid); Methane, compressed)

- CALL 911. Then call emergency response telephone number on shipping paper. If shipping paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.
- Keep unauthorized personnel away.
- Stay upwind, uphill and/or upstream.
- Many gases are heavier than air and will spread along the ground and collect in low or confined areas (sewers, basements, tanks, etc.).

▶ [Emergency Response Guidebook \(ERG\)](#)

Spill or Leak: ERG2024, Guide 115 (Methane, refrigerated liquid (cryogenic liquid); Methane, compressed)

- ELIMINATE all ignition sources (no smoking, flares, sparks or flames) from immediate area.
- All equipment used when handling the product must be grounded.
- Do not touch or walk through spilled material.
- Stop leak if you can do it without risk.
- If possible, turn leaking containers so that gas escapes rather than liquid.
- Use [water](#) spray to reduce vapors or divert vapor cloud drift. Avoid allowing [water](#) runoff to contact spilled material.
- Do not direct [water](#) at spill or source of leak.

CAUTION: For LNG - Liquefied natural gas (UN1972), DO NOT apply [water](#), regular or alcohol-resistant foam directly on spill. Use a high-expansion foam if available to reduce vapors.

- Prevent spreading of vapors through sewers, ventilation systems and confined areas.
- Isolate area until gas has dispersed.

CAUTION: When in contact with refrigerated/cryogenic liquids, many materials become brittle and are likely to break without warning.

▶ [Emergency Response Guidebook \(ERG\)](#)

10.5.1 Isolation and Evacuation



Excerpt from ERG Guide 115 [Gases - Flammable (Including Refrigerated Liquids)]:

IMMEDIATE PRECAUTIONARY MEASURE: Isolate spill or leak area for at least 100 meters (330 feet) in all directions.

LARGE SPILL: Consider initial downwind evacuation for at least 800 meters (1/2 mile).

FIRE: If tank, rail tank car or highway tank is involved in a fire, ISOLATE for 1600 meters (1 mile) in all directions; also, consider initial evacuation for 1600 meters (1 mile) in all directions. In fires involving Liquefied Petroleum Gases (LPG) (UN1075), [Butane \(UN1011\)](#), Butylene

(UN1012), Isobutylene (UN1055), Propylene (UN1077), Isobutane (UN1969), and Propane (UN1978), also refer to the "BLEVE - Safety Precautions" section. (ERG, 2024)

2024 Emergency Response Guidebook, <https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg>

2024 Emergency Response Guidebook, <https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg>

2024 Emergency Response Guidebook, <https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg>

2024 Emergency Response Guidebook, <https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg>

► CAMEO Chemicals

Evacuation: ERG2024, Guide 115 (Methane, refrigerated liquid (cryogenic liquid); Methane, compressed)

Immediate precautionary measure

- Isolate spill or leak area for at least 100 meters (330 feet) in all directions.

Large Spill

- Consider initial downwind evacuation for at least 800 meters (1/2 mile).

Fire

- If tank, rail tank car or highway tank is involved in a fire, ISOLATE for 1600 meters (1 mile) in all directions; also, consider initial evacuation for 1600 meters (1 mile) in all directions.
- In fires involving Liquefied Petroleum Gases (LPG) (UN1075), Butane (UN1011), Butylene (UN1012), Isobutylene (UN1055), Propylene (UN1077), Isobutane (UN1969), and Propane (UN1978), also refer to the "BLEVE - Safety Precautions" section.

► Emergency Response Guidebook (ERG)



10.5.2 Spillage Disposal

Evacuate danger area! Personal protection: self-contained breathing apparatus. Consult an expert! Ventilation. Remove all ignition sources. NEVER direct water jet on liquid.

► ILO-WHO International Chemical Safety Cards (ICSCs)



10.5.3 Cleanup Methods

Clean up promptly by sweeping or vacuum.

Sigma-Aldrich Material Safety Data Sheet for methane. Product number 295477. Version 3.3. (December 5, 2012). Available from, as of November 6, 2013.

<https://www.sigmaaldrich.com/catalog/product/aldrich/295477?lang=en®ion=US>

► [Hazardous Substances Data Bank \(HSDB\)](#)

Do not let product enter drains.

Sigma-Aldrich Material Safety Data Sheet for methane. Product number 295477. Version 3.3. (December 5, 2012). Available from, as of November 6, 2013.

<https://www.sigmaaldrich.com/catalog/product/aldrich/295477?lang=en®ion=US>

► [Hazardous Substances Data Bank \(HSDB\)](#)

Evacuate danger area! Personal protection: self-contained breathing apparatus. Consult an expert! Ventilation. Remove all ignition sources. NEVER direct water jet on liquid.

IPCS, CEC; International Chemical Safety Card on methane. (October 2, 2000). Available from, as of November 6, 2013. <https://www.inchem.org/documents/icsc/icsc/eics0291.htm>

► [Hazardous Substances Data Bank \(HSDB\)](#)

By forced ventilation, maintain concn of gas below the range of explosive mixture. Remove the tank or cylinder to an open area. Leave to bleed off in the atmosphere.

ITII. Toxic and Hazardous Industrial Chemicals Safety Manual. Tokyo, Japan: The International Technical Information Institute, 1982., p. 321

► [Hazardous Substances Data Bank \(HSDB\)](#)



10.5.4 Disposal Methods

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Sigma-Aldrich Material Safety Data Sheet for methane. Product number 295477. Version 3.3. (December 5, 2012). Available from, as of November 6, 2013.

<https://www.sigmaaldrich.com/catalog/product/aldrich/295477?lang=en®ion=US>

► [Hazardous Substances Data Bank \(HSDB\)](#)

SRP: The most favorable course of action is to use an alternative chemical product with less inherent propensity for occupational exposure or environmental contamination. Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations.

► Hazardous Substances Data Bank (HSDB)

10.6 Handling and Storage



10.6.1 Nonfire Spill Response



Excerpt from ERG Guide 115 [Gases - Flammable (Including Refrigerated Liquids)]:

ELIMINATE all ignition sources (no smoking, flares, sparks or flames) from immediate area. All equipment used when handling the product must be grounded. Do not touch or walk through spilled material. Stop leak if you can do it without risk. If possible, turn leaking containers so that gas escapes rather than liquid. Use [water](#) spray to reduce vapors or divert vapor cloud drift. Avoid allowing [water](#) runoff to contact spilled material. Do not direct [water](#) at spill or source of leak. CAUTION: For LNG - Liquefied natural gas (UN1972), DO NOT apply [water](#), regular or alcohol-resistant foam directly on spill. Use a high-expansion foam if available to reduce vapors. Prevent spreading of vapors through sewers, ventilation systems and confined areas. Isolate area until gas has dispersed. CAUTION: When in contact with refrigerated/cryogenic liquids, many materials become brittle and are likely to break without warning. (ERG, 2024)

2024 Emergency Response Guidebook, <https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg>

2024 Emergency Response Guidebook, <https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg>

2024 Emergency Response Guidebook, <https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg>

2024 Emergency Response Guidebook, <https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg>

► CAMEO Chemicals

10.6.2 Safe Storage



Fireproof. Cool. Ventilation along the floor and ceiling.

► ILO-WHO International Chemical Safety Cards (ICSCs)

10.6.3 Storage Conditions



Store in a cool, dry, well-ventilated location. Separate from halogens and [oxygen](#). Outside or detached storage is preferred.

National Fire Protection Association; Fire Protection Guide to Hazardous Materials. 14TH Edition, Quincy, MA 2010, p. 49-106

► [Hazardous Substances Data Bank \(HSDB\)](#)

Protect against physical damage. ... Isolate from oxidizing agents. Prohibit open flame. Inspect for leakage occasionally.

ITII. Toxic and Hazardous Industrial Chemicals Safety Manual. Tokyo, Japan: The International Technical Information Institute, 1982., p. 320

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.7 Exposure Control and Personal Protection



Protective Clothing: ERG2024, Guide 115 (Methane, refrigerated liquid (cryogenic liquid); Methane, compressed)

- Wear positive pressure self-contained breathing apparatus (SCBA).
- Structural firefighters' protective clothing provides thermal protection but only limited chemical protection.
- Always wear thermal protective clothing when handling refrigerated/cryogenic liquids.

► [Emergency Response Guidebook \(ERG\)](#)

10.7.1 Protective Action Criteria (PAC)



► [EPA Toxicity Values Database \(ToxValDB\)](#)

PAC-1

2292 [ppm]

- ▶ [PAC Chemical Database, U.S. Department of Energy](#)

PAC-2

25000 [ppm]

- ▶ [PAC Chemical Database, U.S. Department of Energy](#)

PAC-3

150000 [ppm]

- ▶ [PAC Chemical Database, U.S. Department of Energy](#)

10.7.2 Threshold Limit Values (TLV)



Minimal **Oxygen** Content. ACGIH recommends a minimal ambient **oxygen** partial pressure of 132 torr, which is protective against inert **oxygen**-displacing gases and **oxygen**-consuming processes for altitudes up to 5000 feet.

American Conference of Governmental Industrial Hygienists. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. ACGIH, Cincinnati, OH 2014, p. 38

- ▶ [Hazardous Substances Data Bank \(HSDB\)](#)

10.7.3 Emergency Response Planning Guidelines



Emergency Response: ERG2024, Guide 115 (Methane, refrigerated liquid (cryogenic liquid); Methane, compressed)

- DO NOT EXTINGUISH A LEAKING GAS FIRE UNLESS LEAK CAN BE STOPPED.

CAUTION: **Hydrogen** (UN1049), **Deuterium** (UN1957), **Hydrogen**, refrigerated liquid (UN1966) and **Hydrogen** and Methane mixture, compressed (UN2034) will burn with an invisible flame. Use an alternate method of detection (thermal camera, broom handle, etc.)

Small Fire

- Dry chemical or CO₂.

Large Fire

- Water spray or fog.
- If it can be done safely, move undamaged containers away from the area around the fire.

CAUTION: For LNG - Liquefied natural gas (UN1972) pool fires, DO NOT USE [water](#). Use dry chemical or high-expansion foam.

Fire Involving Tanks

- Fight fire from maximum distance or use unmanned master stream devices or monitor nozzles.
- Cool containers with flooding quantities of [water](#) until well after fire is out.
- Do not direct [water](#) at source of leak or safety devices; icing may occur.
- Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.
- ALWAYS stay away from tanks in direct contact with flames.
- For massive fire, use unmanned master stream devices or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

▶ [Emergency Response Guidebook \(ERG\)](#)

10.7.4 Inhalation Risk



On loss of containment this substance can cause suffocation by lowering the [oxygen](#) content of the air in confined areas.

▶ [ILO-WHO International Chemical Safety Cards \(ICSCs\)](#)

10.7.5 Effects of Short Term Exposure



Rapid evaporation of the liquid may cause frostbite.

▶ [ILO-WHO International Chemical Safety Cards \(ICSCs\)](#)

10.7.6 Personal Protective Equipment (PPE)



Self-contained breathing apparatus; protective clothing if exposed to liquid. (USCG, 1999)

U.S. Coast Guard. 1999. Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data. Commandant Instruction 16465.12C. Washington, D.C.: U.S. Government Printing Office.

