MATERIAL SAFETY DATA SHEET

1. SUBSTANCE AND SOURCE IDENTIFICATION

National Institute of Standards and Technology
Standard Reference Materials Program
100 Bureau Drive, Stop 2300
Gaithersburg, Maryland 20899-2300

SRM Number: 2289
MSDS Number: 2289
SRM Name: t-Amyl-methyl Ether in Reference Gasoline (Nominal 2.7 Weight Percent Oxygen)

Date of Issue: 06 July 2012

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Description: This Standard Reference Material (SRM) is intended primarily for use as a primary standard for the calibration of instruments used for the determination of the oxygen content of motor fuels. A unit of SRM 2289 consists of two ampoules of solution of t-amyl-methyl ether in reference gasoline and one ampoule of reference gasoline without the t-amyl-methyl ether to use as a blank. Each 20 mL ampoule contains approximately 18 mL of solution.

Substance: Gasoline and gasoline with t-amyl-methyl ether.

Other Designations:
Gasoline (gasoline, unleaded; motor spirits; petrol; mid-grade gasoline; "A" grade gasoline [NRCA]).

t-Amyl-methyl ether (2-methoxy-methylbutane; 1,1,-dimethylpropyl methyl ether; 2-methyly-2-methoxy butane; methyl 1,1-dimethylpropyl ether; methyl tert-butyl amyl ether; TAME; tert-amyl methyl ether).

2. HAZARDS IDENTIFICATION

NFPA Ratings (Scale 0–4): Health = 1 Fire = 3 Reactivity = 0

Note: The two different formulations (gasoline and gasoline with t-amyl-methyl ether) have many of the same physical properties and present similar health hazards to the user. This MSDS applies to both formulations unless otherwise noted. Gasoline contains many different components at varying concentrations (See Section 3, "Composition and Information on Hazardous Ingredients").

Major Health Hazards: Potentially fatal on contact with the skin, harmful if swallowed, respiratory tract irritation, skin irritation, eye irritation, aspiration hazard, blood damage, liver damage, central nervous system depression, nerve damage, and cancer.

Physical Hazards: Extremely flammable liquid and vapor. Vapor may cause flash fire.

Potential Health Effects (Acute and Chronic)

Inhalation: Irritation, ringing in ears, nausea, vomiting, chest pain, difficulty breathing, irregular heartbeat, headache, drowsiness, symptoms of drunkenness, disorientation, visual disturbances, lung congestions, blood disorders, paralysis, convulsions, and coma. Long-term effects may include hearing loss, kidney damage, nerve damage, reproductive effects, brain damage, and cancer.

Skin Contact: Short-term contact may cause irritation, blisters, rash, and kidney damage; long-term contact may cause burns and tingling sensation.

Eye Contact: Tearing and irritation.

Ingestion: Vomiting, digestive disorders, chest pain, difficulty breathing, irregular heartbeat, headache, drowsiness, symptoms of drunkenness, disorientation, visual disturbances, dilated pupils, bluish skin color, lung congestion, lung damage, liver damage, paralysis, convulsions, and coma. Long-term effects may include impotence and cancer.

Listed as a Carcinogen/Potential Carcinogen

	Yes	No
In the National Toxicology Program (NTP) Report on Carcinogens	X[(a)]	
In the International Agency for Research on Cancer (IARC) Monographs	X[(a,b,c)]	
By the Occupational Safety and Health Administration (OSHA)	X[(a)]	

[(a)] NTP lists benzene as *known human carcinogen*. IARC lists benzene as Group 1 (*carcinogenic to humans*). OSHA lists benzene as a cancer hazard (see 29 CFR 1910.1028).
[(b)] IARC lists gasoline and possible components as Group 2B (*possibly carcinogenic to humans*).
[(c)] IARC lists toluene as Group 3 (*not classifiable*).

3