▶ [CAMEO Chemicals](#)

Self-contained breathing apparatus for high concentrations; protective clothing if exposed to liquid. (USCG, 1999)

U.S. Coast Guard. 1999. *Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data. Commandant Instruction 16465.12C*. Washington, D.C.: U.S. Government Printing Office.

► CAMEO Chemicals

Excerpt from ERG Guide 115 [Gases - Flammable (Including Refrigerated Liquids)]:

Wear positive pressure self-contained breathing apparatus (SCBA). Structural firefighters' protective clothing provides thermal protection but only limited chemical protection. Always wear thermal protective clothing when handling refrigerated/cryogenic liquids. (ERG, 2024)

2024 Emergency Response Guidebook, <https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg>

2024 Emergency Response Guidebook, <https://www.phmsa.dot.gov/training/hazmat/erg/emergency-response-guidebook-erg>

► CAMEO Chemicals

Skin and body protection: Impervious clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Sigma-Aldrich Material Safety Data Sheet for methane. Product number 295477. Version 3.3. (December 5, 2012). Available from, as of November 6, 2013.

<https://www.sigmaaldrich.com/catalog/product/aldrich/295477?lang=en®ion=US>

► Hazardous Substances Data Bank (HSDB)

Eye protection: Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Sigma-Aldrich Material Safety Data Sheet for methane. Product number 295477. Version 3.3. (December 5, 2012). Available from, as of November 6, 2013.

<https://www.sigmaaldrich.com/catalog/product/aldrich/295477?lang=en®ion=US>

► Hazardous Substances Data Bank (HSDB)

Hand protection: Handle with gloves.

Sigma-Aldrich Material Safety Data Sheet for methane. Product number 295477. Version 3.3. (December 5, 2012). Available from, as of November 6, 2013.

<https://www.sigmaaldrich.com/catalog/product/aldrich/295477?lang=en®ion=US>

► Hazardous Substances Data Bank (HSDB)

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).

Sigma-Aldrich Material Safety Data Sheet for methane. Product number 295477. Version 3.3. (December 5, 2012). Available from, as of November 6, 2013.

<https://www.sigmaaldrich.com/catalog/product/aldrich/295477?lang=en®ion=US>

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.7.7 Fire Prevention



NO open flames, NO sparks and NO smoking. Closed system, ventilation, explosion-proof electrical equipment and lighting. Use non-sparking handtools.

► [ILO-WHO International Chemical Safety Cards \(ICSCs\)](#)

10.7.8 Inhalation Prevention



Use ventilation. Use breathing protection.

► [ILO-WHO International Chemical Safety Cards \(ICSCs\)](#)

10.7.9 Skin Prevention



Cold-insulating gloves.

► [ILO-WHO International Chemical Safety Cards \(ICSCs\)](#)

10.7.10 Eye Prevention



Wear safety goggles.

► [ILO-WHO International Chemical Safety Cards \(ICSCs\)](#)

10.8 Stability and Reactivity



10.8.1 Air and Water Reactions



Highly flammable.

▶ [CAMEO Chemicals](#)

Highly flammable. Insoluble in [water](#).

▶ [CAMEO Chemicals](#)

10.8.2 Reactive Group



Hydrocarbons, Aliphatic Saturated

▶ [CAMEO Chemicals](#)

10.8.3 Reactivity Alerts



Highly Flammable

▶ [CAMEO Chemicals](#)

Highly Flammable

Strong Reducing Agent

▶ [CAMEO Chemicals](#)

10.8.4 Reactivity Profile



Contact of very cold liquefied gas with [water](#) may result in vigorous or violent boiling of the product and extremely rapid vaporization due to the large temperature differences involved. If the [water](#) is hot, there is the possibility that a liquid "superheat" explosion may occur. Pressures may build to dangerous levels if liquid gas contacts [water](#) in a closed container [Handling Chemicals Safely 1980].

▶ [CAMEO Chemicals](#)

METHANE is a reducing agent, it is involved in many explosions when combined with especially powerful oxidizers such as [bromine pentafluoride](#), [chlorine trifluoride](#), [chlorine](#), [iodine](#), [heptafluoride](#), [dioxygenyl tetrafluoroborate](#), [dioxygen difluoride](#), [trioxygen difluoride](#) and liquid [oxygen](#). Other violent reactions include, [chlorine dioxide](#) and [nitrogen trifluoride](#). Liquid [oxygen](#) gives an explosive mixture when combined with liquid methane [NFPA 1991]. Contact of very cold liquefied gas with [water](#) may result in vigorous or violent boiling of the product and extremely rapid vaporization due to the large temperature differences involved. If

the [water](#) is hot, there is the possibility that a liquid "superheat" explosion may occur. Pressures may build to dangerous levels if liquid gas contacts [water](#) in a closed container [Handling Chemicals Safely 1980].

► [CAMEO Chemicals](#)

Liquid [oxygen](#) gives an explosive mixture when combined with liquid methane [NFPA 1991]. Contact of very cold liquefied gas with [water](#) may result in vigorous or violent boiling of the product and extremely rapid vaporization due to the large temperature differences involved. If the [water](#) is hot, there is the possibility that a liquid "superheat" explosion may occur. Pressures may build to dangerous levels if liquid gas contacts [water](#) in a closed container [Handling Chemicals Safely 1980]. Involved in many explosions when combined with especially powerful oxidizers such as [bromine pentafluoride](#), [chlorine trifluoride](#), [chlorine](#), [iodine](#), [heptafluoride](#), [dioxygenyl tetrafluoroborate](#), [dioxygen difluoride](#), [trioxygen difluoride](#) and liquid [oxygen](#). Other violent reactions include, [chlorine dioxide](#) and [nitrogen trifluoride](#).

► [CAMEO Chemicals](#)

10.8.5 Hazardous Reactivities and Incompatibilities



... Reacts with [chlorine](#) and [bromine](#) in light (explosively in direct sunlight)

Lewis, R.J. Sr.; Hawley's Condensed Chemical Dictionary 15th Edition. John Wiley & Sons, Inc. New York, NY 2007., p. 810

► [Hazardous Substances Data Bank \(HSDB\)](#)

Explosive reactions occur upon ignition of mixtures of [nitrogen trifluoride](#) with good reducing agents such as ... methane.

National Fire Protection Association; Fire Protection Guide to Hazardous Materials. 14TH Edition, Quincy, MA 2010, p. 491-96

► [Hazardous Substances Data Bank \(HSDB\)](#)

Liquid [oxygen](#) gives an explosive mixture when combined with liquid methane.

National Fire Protection Association; Fire Protection Guide to Hazardous Materials. 14TH Edition, Quincy, MA 2010, p. 491-138

► [Hazardous Substances Data Bank \(HSDB\)](#)

The reaction of [chlorine](#) and methane is explosive at room temperature over yellow [mercuric oxide](#).

National Fire Protection Association; Fire Protection Guide to Hazardous Materials. 14TH Edition, Quincy, MA 2010, p. 491-53

► [Hazardous Substances Data Bank \(HSDB\)](#)

For more Hazardous Reactivities and Incompatibilities (Complete) data for METHANE (14 total), please visit the [HSDB record page](#).

► [Hazardous Substances Data Bank \(HSDB\)](#)

10.9 Transport Information



10.9.1 DOT Emergency Guidelines



/GUIDE 115: GASES - FLAMMABLE (INCLUDING REFRIGERATED LIQUIDS)/ Fire or Explosion: EXTREMELY FLAMMABLE. Will be easily ignited by heat, sparks or flames. Will form explosive mixtures with air. Vapors from liquefied gas are initially heavier than air and spread along ground. ... Vapors may travel to source of ignition and flash back. Cylinders exposed to fire may vent and release flammable gas through pressure relief devices. Containers may explode when heated. Ruptured cylinders may rocket. /Methane; Methane, compressed; Methane, refrigerated liquid (cryogenic liquid)/

U.S. Department of Transportation. 2012 Emergency Response Guidebook. Washington, D.C. 2012

► [Hazardous Substances Data Bank \(HSDB\)](#)

/GUIDE 115: GASES - FLAMMABLE (INCLUDING REFRIGERATED LIQUIDS)/ Health: Vapors may cause dizziness or asphyxiation without warning. Some may be irritating if inhaled at high concentrations. Contact with gas or liquefied gas may cause burns, severe injury and/or frostbite. Fire may produce irritating and/or toxic gases. /Methane; Methane, compressed; Methane, refrigerated liquid (cryogenic liquid)/

U.S. Department of Transportation. 2012 Emergency Response Guidebook. Washington, D.C. 2012

► [Hazardous Substances Data Bank \(HSDB\)](#)

/GUIDE 115: GASES - FLAMMABLE (INCLUDING REFRIGERATED LIQUIDS)/ Public Safety: CALL Emergency Response Telephone Number ... As an immediate precautionary measure, isolate spill or leak area for at least 100 meters (330 feet) in all directions. Keep unauthorized personnel away. Stay upwind. Many gases are heavier than air and will spread along ground and collect in low or confined areas (sewers, basements, tanks). Keep out of low areas. /Methane; Methane, compressed; Methane, refrigerated liquid (cryogenic liquid)/

U.S. Department of Transportation. 2012 Emergency Response Guidebook. Washington, D.C. 2012

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

/GUIDE 115: GASES - FLAMMABLE (INCLUDING REFRIGERATED LIQUIDS)/ Protective Clothing: Wear positive pressure self-contained breathing apparatus (SCBA). Structural firefighters' protective clothing will only provide limited protection. Always wear thermal protective clothing when handling refrigerated/cryogenic liquids. /Methane; Methane, compressed; Methane, refrigerated liquid (cryogenic liquid)/

U.S. Department of Transportation. 2012 Emergency Response Guidebook. Washington, D.C. 2012

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

For more DOT Emergency Guidelines (Complete) data for METHANE (8 total), please visit the [HSDB record page](#).

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

10.9.2 DOT ID and Guide



1972 115

▶ [Emergency Response Guidebook \(ERG\)](#)

1971 115

▶ [Emergency Response Guidebook \(ERG\)](#)

10.9.3 Shipping Name / Number DOT/UN/NA/IMO



UN 1971; Methane compressed

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

UN 1972; Methane, refrigerated liquid (cryogenic liquid)

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

IMO 2.1; Methane, refrigerated liquid (cryogenic liquid); methane compressed

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

10.9.4 Standard Transportation Number



49 057 55; Methane

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

49 057 56; Methane, cryogenic liquid

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

10.9.5 Shipment Methods and Regulations



No person may /transport,/ offer or accept a hazardous material for transportation in commerce unless that person is registered in conformance ... and the hazardous material is properly classed, described, packaged, marked, labeled, and in condition for shipment as required or authorized by ... /the hazardous materials regulations (49 CFR 171-177)./

49 CFR 171.2 (USDOT); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of November 4, 2013: <https://www.ecfr.gov/cgi-bin/ECFR?page=browse>

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

The International Air Transport Association (IATA) Dangerous Goods Regulations are published by the IATA Dangerous Goods Board pursuant to IATA Resolutions 618 and 619 and constitute a manual of industry carrier regulations to be followed by all IATA Member airlines when transporting hazardous materials.

International Air Transport Association. Dangerous Goods Regulations. 47th Edition. Montreal, Quebec Canada. 2006., p. 217

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

The International Maritime Dangerous Goods Code lays down basic principles for transporting hazardous chemicals. Detailed recommendations for individual substances and a number of recommendations for good practice are included in the classes dealing with such substances. A general index of technical names has also been compiled. This index should always be consulted when attempting to locate the appropriate procedures to be used when shipping any substance or article.

International Maritime Organization. IMDG Code. International Maritime Dangerous Goods Code Volume 2 2006, p. 95

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

10.9.6 DOT Label



Flammable Gas

- ▶ CAMEO Chemicals

10.9.7 EC Classification



Symbol: F+; R: 12; S: (2)-9-16-33

- ▶ ILO-WHO International Chemical Safety Cards (ICSCs)

10.9.8 UN Classification



UN Hazard Class: 2.1

- ▶ ILO-WHO International Chemical Safety Cards (ICSCs)

10.10 Regulatory Information



The Australian Inventory of Industrial Chemicals

Chemical: Methane

- ▶ Australian Industrial Chemicals Introduction Scheme (AICIS)

Methane is listed on the EPA's Chemical Data Reporting (CDR) system. Manufacturers and importers of Methane are required to report information about their production and use of this chemical to the EPA under the Toxic Substances Control Act (TSCA). (40 eCFR Part 711)

- ▶ EPA Chemical Data Reporting (CDR)

REACH Registered Substance

Status: Active Update: 23-03-2023 <https://echa.europa.eu/registration-dossier/-/registered-dossier/14250>

- ▶ European Chemicals Agency (ECHA)

New Zealand EPA Inventory of Chemical Status

Methane or natural gas but excluding refrigerated liquid methane or natural gas: HSNO
Approval: HSR001005 Approved with controls

- ▶ New Zealand Environmental Protection Authority (EPA)

New Jersey Worker and Community Right to Know Act

The New Jersey Worker and Community Right to Know Act requires public and private employers to provide information about hazardous substances at their workplaces. (N.J.S.A. 34:5A-1 et. seq.)

► [NJDOH RTK Hazardous Substance List](#)

10.10.1 DHS Chemicals of Interest (COI)



Chemicals of Interest(COI)	Methane
Release: Minimum Concentration (%)	1
Release: Screening Threshold Quantities (in pounds)	10000
Security Issue: Release - Flammables	Flammable chemical that can be released at a facility.

► [DHS Chemical Facility Anti-Terrorism Standards \(CFATS\) Chemicals of Interest](#)

10.11 Other Safety Information



Chemical Assessment

IMAP assessments - Methane: Human health tier I assessment

► [Australian Industrial Chemicals Introduction Scheme \(AICIS\)](#)

10.11.1 Toxic Combustion Products



Hazardous decomposition products formed under fire conditions. -Carbon oxides.

Sigma-Aldrich Material Safety Data Sheet for methane. Product number 295477. Version 3.3. (December 5, 2012). Available from, as of November 6, 2013.

<https://www.sigmaaldrich.com/catalog/product/aldrich/295477?lang=en®ion=US>

► [Hazardous Substances Data Bank \(HSDB\)](#)

11 Toxicity



11.1 Toxicological Information



11.1.1 Toxicity Summary



Methane is an asphyxiant and displaces [oxygen](#) in enclosed spaces. At high enough concentrations, [oxygen](#) depletion may cause asphyxiation. Low concentrations of surrounding [oxygen](#) results in deficient [oxygen](#) to the organs, compounded by increased [oxygen](#) exhalation during respiration. This results in generalized hypoxia and possibly death. (L171, A120)

▶ [Toxin and Toxin Target Database \(T3DB\)](#)

11.1.2 Carcinogen Classification



Carcinogen Classification	No indication of carcinogenicity to humans (not listed by IARC).
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▶ [Toxin and Toxin Target Database \(T3DB\)](#)

11.1.3 Health Effects



Methane is an asphyxiant and displaces [oxygen](#) in enclosed spaces. At high enough concentrations, [oxygen](#) depletion may cause asphyxiation, resulting in generalized hypoxia and possibly death. (L171, L172)

▶ [Toxin and Toxin Target Database \(T3DB\)](#)

11.1.4 Exposure Routes



The substance can be absorbed into the body by inhalation.

▶ [ILO-WHO International Chemical Safety Cards \(ICSCs\)](#)

Inhalation (L172)

▶ [Toxin and Toxin Target Database \(T3DB\)](#)

11.1.5 Signs and Symptoms



Inhalation Exposure

Suffocation.

- ▶ [ILO-WHO International Chemical Safety Cards \(ICSCs\)](#)

Skin Exposure

ON CONTACT WITH LIQUID: FROSTBITE.

- ▶ [ILO-WHO International Chemical Safety Cards \(ICSCs\)](#)

Symptoms of methane asphyxiation include nausea, vomiting, difficulty breathing, irregular heartbeat, headache, drowsiness, fatigue, dizziness, disorientation, mood swings, tingling sensation, loss of coordination, suffocation, convulsions, unconsciousness, coma, and possibly death. (L173)

- ▶ [Toxin and Toxin Target Database \(T3DB\)](#)

11.1.6 Adverse Effects



Other Poison - Simple Asphyxiant

- ▶ [Haz-Map, Information on Hazardous Chemicals and Occupational Diseases](#)

11.1.7 Acute Effects



- ▶ [ChemIDplus](#)



► [ChemIDplus](#)

11.1.8 Toxicity Data and Values



11.1.8.1 Toxicity Data



LC50: 326 gm/m³ over 2 hours (Inhalation, Mouse) (L173)

► [Toxin and Toxin Target Database \(T3DB\)](#)

11.1.8.2 Lethal Concentration



▶ [EPA Toxicity Values Database \(ToxValDB\)](#)

11.1.8.3 Effect Level



▶ [EPA Toxicity Values Database \(ToxValDB\)](#)

11.1.8.4 Military Exposure Guidelines (MEGs)



▶ [EPA Toxicity Values Database \(ToxValDB\)](#)



11.1.9 Treatment

Asphyxiation should be treated by moving the affected person to an uncontaminated area, then giving artificial respiration and administering [oxygen](#), if necessary. (L173)

► [Toxin and Toxin Target Database \(T3DB\)](#)



11.1.10 Antidote and Emergency Treatment

Immediate first aid: Ensure that adequate decontamination has been carried out. If patient is not breathing, start artificial respiration, preferably with a demand valve resuscitator, bag-valve-mask device, or pocket mask, as trained. Perform CPR if necessary. Immediately flush contaminated eyes with gently flowing [water](#). Do not induce vomiting. If vomiting occurs, lean patient forward or place on the left side (head-down position, if possible) to maintain an open airway and prevent aspiration. Keep patient quiet and maintain normal body temperature. Obtain medical attention. /Aliphatic hydrocarbons and related compounds/

Currance, P.L. Clements, B., Bronstein, A.C. (Eds.); Emergency Care For Hazardous Materials Exposure. 3Rd edition, Elsevier Mosby, St. Louis, MO 2005, p. 241

► [Hazardous Substances Data Bank \(HSDB\)](#)

Basic treatment: Establish a patent airway (oropharyngeal or nasopharyngeal airway, if needed). Suction if necessary. Watch for signs of respiratory insufficiency and assist ventilations if necessary. Administer [oxygen](#) by nonrebreather mask at 10 to 15 L/min. Monitor for pulmonary edema and treat if necessary Anticipate seizures and treat if necessary For eye contamination, flush eyes immediately with [water](#). Irrigate each eye continuously with 0.9% saline (NS) during transport Do not use emetics. For ingestion, rinse mouth and administer 5 mL/kg up to 200 mL of [water](#) for dilution if the patient can swallow, has a strong gag reflex, and does not drool. Administer activated [charcoal](#) Treat frostbite with rapid rewarming techniques /Aliphatic hydrocarbons and related compounds/

Currance, P.L. Clements, B., Bronstein, A.C. (Eds.); Emergency Care For Hazardous Materials Exposure. 3Rd edition, Elsevier Mosby, St. Louis, MO 2005, p. 241-2

► [Hazardous Substances Data Bank \(HSDB\)](#)

Advanced treatment: Consider orotracheal or nasotracheal intubation for airway control in the patient who is unconscious, has severe pulmonary edema, or is in severe respiratory distress. Positive-pressure ventilation techniques with a bag-valve-mask device may be beneficial. Consider drug therapy for pulmonary edema Monitor cardiac rhythm and treat arrhythmias as necessary Start IV administration of D5W /SRP: "To keep open", minimal flow rate/. Use 0.9% saline (NS) or lactated Ringer's (LR) if signs of hypovolemia are present. For hypotension

with signs of hypovolemia, administer fluid cautiously. Watch for signs of fluid overload
Treat seizures with [diazepam](#) or [lorazepam](#) Use [proparacaine hydrochloride](#) to assist eye
irrigation /Aliphatic hydrocarbons and related compounds/

Currance, P.L. Clements, B., Bronstein, A.C. (Eds.); Emergency Care For Hazardous Materials Exposure. 3Rd edition, Elsevier Mosby, St. Louis, MO 2005, p. 242

► [Hazardous Substances Data Bank \(HSDB\)](#)

Immediate first aid: Ensure that adequate decontamination has been carried out. If patient is not breathing, start artificial respiration, preferably with a demand-valve resuscitator, bag-valve-mask device, or pocket mask, as trained. Perform CPR as necessary. Immediately flush contaminated eyes with gently flowing [water](#). Do not induce vomiting. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain an open airway and prevent aspiration. Keep patient quiet and maintain normal body temperature. Obtain medical attention. /Simple asphyxiants and related compounds/

Currance, P.L. Clements, B., Bronstein, A.C. (Eds.); Emergency Care For Hazardous Materials Exposure. 3Rd edition, Elsevier Mosby, St. Louis, MO 2005, p. 449

► [Hazardous Substances Data Bank \(HSDB\)](#)

For more Antidote and Emergency Treatment (Complete) data for METHANE (6 total), please visit the [HSDB record page](#).

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.1.11 Human Toxicity Excerpts



/HUMAN EXPOSURE STUDIES/ ...May cause frostbite /like effects/ on skin contact. /Liquified methane/

Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V4 6

► [Hazardous Substances Data Bank \(HSDB\)](#)

/HUMAN EXPOSURE STUDIES/ ... Methane... acts as a simple asphyxiant when inhaled. /Its/ presence displaces air, which lowers the partial pressure of [oxygen](#) and causes hypoxia.

Ford MD, Delaney KA, Ling LJ, Erickson T; Clinical Toxicology. W.B. Saunders Company., Philadelphia, PA. 2001, p. 789

► [Hazardous Substances Data Bank \(HSDB\)](#)

/CASE REPORTS/ It has been known that methane gas intoxication causes loss of consciousness or asphyxia. There is, however, a paucity of information about acute pulmonary toxicity from methane gas inhalation. A 21-year-old man was presented with respiratory distress after an accidental exposure to methane gas for one minute. He came in with a drowsy mentality and hypoxemia. Mechanical ventilation was applied immediately. The patient's symptoms and chest radiographic findings were consistent with acute pneumonitis. He recovered spontaneously and was discharged after 5 days without other specific treatment. His pulmonary function test, 4 days after methane gas exposure, revealed a restrictive ventilatory defect. In conclusion, acute pulmonary injury can occur with a restrictive ventilator defect after a short exposure to methane gas. The lung injury was spontaneously resolved without any significant sequela.

PMID:23579434

Full text: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3617131>

Jo JY et al; *Tuberc Respir Dis (Seoul)* 74 (3): 120-3 (2013)

► [Hazardous Substances Data Bank \(HSDB\)](#)

/OTHER TOXICITY INFORMATION/ The impact of major gaseous and particulate pollutants emitted by the wildfire of October 2003 on ambient air quality and health of San Diego residents before, during, and after the fire are analyzed using data available from the San Diego County Air Pollution Control District and California Air Resources Board. It was found that fine particulate matter (PM) levels exceeded the federal daily 24-hr average standard during the fire. There was a slight increase in some of the gaseous pollutants, such as [carbon monoxide](#), which exceeded federal standards. [Ozone](#) (O3) precursors, such as total hydrocarbons and methane gases, experienced elevated concentration during the fire. Fortunately, the absence of sunlight because of the cloud of thick smoke that covered most of the county during the fire appears to have prevented the photochemical conversion of the precursor gases to harmful concentrations of O3. Statistical analysis of the compiled medical surveillance data has been used to establish correlations between pollutant levels in the region and the resultant health problems experienced by the county citizens. The study shows that the increased PM concentration above the federal standard resulted in a significant increase in hospital emergency room visits for asthma, respiratory problems, eye irritation, and smoke inhalation...

PMID:16499147

Viswanathan S et al; *J Air Waste Manag Assoc.* 2006 Jan;56(1):56-67

► [Hazardous Substances Data Bank \(HSDB\)](#)

/OTHER TOXICITY INFORMATION/ A simple asphyxiant.

Lewis, R.J. Sr. (ed) *Sax's Dangerous Properties of Industrial Materials*. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 2331

► [Hazardous Substances Data Bank \(HSDB\)](#)



11.1.12 Non-Human Toxicity Excerpts

/LABORATORY ANIMALS: Subchronic or Prechronic Exposure/ Because it is biologically inert, Toxicity occurs only when its presence reduces or eliminates the [oxygen](#) in the environment. Rabbits can inhale a mixture of one volume of [oxygen](#) and four volumes of methane for any length of time without showing any ill effects.

Rom, W.N. (ed.). Environmental and Occupational Medicine. 2nd ed. Boston, MA: Little, Brown and Company, 1992., p. 536

► [Hazardous Substances Data Bank \(HSDB\)](#)

/LABORATORY ANIMALS: Developmental or Reproductive Toxicity/ ...Pregnant mice /were exposed/ on the 8th day for 1 hr to 5-8% concentration of fuel gas. In addition to 85% methane most natural gases contain small amounts of [ethane](#), [propane](#) and [butane](#). Abnormalities of the fetal brains were found to result in brain hernia and hydrocephalus.

Shepard, T.H. Catalog of Teratogenic Agents. 5th ed. Baltimore, MD: The Johns Hopkins University Press, 1986., p. 371

► [Hazardous Substances Data Bank \(HSDB\)](#)

/OTHER TOXICITY INFORMATION/ The inhibitory action of compressed hydrocarbon gases on the growth of the yeast *Saccharomyces cerevisiae* was investigated quantitatively by microcalorimetry. Both the 50% inhibitory pressure (IP(50)) and the minimum inhibitory pressure (MIP), which are regarded as indices of the toxicity of hydrocarbon gases, were determined from growth thermograms. Based on these values, the inhibitory potency of the hydrocarbon gases increased in the order methane << ethane < propane < i-butane < n-butane. The toxicity of these hydrocarbon gases correlated to their hydrophobicity, suggesting that hydrocarbon gases interact with some hydrophobic regions of the cell membrane. In support of this, /the authors/ found that UV absorbing materials at 260 nm were released from yeast cells exposed to compressed hydrocarbon gases. Additionally, scanning electron microscopy indicated that morphological changes occurred in these cells.

[PMID:20944432](#)

Kawachi S et al; Biosci Biotechnol Biochem. 74(10):1991-6 (2010)

► [Hazardous Substances Data Bank \(HSDB\)](#)

/OTHER TOXICITY INFORMATION/ A simple asphyxiant.

Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley-Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 2331

11.2 Ecological Information



11.2.1 Environmental Fate / Exposure Summary



Methane is the principal constituent of natural gas (85%) and is also a major greenhouse gas found in the atmosphere. It is released to the environment as natural emissions from microbes, animal waste, and volcanos. Other important sources of methane is the rumen of domestic animals (especially cattle) and emissions during the growing of rice. Methane is stored as methane hydrates in immense amounts both in Arctic regions and in marine sediments. The worldwide amounts of methane hydrates are conservatively estimated to total twice the amount of [carbon](#) found in all known fossil fuels on earth. Methane may be released as a fugitive emission from hydrofracking gas processing equipment. The compound's production and use in synthesis gas production, in manufacture of [hydrogen](#), [hydrogen cyanide](#), [ammonia](#), [acetylene](#), [formaldehyde](#), and in organic syntheses may result in its release to the environment through various waste streams. Its use as a constituent of illuminating and cooking gas will result in its direct release to the environment. Direct release of methane to the environment will also occur due to hydrocarbon venting and [water](#) discharges from offshore production operations, two major sources of methane. Methane gas is a major product in sludge digestion with sludge gas consisting of 65-70% methane. Methane may be released to the environment as emissions from coal outgassing, combustion and liquefaction, and as emissions from waste incineration. Methane may be released to the environment as emissions from automobile, turbine and diesel exhaust. Methane may be released to the environment as emissions from biomass and polymer combustion, foundries, sewage and [water](#) treatment, veneer drying and wood pulping, and landfills. If released to air, a vapor pressure of 4.66×10^5 mm Hg at 25 °C indicates methane will exist solely as a gas in the atmosphere. Gas-phase methane will be degraded in the atmosphere by reaction with photochemically-produced [hydroxyl](#) radicals; the half-life for this reaction in air is estimated to be 4 yrs. Methane does not contain chromophores that absorb at wavelengths >290 nm and, therefore, is not expected to be susceptible to direct photolysis by sunlight. If released to soil, methane is expected to have very high mobility based upon an estimated Koc of 9. Volatilization from moist soil surfaces is expected to be an important fate process based upon an estimated Henry's Law constant of 0.66 atm-cu m/mole. Methane may volatilize from dry soil surfaces based upon its vapor pressure. An average utilization of 55% for methane by anaerobic soil microorganisms suggests that biodegradation may be an environmental fate process in soil. If released into [water](#), methane is not expected to adsorb to suspended solids and sediment based upon the estimated Koc. Biodegradation half-lives were estimated to range from 70 days to infinity using anaerobic model estuarine ecosystems, indicating that biodegradation is not an

important environmental fate process in [water](#). Volatilization from [water](#) surfaces is expected to be an important fate process based upon this compound's estimated Henry's Law constant. An estimated BCF of 2 suggests the potential for bioconcentration in aquatic organisms is low. Hydrolysis is not expected to be an important environmental fate process since this compound lacks functional groups that hydrolyze under environmental conditions (pH 5 to 9). Occupational exposure to methane may occur through inhalation of this compound at workplaces where methane is produced or used. Monitoring data indicate that the general population may be exposed to methane via inhalation of ambient air. (SRC)

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.2 Natural Pollution Sources



Methane may be released to the environment as emissions from microbes, animal waste and volcanoes(1,2). Methane is the principal constituent of natural gas(1,3); natural gas from America is approximately 85% methane(4). Emissions of geothermal steam may release methane to the environment(1,5). Methane is a constituent of petroleum gases(6). An important source of methane is the rumen of domestic animals, especially of cattle(7). Methane may be released to the environment through emissions during the growing of rice(7).

(1) Graedel TE; *Atmospheric Chemical Compounds*. Orlando, FL: Academic Press p 268 (1986)

(2) Clark JP; *Kirk-Othmer Encycl Chem Tech 3rd ed* New York, NY: Wiley 5: 559 (1979)

(3) Hillard JH; *Kirk-Othmer Encycl Chem Tech 3rd ed* New York, NY: Wiley 11: 633 (1980)

(4) O'Neil MJ et al, ed; *The Merck Index*. 15th ed. Cambridge, UK: Royal Society of Chemistry, p. 1105 (2013)

(5) Duchane D; *Kirk-Othmer Encycl Chem Tech 4th ed* New York, NY: Wiley 12: 520 (1994)

(6) Robbins WK, Hsu CS; *Kirk-Othmer Encycl Chem Tech 4th ed* New York, NY: Wiley 18: 359 (1996)

(7) Rowland F; *Origins of Life* 15: 279-97 (1985)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Methane is found as hydrates (i.e., methane hydrate) in immense amounts both in Arctic regions and in marine sediments(1). Methane hydrate is stable in ocean floor sediments at [water](#) depths greater than 300 meters, and where it occurs, it is known to cement loose sediments in a surface layer several hundred meters thick(1). The worldwide amounts of [carbon](#) bound as gas hydrates (e.g., methane hydrate) is conservatively estimated to total twice the amount of [carbon](#) found in all known fossil fuels on Earth(1). The earth's atmosphere contains 0.00022% methane by volume(2).

(1) USGS; *Gas Hydrates Project*. USGS Woods Hole Science Center. Available from, as of Nov 8, 2013: <https://woodshole.er.usgs.gov/project-pages/hydrates/>

(2) O'Neil MJ et al, ed; *The Merck Index*. 15th ed. Cambridge, UK: Royal Society of Chemistry, p. 1105 (2013)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Potential rates of methane generation and [carbon dioxide](#) generation were measured on 11 dates in 1986 in peat from six plant communities typical of moss dominated peatlands in the Appalachian Mountains(1). Annual methane generation ranged from 2.7 to 17.5 M/sq m, and annual [carbon dioxide](#) production ranged from 30.6 to 79.0 M/sq m(1). The wide range in methane generation values among the communities found within a single peatland indicates that obtaining one generation value for a peatland may not be appropriate(1). Low temperature constrained the potential for methane generation in winter, while the chemical quality of the peat substrate appears to control methane generation in the summer(1). Methane oxidation was measured throughout the peat profile to a depth of 30 cm(1). Values for methane oxidation ranged from 0.08 to 18.7 uM/hr among the six plant communities(1). Aerobic methane oxidizing bacteria probably mediated most of the activity(1). On a daily basis during the summer, between 11 and 100% of the methane generated is susceptible to oxidation within the peat column(1). Pools of dissolved methane and dissolved [carbon dioxide](#) in pore waters were <0.2 and <1.0 M/sq m, respectively, indicating that methane does not accumulate in the pore waters. Peatlands have been considered as an important source of biologically produced methane(1). Despite the high rates of methane generation, the high rates of methane oxidation dampen the potential emission of methane to the atmosphere(1).

(1) Yavitt JB et al; *Global Biogeochem Cycles* 2: 253-68 (1988)

► [Hazardous Substances Data Bank \(HSDB\)](#)

C(14) content of atmospheric methane prior to nuclear and thermal nuclear bomb-testing contamination suggests that greater than 80% of atmospheric methane is from decay of recent organic matter. /14(C)-Methane/

Ehhl DA, Schmidt V; *Pure Appl Geophys* 116: 452 (1978)

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.3 Artificial Pollution Sources



Methane's production and use in synthesis gas production(1), in manufacture of [hydrogen](#), [hydrogen cyanide](#), [ammonia](#), [acetylene](#), [formaldehyde](#), and in organic syntheses(2) may result in its release to the environment through various waste streams(SRC). Its use as a constituent of illuminating and cooking gas(2) will result in its direct release to the environment(SRC). Natural gas production from hydrocarbon-rich shale formations, known as "shale gas" is one of the most rapidly expanding trends in on-shore domestic oil and gas exploration and production today. Natural gas supplies about 22% of the total US energy demands. Methane is

the principle component of natural gas and a known Greenhouse Gas. Methane may be released as a fugitive emission from gas processing equipment(3).

(1) Eastman AD, Mears D; *Hydrocarbons, C1-C6. Kirk-Othmer Encyclopedia of Chemical Technology. (1999-2013). New York, NY: John Wiley & Sons. Online Posting Date: 4 Dec 2000*

(2) O'Neil MJ et al, ed; *The Merck Index. 15th ed. Cambridge, UK: Royal Society of Chemistry, p. 1105 (2013)*

(3) U.S. Department of Energy; *Modern shale gas development in the United State: A primer. Washington, DC: U.S. Department of Energy, Office of Fossil Energy, National Energy Technology Laboratory (2009)*

► [Hazardous Substances Data Bank \(HSDB\)](#)

Direct release of methane to the environment will also occur due to hydrocarbon venting and [water](#) discharges from offshore production operations, two major sources of methane(1). Methane gas is a major product in sludge digestion with sludge gas consisting of 65-70% methane(2,3). Methane may be released to the environment as emissions from coal outgassing, combustion and liquefaction(4-6). Methane may be released to the environment as emissions from waste incineration (2,7,8). Methane may be released to the environment as emissions from automobile, turbine and diesel exhaust(4,9,10). Methane may be released to the environment as emissions from biomass and polymer combustion, foundries, sewage and [water](#) treatment, veneer drying and wood pulping(2), and landfills(11). The compound is generated as a result of biodegradation of short-chain n-alkanes in oil sand tailings under methanogenic conditions(12).

(1) Sauer TCJR; *Environ Sci Techol* 15: 917-22 (1981)

(2) Atlas E et al; *J WPCF* 52:326-50 (1980)

(3) Pfafflin JR; *Kirk-Othmer Encycl Chem Tech 3rd ed New York, NY: Wiley* 12: 1016 (1984)

(4) Graedel TE; *Atmospheric Chemical Compounds. Orlando, FL: Academic Press* p. 123 (1986)

(5) Junk GA et al; *ACS Symp Ser* 319: 109-23 (1986)

(6) Bockris J O'M; *Kirk-Othmer Encycl Chem Tech 3rd ed New York, NY: Wiley* 12: 1016 (1980)

(7) Carotti AA, Kaiser ER; *J Air Pollut Cont Assoc* 22: 248-53 (1972)

(8) Crocker BB, Baile RC; *Kirk-Othmer Encycl Chem Tech 3rd ed New York, NY: Wiley* 13: 194 (1981)

(9) Sigsby JE Jr et al; *Environ Sci Technol* 21: 466-75 (1987)

(10) Stump F et al; *Atmos Environ* 23: 307-20 (1989)

(11) Wood JA, Porter ML; *J Air Pollut Control Assoc* 37: 609-15 (1987)

(12) Siddique T et al; *Environ Sci Technol* 40: 5459-5464 (2006)

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.4 Environmental Fate



TERRESTRIAL FATE: Based on a classification scheme(1), an estimated Koc value of 9(SRC), determined from a log Kow of 1.09(2) and a regression-derived equation(3), indicates that methane is expected to have very high mobility in soil(SRC). Volatilization of methane from moist soil surfaces is expected to be an important fate process(SRC) given an estimated Henry's Law constant of 0.66 atm-cu m/mole(SRC), derived from its vapor pressure, 4.66X10+5 mm Hg(4), and [water](#) solubility, 22 mg/L(5). Methane is expected to volatilize from dry soil surfaces(SRC) based upon its vapor pressure(4). An average utilization of 55% for methane by anaerobic soil microorganisms(6) suggests that biodegradation may be an environmental fate process in soil(SRC).

(1) Swann RL et al; *Res Rev* 85: 17-28 (1983)

(2) Hansch C et al; *Exploring QSAR. Hydrophobic, Electronic, and Steric Constants*. ACS Prof Ref Book. Heller SR, consult. ed., Washington, DC: Amer Chem Soc p. 3 (1995)

(3) US EPA; *Estimation Program Interface (EPI) Suite*. Ver. 4.1. Nov, 2012. Available from, as of Nov 6, 2013: <https://www.epa.gov/oppt/exposure/pubs/episuite.html>

(4) Daubert TE, Danner RP; *Physical and Thermodynamic Properties of Pure Chemicals: Evaluated Process Design Data*. Philadelphia, PA: Taylor and Francis (1999)

(5) Yalkowsky SH et al; *Handbook of Aqueous Solubility Data*. 2nd ed. Boca Raton, FL: CRC Press, P. 8 (2010)

(6) Brisbane PG, Ladd JN; *J Gen Appl Microbiol* 14: 447-50 (1968)

► [Hazardous Substances Data Bank \(HSDB\)](#)

AQUATIC FATE: Based on a classification scheme(1), an estimated Koc value of 9(SRC), determined from a log Kow of 1.09(2) and a regression-derived equation(3), indicates that methane is not expected to adsorb to suspended solids and sediment(SRC). Volatilization from [water](#) surfaces is expected(4) based upon an estimated Henry's Law constant of 0.66 atm-cu m/mole(SRC), derived from its vapor pressure, 4.66X10+5 mm Hg(5), and [water](#) solubility, 22 mg/L(6). Using this Henry's Law constant and an estimation method(4), volatilization half-lives for a model river and model lake are 2 hours(SRC). According to a classification scheme(7), an estimated BCF of 2(SRC), from its log Kow(2) and a regression-derived equation(3), suggests the potential for bioconcentration in aquatic organisms is low(SRC). The biodegradation half-life of methane was estimated to range from 70 days to infinity in model anaerobic estuarine ecosystems(8), indicating that biodegradation is not an important environmental fate process in [water](#)(SRC).

(1) Swann RL et al; *Res Rev* 85: 17-28 (1983)

(2) Hansch C et al; *Exploring QSAR. Hydrophobic, Electronic, and Steric Constants*. ACS Prof Ref Book. Heller SR, consult. ed., Washington, DC: Amer Chem Soc p. 3 (1995)

(3) US EPA; *Estimation Program Interface (EPI) Suite*. Ver. 4.1. Nov, 2012. Available from, as of Nov 6, 2013: <https://www.epa.gov/oppt/exposure/pubs/episuite.html>

(4) Lyman WJ et al; *Handbook of Chemical Property Estimation Methods*. Washington, DC: Amer Chem Soc pp. 15-1 to 15-29 (1990)

(5) Daubert TE, Danner RP; *Physical and Thermodynamic Properties of Pure Chemicals: Evaluated Process Design Data*. Philadelphia, PA: Taylor and Francis (1999)

(6) Yalkowsky SH et al; *Handbook of Aqueous Solubility Data*. 2nd ed. Boca Raton, FL: CRC Press, P. 8 (2010)

(7) Franke C et al; *Chemosphere* 29: 1501-14 (1994)

(8) Bopp RF et al; *Org Geochem* 3: 9-14 (1981)

► [Hazardous Substances Data Bank \(HSDB\)](#)

ATMOSPHERIC FATE: According to a model of gas/particle partitioning of semivolatile organic compounds in the atmosphere(1), methane, which has a vapor pressure of 4.66×10^{-5} mm Hg at 25 °C(2), is expected to exist solely as a gas in the ambient atmosphere. Gas-phase methane is degraded in the atmosphere by reaction with photochemically-produced [hydroxyl radicals](#)(SRC); the half-life for this reaction in air is estimated to be 4 yrs(3), calculated from its rate constant of 6.85×10^{-15} cu cm/molecule-sec at 25 °C(4). Methane does not contain chromophores that absorb at wavelengths >290 nm(5) and, therefore, is not expected to be susceptible to direct photolysis by sunlight(SRC).

(1) Bidleman TF; *Environ Sci Technol* 22: 361-367 (1988)

(2) Daubert TE, Danner RP; *Physical and Thermodynamic Properties of Pure Chemicals: Evaluated Process Design Data*. Philadelphia, PA: Taylor and Francis (1999)

(3) US EPA; *Estimation Program Interface (EPI) Suite*. Ver. 4.1. Nov, 2012. Available from, as of Nov 6, 2013: <https://www.epa.gov/oppt/exposure/pubs/episuite.html>

(4) Atkinson R; *J Phys Chem Ref Data Monograph No. 2* (1994)

(5) Lyman WJ et al; *Handbook of Chemical Property Estimation Methods*. Washington, DC: Amer Chem Soc pp. 8-12 (1990)

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.5 Environmental Biodegradation



ANAEROBIC: Utilization of methane by soil microorganisms has been detected using five enriched soil samples collected from sites near Adelaide, South Australia; an average methane utilization of 55% was observed over 69 days. Methane utilization, expressed as % of control were as follows (value (soil type): 10 (litchfield podzolic, pH 5.9, 14% clay, 2.3% organic [carbon](#), 17% moisture); 73 (pond mud, pH 7.9, 49% clay, 2.5% organic [carbon](#), 126% moisture); 55 (red brown earth, pH 7.7, 16% clay, 2.4% organic [carbon](#), 8% moisture); 61 (Grey clay, pH 8.0, 36% clay, 3.1% organic [carbon](#), 41% moisture); 75 (siliceous sands, pH 5.1, 5% clay, 2.4% organic [carbon](#), 19% moisture)(1). The half-life of methane was estimated to range from 70 days to infinity based on gas exchange biodegradation experiments conducted in model estuarine ecosystems; inoculum sediments were obtained from Narragansett Bay, RI(2).

(1) Brisbane PG, Ladd JN; *J Gen Appl Microbiol* 14: 447-50 (1968)

(2) Bopp RF et al; *Org Geochem* 3: 9-14 (1981)

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.6 Environmental Abiotic Degradation



The rate constant for the vapor-phase reaction of methane with photochemically-produced hydroxyl radicals is 6.86×10^{-15} cu cm/molecule-sec at 25 °C(1). This corresponds to an atmospheric half-life of about 4 years at an atmospheric concentration of 5×10^5 hydroxyl radicals per cu cm(2). Methane is not expected to undergo hydrolysis in the environment due to the lack of functional groups that hydrolyze under environmental conditions(3). Methane does not contain chromophores that absorb at wavelengths >290 nm(3) and, therefore, is not expected to be susceptible to direct photolysis by sunlight(SRC).

(1) Atkinson R; *J Phys Chem Ref Data Monograph No. 2* (1994)

(2) US EPA; *Estimation Program Interface (EPI) Suite. Ver. 4.1. Nov, 2012. Available from, as of Nov 6, 2013: <https://www.epa.gov/oppt/exposure/pubs/episuite.html>*

(3) Lyman WJ et al; *Handbook of Chemical Property Estimation Methods. Washington, DC: Amer Chem Soc pp. 7-4, 7-5, 8-12* (1990)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Evidence of methane oxidation was seen in lakes impacted by the May 18, 1980 eruption of Mount St. Helens in Washington state during the summer of 1981, and rates of methane oxidation using ¹⁴C-methane were measured in Spirit Lake from 1982 to 1986. The highest rates of methane oxidation measured were during the summer stratification and ranged from 50 to 150 nM methane oxidized/L/day. Methane oxidation rates were measured in waters having oxygen concentrations <100 uM with highest activity occurring at concentrations of 30-60 uM. Spirit Lake samples taken during 1986 showed a marked reduction in the levels of methane. This has corresponded with a marked reduction in the levels of dissolved organic material in the lake and an apparent decline in sedimentary methanogenesis.

Lilley MD et al; *Global Biogeochem Cycles* 2: 357-70 (1988)

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.7 Environmental Bioconcentration



An estimated BCF of 2 was calculated in fish for methane(SRC), using a log Kow of 1.09(1) and a regression-derived equation(1). According to a classification scheme(2), this BCF suggests the potential for bioconcentration in aquatic organisms is low(SRC).

(1) Hansch C et al; *Exploring QSAR. Hydrophobic, Electronic, and Steric Constants*. ACS Prof Ref Book. Heller SR, consult. ed., Washington, DC: Amer Chem Soc p. 3 (1995)

(2) US EPA; *Estimation Program Interface (EPI) Suite*. Ver. 4.1. Nov, 2012. Available from, as of Nov 6, 2013: <https://www.epa.gov/oppt/exposure/pubs/episuite.html>

(3) Franke C et al; *Chemosphere* 29: 1501-14 (1994)

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.8 Soil Adsorption / Mobility



The K_{oc} of methane is estimated as 9(SRC), using a log K_{ow} of 1.09(1) and a regression-derived equation(2). According to a classification scheme(3), this estimated K_{oc} value suggests that methane is expected to have very high mobility in soil. Methane's vapor pressure of 4.7X10⁺⁵ mm Hg(4) suggests that this compound will permeate through soil(SRC).

(1) Hansch C et al; *Exploring QSAR. Hydrophobic, Electronic, and Steric Constants*. ACS Prof Ref Book. Heller SR, consult. ed., Washington, DC: Amer Chem Soc p. 3 (1995)

(2) US EPA; *Estimation Program Interface (EPI) Suite*. Ver. 4.1. Nov, 2012. Available from, as of Nov 6, 2013: <https://www.epa.gov/oppt/exposure/pubs/episuite.html>

(3) Swann RL et al; *Res Rev* 85: 17-28 (1983)

(4) Daubert TE, Danner RP; *Physical and Thermodynamic Properties of Pure Chemicals: Evaluated Process Design Data*. Philadelphia, PA: Taylor and Francis (1999)

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.9 Volatilization from Water / Soil



The Henry's Law constant for methane is estimated as 0.66 atm-cu m/mole(SRC) derived from its vapor pressure, 4.66X10⁺⁵ mm Hg(1), and water solubility, 22 mg/L(2). This Henry's Law constant indicates that methane is expected to volatilize rapidly from water surfaces(3). Based on this Henry's Law constant, the volatilization half-life from a model river (1 m deep, flowing 1 m/sec, wind velocity of 3 m/sec)(3) is estimated as 2 hours(SRC). The volatilization half-life from a model lake (1 m deep, flowing 0.05 m/sec, wind velocity of 0.5 m/sec)(3) is estimated as 2 hours(SRC). Methane's estimated Henry's Law constant indicates that volatilization from moist soil surfaces may occur(SRC). The potential for volatilization of methane from dry soil surfaces may exist(SRC) based upon the vapor pressure(1).

(1) Daubert TE, Danner RP; *Physical and Thermodynamic Properties of Pure Chemicals: Evaluated Process Design Data*. Philadelphia, PA: Taylor and Francis (1999)

(2) Yalkowsky SH et al; *Handbook of Aqueous Solubility Data*. 2nd ed. Boca Raton, FL: CRC Press, P. 8 (2010)

(3) Lyman WJ et al; *Handbook of Chemical Property Estimation Methods*. Washington, DC: Amer Chem Soc pp. 15-1 to 15-29 (1990)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Methane emissions to the atmosphere was studied in the deepest, central (pelagic) regions of one freshwater and three meromictic, alkaline saline lakes. The range of methane emissions was 0.0004 to 2.916 mM/sq m/hr (n = 41). Outward flux was dominated by bubble ebullition only in the freshwater lake. Diffusive gas exchange was the sole mechanism of transfer in the meromictic lakes, and flux from these lakes was equivalent to or lower than that from the freshwater lake during its periods of ebullition. A comparison of measured flux with flux calculated using a model of gas exchange in Mono Lake suggested that floating chambers provide reasonable estimates of the magnitude of methane emissions from diffusion-dominated systems.

Miller LG, Oremland RS; Global Biogeochem Cycles 2 (3): 269-77 (1988)

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.10 Environmental Water Concentrations



GROUNDWATER: Methane was detected in three of eleven bedrock domestic wells near the Granby, CT landfill at concentrations of 240 ppb, 10,000 ppb and an unspecified high concentration.

Sawhney BL, Raabe JA; The Connecticut Agricultural Experiment Bulletin 833 New Haven,CT: pp 1-9 (1986)

► [Hazardous Substances Data Bank \(HSDB\)](#)

DRINKING WATER: Methane has been identified in drinking water in the United States(1).

(1) *Kopfler FC et al; Environ Sci Technol 8: 419-33 (1977)*

► [Hazardous Substances Data Bank \(HSDB\)](#)

SURFACE WATER: The concentrations of methane and methane oxidation rates were measured in lakes impacted by the May 18, 1980 eruption of Mount St. Helens(1). The highest methane concentrations were recorded during the first summer after the eruption and ranged in surface waters from 5 uM in the moderately impacted Ryan Lake to 28 uM in the heavily impacted North Coldwater Lake(1). At depths below the oxic/anoxic interface, methane levels reached 250 uM in North Coldwater Lake, 184 uM in Spirit Lake, 70 uM in Castle Creek Lake, and 60 uM in Ryan Lake(1). The methane flux measurements from these lakes during the summer following the May 18, 1980 eruption were the highest ever recorded in lakes with ranges of 1.1-2.9 mM CH₄/sq m/day in the light to moderately impacted McBride and Ryan Lakes to ranges of 17.4-25.3 mM methane/sq m/day in the heavily impacted Castle Creek, North Coldwater, and Spirit Lakes(1).

(1) Lilley MD et al; *Global Biogeochem Cycles* 2: 357-70 (1988)

► [Hazardous Substances Data Bank \(HSDB\)](#)

SURFACE WATER: Methane was detected in surface **water** at nine dump sites of municipal and industrial wastes in the western Gulf of Mexico at concentrations ranging from 55 to 667 nL/L(1). Methane concentrations of 42 to 370 nL/L have been detected from six stations in south Texas coastal waters(2).

(1) Atlas E et al; *J WPCF* 52: 326-50 (1980)

(2) Brooks et al; *Fate and Effects of Petroleum Hydrocarbons in Marine Organisms and Ecosystems* NY:Pergamon Press pp 373-84 (1977)

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.11 Effluent Concentrations



In exhaust of diesel engine: 17% of emitted hydrocarbons; in exhaust of reciprocating gasoline engine: 24% of emitted hydrocarbons; in exhaust of rotary gasoline engine: 4.9% of emitted hydrocarbons; expected glc's in USA urban air: range: 1.6-10 ppm; in combustion gas of household central heating on gasoil: 20 ppm; in flue gas of municipal incinerator: < 0.4-13.0 ppm; in exhaust of gasoline engine: 14-17% of total exhaust hydrocarbons; 15 fuel survey: 18 vol % of total exhaust hydrocarbons

Verschuieren, K. *Handbook of Environmental Data on Organic Chemicals. Volumes 1-2. 4th ed. John Wiley & Sons. New York, NY. 2001, p. V2: 1423*

► [Hazardous Substances Data Bank \(HSDB\)](#)

In 1990, emissions of methane to the atmosphere were approximately 380 million tons/yr; in 1860, 80 million tons/yr of methane were released(1). Methane emissions estimates for 1993 were as follows: gas flaring, 18.0×10^{12} g/yr; gas supply, 16.9×10^{12} g/yr; coal mining 46.3×10^{12} g/yr; biomass burning, 38.4×10^{12} g/yr; livestock, 112.1×10^{12} g/yr; rice, 101.4×10^{12} g/yr; landfills, 43.9×10^{12} g/yr(1). Methane emissions estimates for 1860 were as follows: gas flaring, 0.0×10^{12} g/yr; gas supply, 0.0×10^{12} g/yr; coal mining 2.2×10^{12} g/yr; biomass burning, 9.8×10^{12} g/yr; livestock, 25.6×10^{12} g/yr; rice, 40.1×10^{12} g/yr; landfills, 1.6×10^{12} g/yr(1). Livestock farming is the largest anthropogenic source of methane(1).

(1) Stern DI, Kaufmann RK; *Chemosphere* 33: 159-176 (1996)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Methane was detected in the flue gas of an incineration plant located in the town of Babylon, NY during three different tests at concentrations ranging from less than 0.4 to 13.0 ppm(1). Methane was found in combustion gas of light fuel oil at concentrations ranging from 0.32 to

26.80 mL/L and it was detected in the exhaust gas of light fuel oil at a concentration of 0.11 mL/L(2). Automotive exhaust emissions have been found to contain methane(6,7). It was found to be present in effluents from coal combustion(3). Methane was detected in ten samples of emissions from jet engines at concentrations ranging from 0.05 to 48.0 ppm(4). Wood smoke has been found to contain methane in the gas-phase at final concentrations of 4,500 and 3,920 ppb(5). Methane was detected in the ambient air of five California landfills at concentrations ranging from 16,600 to 587,000 ppm(8). The rate of methane from fireplace combustion of wood was 4,120 mg/kg wood burned(9). The concentration of methane measured in the Caldecott Tunnel located in San Francisco Bay, CA was approx 413 mg/L during a period when low oxygenated fuel was used(10). When high oxygenated fuel was used, the concentration of methane in tunnel air was about 459 mg/L(10).

(1) Carotti AA, Kaiser ER; *J Air Pollut Cont Assoc* 22: 248-53 (1972)

(2) Hayano S et al; *Atm Environ* 19: 1009-15 (1985)

(3) Junk GA et al; *ACS Symp Ser* 319: 109-23 (1986)

(4) Katzman H, Libby WF; *Atm Environ* 9: 39-43 (1975)

(5) Kleindienst TE et al; *ACS Environ Sci Technol* 20: 493-501 (1986)

(6) Sigsby JEJR et al; *Environ Sci Technol* 21: 466-75 (1987)

(7) Stump F et al; *Atmos Environ* 23: 307-20 (1989)

(8) Wood JA, Porter ML; *J Air Pollut Control Assoc* 37: 609-15 (1987)

(9) Schauer JJ et al; *Environ Sci Technol* 35: 1716-28 (2001)

(10) Kirchstetter TW et al; *Environ Sci Technol* 30: 661-70 (1996)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Direct measurement of methane (CH₄) flux from wetland ecosystems of south Florida demonstrates that freshwater wet prairies and inundated sawgrass marsh are the dominant sources of atmospheric CH₄ in the region(1). Fluctuations in soil moisture are an important environmental factor controlling both seasonal and interannual fluctuations in CH₄ emissions from undisturbed wetlands(1). Land use estimates for 1900 and 1973 were used to calculate regional CH₄ flux(1). Human settlement in south Florida has modified wetland sources of CH₄, reducing the natural prairies and marsh sources by 37%(1). During the same period, impoundments and disturbed wetlands were created which produce CH₄ at rates approximately 50% higher than the natural wetlands they replaced(1). The mean standard error, in mg methane/sq m/day, was 61 for wet prairies and sawgrass marsh, 59 for wetland forests, 4 for saltwater mangroves, and 74 for impoundments and disturbed wetlands(1).

(1) Harriss RC et al; *Global Biogeochem Cycles* 2: 231-43 (1988)

► [Hazardous Substances Data Bank \(HSDB\)](#)



11.2.12 Sediment / Soil Concentrations

SEDIMENT: Methane flux and the stable isotopic composition of sedimentary methane were measured at four locations in the Florida Everglades system. Individual estimates of methane flux ranged over more than 3 orders of magnitude, from about 0.001 to 2.6 mg/sq m/day. Significant interstation differences in total methane flux were observed and judged to be most likely due to differences in the size and spacing of emergent aquatic vegetation, and possibly differences in the type of organic matter incorporated into the sediments. The C(13) mean delta of sedimentary methane samples measured in the Everglades system (61.7 parts per trillion, standard deviation = 3.6 parts per trillion, n = 51) was not significantly different from the estimated C(13) average delta of all natural sources (-58.3 parts per trillion).

Burke RA et al; Global Biogeochem Cycles 2 (4): 329-40 (1988)

► [Hazardous Substances Data Bank \(HSDB\)](#)

SEDIMENT: Methane has been detected in sediment from the shelf, slope, and basin of the Bering Sea at concentrations ranging from 1300 to 13000 nL/L, 700 to 8400 nL/L, and 300 to 21000 nL/L, respectively.

Kvenvolden KA, Redden GD; Geochim Cosmochim ACTA 44: 1145-50 (1980)

► [Hazardous Substances Data Bank \(HSDB\)](#)



11.2.13 Atmospheric Concentrations

A factor of 2.5 increase in the global abundance of atmospheric methane (CH₄) since 1750 contributes 0.5 Wm⁻² to total direct radiative forcing by long-lived greenhouse gases (2.77 Wm⁻² in 2009), while its role in atmospheric chemistry adds another approximately 0.2 Wm⁻² of indirect forcing. Since CH₄ has a relatively short lifetime and it is very close to a steady state, reductions in its emissions would quickly benefit climate. Sensible emission mitigation strategies require quantitative understanding of CH₄'s budget of emissions and sinks. Atmospheric observations of CH₄ abundance and its rate of increase, combined with an estimate of the CH₄ lifetime, constrain total global CH₄ emissions to between 500 and 600 Tg CH₄ yr⁻¹. While total global emissions are constrained reasonably well, estimates of emissions by source sector vary by up to a factor of 2. Current observation networks are suitable to constrain emissions at large scales (e.g. global) but not at the regional to national scales necessary to verify emission reductions under emissions trading schemes. Improved constraints on the global CH₄ budget and its break down of emissions by source sector and country will come from an enhanced observation network for CH₄ abundance and its isotopic composition (delta(13)C, deltaD(D=(2)H) and delta(14)C). Isotopic measurements are a valuable tool in distinguishing among various sources that contribute emissions to an air

parcel, once fractionation by loss processes is accounted for. Isotopic measurements are especially useful at regional scales where signals are larger. Reducing emissions from many anthropogenic source sectors is cost-effective, but these gains may be cancelled, in part, by increasing emissions related to economic development in many parts of the world. An observation network that can quantitatively assess these changing emissions, both positive and negative, is required, especially in the context of emissions trading schemes.

PMID:21502176

Dlugokencky EJ et al; Philos Trans A Math Phys Eng Sci 369(1943): 2058-72 (2011)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Methane is an important greenhouse gas, and its atmospheric concentration has nearly tripled since pre-industrial times. The growth rate of atmospheric methane is determined by the balance between surface emissions and photochemical destruction by the [hydroxyl](#) radical, the major atmospheric oxidant. Remarkably, this growth rate has decreased markedly since the early 1990s, and the level of methane has remained relatively constant since 1999, leading to a downward revision of its projected influence on global temperatures. Large fluctuations in the growth rate of atmospheric methane are also observed from one year to the next, but their causes remain uncertain. Here we quantify the processes that controlled variations in methane emissions between 1984 and 2003 using an inversion model of atmospheric transport and chemistry. Our results indicate that wetland emissions dominated the inter-annual variability of methane sources, whereas fire emissions played a smaller role, except during the 1997-1998 El Nino event. These top-down estimates of changes in wetland and fire emissions are in good agreement with independent estimates based on remote sensing information and biogeochemical models. On longer timescales, our results show that the decrease in atmospheric methane growth during the 1990s was caused by a decline in anthropogenic emissions. Since 1999, however, they indicate that anthropogenic emissions of methane have risen again. The effect of this increase on the growth rate of atmospheric methane has been masked by a coincident decrease in wetland emissions, but atmospheric methane levels may increase in the near future if wetland emissions return to their mean 1990s levels.

PMID:17006511

Bousquet P et al; Nature 443(7110): 439-43 (2006)

► [Hazardous Substances Data Bank \(HSDB\)](#)

URBAN/SUBURBAN: The concentration of methane measured at Exhibition Road, London, UK ranged from 1.34-2.45 ppm (average, 1.59 ppm) between the period of January 1991 to July 1992(1). Methane has been detected in five air samples collected in Houston, TX on April 2, 1974 at concentrations ranging from 1.91 to 2.31 ppm(2). Methane detected of Riverside, CA in smoggy air at 2.02 ppm(3).

(1) Brown JR et al; Sci Total Environ 177: 73-84 (1996)

(2) Lonneman WA et al; *Hydrocarbons in Houston Air. USEPA/600/3-79/018 p 29 (1979)*

(3) Stephens ER, Burleson FR; *J Air Pollut Control Assoc* 19: 929 (1969)

► [Hazardous Substances Data Bank \(HSDB\)](#)

URBAN/SUBURBAN: Methane emission in the Mexico City Metropolitan Area, 2000(1).

Table: Emission Inventory by Sector

Emission source	tonnes/day	% of Total
Stationary sources	0	0
Area-wide sources	462	93
On-road motor vehicles	31	6
Other mobile sources	1	0
Vegetation and soils	not applicable	not applicable
TOTAL	494	

(1) Molina LT et al; *J Air Waste Manage Assoc* 55: 1-73 (2004)

► [Hazardous Substances Data Bank \(HSDB\)](#)

For more Atmospheric Concentrations (Complete) data for METHANE (7 total), please visit the [HSDB record page](#).

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.14 Other Environmental Concentrations



Geofluids are usually assumed to be saturated with methane with (6.9-8.9)X10⁻³ cu m methane/kg water(1). American natural gas is approximately 85% methane(2). Composition of typical natural gases are (vol%): 95.0 (Salt Lake, UT); 89.4 (Webb, TX); 65.8 (Kliffside, TX); 93.2 (Sussex, England); 70.0 (Lacq, France)(3).

(1) Tester J, Grigsby CO; *Kirk-Othmer Encycl Chem Tech* 3rd ed New York, NY: Wiley 11: 748 (1980)

(2) O'Neil MJ, ed; *The Merck Index. 15 th ed., Cambridge, UK: Royal Society of Chemistry,p. 1105 2013.*

(3) Eastman AD, Mears D; *Hydrocarbons, C1-C6. Kirk-Othmer Encyclopedia of Chemical Technology. (1999-2013). New York, NY: John Wiley & Sons. Online Posting Date: 4 Dec 2000*

► [Hazardous Substances Data Bank \(HSDB\)](#)

The methane emission factor of 14000 mg/kg at 1100 °C was measured in a laboratory-scale furnace using lignin samples, a sub-product in the Kraft process that is used to obtain cellulose by combustion of eucalyptus wood(1). Methane was released at an emmission factor range of 88,600-1,032,000 mg/kg as a result of pyrolysis of used cotton fabrics, a possible biomass fuel source(2).

(1) Font R et al; Chemosphere 52: 1047-58 (2003)

(2) Molto J et al; Environ Sci Technol 39: 5141-7 (2005)

► [Hazardous Substances Data Bank \(HSDB\)](#)

Estimated emission factors for methane from fires in North America(1).

Land cover type	kg CH4/Mg biomass burned	Land cover type	kg CH4/Mg biomass burned
Tropical or sub-trop broadleaved deciduous closed canopy	6.6	Temperate or subpolar grassland with sparse shrub layer	3.1
Temperate or sub-polar broadleaved decidous closed canopy	4.5	Polar grassland with sparse shrub layer	3.1
Temperate or sub-polar needleleaved evergreen closed canopy	4.8	Polar grassland with dwarf-sparse shrub layer	3.1
Temperate or sub-polar needleleaved evergreen open canopy	4.8	Cropland	2.2
Temperate or sub-polar needleleaved mixed closed canopy	4.5	Cropland and shrubland/woodland	2.2
Temperate or sub-polar mixed broadleaved closed canopy	4.5	Subpolar needleleaved evergreen forest open canopy-lichen understory	4.8
Temperate or sub-polar mixed broadleaved or needleleaved open canopy	4.5	Unconsollidated material spare vegetation	3.1
Temperate or sub-polar broadleaved evergreen	3.1	Urban and built-up	0.0

shrubland closed canopy			
Temperate or sub-polar broadleaved deciduous shrubland open canopy	3.1	Consolidated rock sparse vegetation	3.1
Temperate or sub-polar needleleaved evergreen shrubland open canopy	3.1	Water bodies	0.0
Temperate or sub-polar mixed broadleaved and needleleaved dwarf shrubland open canopy	3.1	Burnt area	3.1
Temperate or subpolar grassland	3.1	Snow and ice	0.0
Temperate or subpolar grassland with sparse tree layer	3.1	Wetlands	4.5
Tropical or sub-tropical broadleaved evergreen open	6.6	Herbaceous wetlands	3.1

(1) Wiedinmyer C et al; Atmos Environ 40: 3419-3432 (2006)

► [Hazardous Substances Data Bank \(HSDB\)](#)

11.2.15 Probable Routes of Human Exposure

According to the 2006 [TSCA](#) Inventory Update Reporting data, the number of persons reasonably likely to be exposed in the industrial manufacturing, processing, and use of methane is 1000 or greater; the data may be greatly underestimated(1).

(1) US EPA; Inventory Update Reporting (IUR). Non-confidential 2006 IUR Records by Chemical, including Manufacturing, Processing and Use Information. Washington, DC: U.S. Environmental Protection Agency. Available from, as of Nov 6, 2013: <https://cfpub.epa.gov/iursearch/index.cfm>

► [Hazardous Substances Data Bank \(HSDB\)](#)

NIOSH (NOES Survey 1981-1983) has statistically estimated that 65,649 workers (2,728 of these were female) were potentially exposed to methane in the US(1). Occupational exposure to methane may occur through inhalation of this compound at workplaces where methane is

produced or used. Monitoring data indicate that the general population may be exposed to methane via inhalation of ambient air(SRC).

(1) NIOSH; NOES. National Occupational Exposure Survey conducted from 1981-1983. Estimated numbers of employees potentially exposed to specific agents by 2-digit standard industrial classification (SIC). Available from, as of Nov 6, 2013: <https://www.cdc.gov/noes/>

▶ [Hazardous Substances Data Bank \(HSDB\)](#)

12 Associated Disorders and Diseases



▶ [Comparative Toxicogenomics Database \(CTD\)](#); [Therapeutic Target Database \(TTD\)](#)

Associated Occupational Diseases with Exposure to the Compound

Asphyxiation, simple [Category: Acute Poisoning]

▶ [Haz-Map, Information on Hazardous Chemicals and Occupational Diseases](#)

Disease	References
Crohn's disease	PubMed: 16440420, 11418788, 8723414, 19491857, 17269711, 23516449, 23867873, 24811995, 25598765, 26806034, 26848182, 27609529, 28842642

Ulcerative colitis

PubMed: 21059682, 1740537, 17314143, 17269711,
21761941, 23516449, 23867873, 24811995,
25598765, 26806034, 26848182, 27609529,
28842642

► [Human Metabolome Database \(HMDB\)](#)

13 Literature



13.1 Consolidated References



► [PubChem](#)

13.2 NLM Curated PubMed Citations



► Medical Subject Headings (MeSH)

13.3 Springer Nature References



► Springer Nature



► Springer Nature

13.4 Thieme References



► Thieme Chemistry



► Thieme Chemistry

13.5 Wiley References



► Wiley

13.6 Beilstein References



► Beilstein Journals

13.7 Chemical Co-Occurrences in Literature



► PubChem

13.8 Chemical-Gene Co-Occurrences in Literature



► PubChem

13.9 Chemical-Disease Co-Occurrences in Literature



► PubChem

13.10 Chemical-Organism Co-Occurrences in Literature





▶ PubChem

14 Patents



14.1 Depositor-Supplied Patent Identifiers



▶ PubChem

Link to all deposited patent identifiers

▶ PubChem

14.2 WIPO PATENTSCOPE



Patents are available for this chemical structure:

<https://patentscope.wipo.int/search/en/result.jsf?inchikey=VNWKTOKETHGBQD-UHFFFAOYSA-N>

▶ PATENTSCOPE (WIPO)

14.3 Chemical Co-Occurrences in Patents



▶ PubChem

14.4 Chemical-Disease Co-Occurrences in Patents



► PubChem

14.5 Chemical-Gene Co-Occurrences in Patents



► PubChem

14.6 Chemical-Organism Co-Occurrences in Patents



[▶ PubChem](#)

15 Interactions and Pathways



15.1 Protein Bound 3D Structures



View 30 proteins in NCBI Structure

[▶ PubChem](#)

15.2 Chemical-Target Interactions

[▶ Comparative Toxicogenomics Database \(CTD\)](#)

15.3 Pathways



► PubChem

16 Biological Test Results



16.1 BioAssay Results



► PubChem

17 Taxonomy



► E. coli Metabolome Database (ECMDB); Natural Product Activity and Species Source (NPASS)

18 Classification



18.1 MeSH Tree



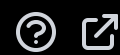
► Medical Subject Headings (MeSH)

18.2 NCI Thesaurus Tree



► NCI Thesaurus (NCIt)

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► ChEBI

18.4 ChemIDplus



► ChemIDplus

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► CAMEO Chemicals

18.6 UN GHS Classification



► GHS Classification (UNECE)

18.7 EPA Chemical Data Reporting Classification



► EPA Chemical Data Reporting (CDR)

18.8 EPA CPDat Classification



► EPA Chemical and Products Database (CPDat)

18.9 NORMAN Suspect List Exchange Classification





▶ NORMAN Suspect List Exchange

18.10 EPA DSSTox Classification



▶ EPA DSSTox

18.11 EPA TSCA and CDR Classification



▶ EPA Chemicals under the TSCA

18.12 LOTUS: Biological Tree



▶ LOTUS - the natural products occurrence database

18.13 FDA Drug Type and Pharmacologic Classification



▶ National Drug Code (NDC) Directory

18.14 EPA Substance Registry Services Tree



▶ EPA Substance Registry Services

18.15 Chemicals in PubChem from Regulatory Sources



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<https://cameochemicals.noaa.gov/chemical/3757>

METHANE

<https://cameochemicals.noaa.gov/chemical/8823>

METHANE, REFRIGERATED LIQUID (CRYOGENIC LIQUID)

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Methane polymer

https://commonchemistry.cas.org/detail?cas_rn=27936-85-2

Methane, dimer

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<https://pubchem.ncbi.nlm.nih.gov/substance/?source=chemidplus&sourceid=0007440440>

<https://pubchem.ncbi.nlm.nih.gov/substance/?source=chemidplus&sourceid=0007782403>

ChemIDplus Chemical Information Classification

<https://pubchem.ncbi.nlm.nih.gov/source/chemidplus>

5. DHS Chemical Facility Anti-Terrorism Standards (CFATS) Chemicals of Interest

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<https://www.cisa.gov/resources-tools/resources/chemical-facility-anti-terrorism-standards-cfats-appendix-chemicals-interest-coi-list>

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Methane

<https://chem.echa.europa.eu/100.000.739>

Methane (EC: 200-812-7)

<https://chem.echa.europa.eu/substance-search?searchText=200-812-7>

graphene oxide (EC: 942-699-3)

<https://chem.echa.europa.eu/substance-search?searchText=942-699-3>

single-walled carbon nanotubes (EC: 922-749-0)

<https://chem.echa.europa.eu/substance-search?searchText=922-749-0>

single-walled carbon nanotubes

<https://chem.echa.europa.eu/100.125.535>

Expandable Graphite

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graphene oxide

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<https://gsrs.ncats.nih.gov/ginas/app/beta/substances/OP0UW79H66>

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https://chemicalsafety.ilo.org/dyn/icsc/showcard.display?p_card_id=0291

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Methane or natural gas but excluding refrigerated liquid methane or natural gas

<https://www.epa.govt.nz/industry-areas/hazardous-substances/guidance-for-importers-and-manufacturers/hazardous-substances-databases/>

16. NJDOH RTK Hazardous Substance List

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<https://www.energy.gov/web-policies>

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<https://emhub1.energy.gov/pacteel/search#74-82-8>

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19. Emergency Response Guidebook (ERG)

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<https://www.transportation.gov/web-policies>

Methane

<https://pubchem.ncbi.nlm.nih.gov/erg/>

20. US Code of Federal Regulations, Hazardous Materials, 49 CFR Part 172

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Methane, compressed or Natural gas, compressed (with high methane content)

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<https://haz-map.com/About>

Methane

<https://haz-map.com/Agents/1074>

22. ChEBI

Methane

<https://www.ebi.ac.uk/chebi/searchId.do?chebiId=CHEBI:16183>

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<https://www.ebi.ac.uk/chembl/explore/compound/CHEMBL17564>

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AST 120

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Methane

<https://ctdbase.org/detail.go?type=chem&acc=D008697>

28. Therapeutic Target Database (TTD)

AST-120

<https://ttd.idrblab.cn/data/drug/details/D06ZVG>

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NPC98121

<https://bidd.group/NPASS/compound.php?compoundID=NPC98121>

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METHANE

<https://comptox.epa.gov/dashboard/DTXSID8025545#exposure>

EPA CPDat Classification

<https://www.epa.gov/chemical-research/chemical-and-products-database-cpd>

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33. NITE-CMC

Methane - FY2006 (New/original classification)

<https://www.chem-info.nite.go.jp/chem/english/ghs/06-imcg-1390e.html>

34. Hazardous Chemical Information System (HCIS), Safe Work Australia

methane

<http://hcis.safeworkaustralia.gov.au/HazardousChemical/Details?chemicalID=2845>

35. MassBank Europe

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[query=exists\(compound.metaData.name:%27InChIKey%27%20and%20compound.metaData.value:%27VNWKTOKETHGBQD-UHFFFAOYSA-N%27\)](https://mona.fiehnlab.ucdavis.edu/spectra/browse?query=exists(compound.metaData.name:%27InChIKey%27%20and%20compound.metaData.value:%27VNWKTOKETHGBQD-UHFFFAOYSA-N%27))

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<https://spectrabase.com/spectrum/ENH1ALZflK5>

Methane

<https://spectrabase.com/spectrum/D312notnklz>

Methane

<https://spectrabase.com/spectrum/EaPShEUd3Dg>

39. Japan Chemical Substance Dictionary (Nikkaji)

http://jglobal.jst.go.jp/en/redirect?Nikkaji_No=J2.380I

http://jglobal.jst.go.jp/en/redirect?Nikkaji_No=J593B

http://jglobal.jst.go.jp/en/redirect?Nikkaji_No=J2.228.533E

http://jglobal.jst.go.jp/en/redirect?Nikkaji_No=J68.119I

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42. NMRShiftDB

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NORMAN Suspect List Exchange Classification

<https://www.norman-network.com/nds/SLE/>

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<https://pubchem.ncbi.nlm.nih.gov/substance/434316137>

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methane

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Methyldyne radical

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50. Wiley

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Biogas

<https://id.nlm.nih.gov/mesh/M0529145.html>

MeSH Tree

<https://www.nlm.nih.gov/mesh/meshhome.html>

52. PubChem

<https://pubchem.ncbi.nlm.nih.gov>

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GHS Classification

<https://unece.org/about-ghs>

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Biological Tree

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FDA Drug Type and Pharmacologic Classification

<https://www.fda.gov/drugs/drug-approvals-and-databases/national-drug-code-directory>

57. EPA Substance Registry Services

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EPA SRS List Classification

<https://maldi.nist.gov>

58. PATENTSCOPE (WIPO)

SID 403029853

<https://pubchem.ncbi.nlm.nih.gov/substance/403029853>

59. NCBI

<https://www.ncbi.nlm.nih.gov/projects/linkout>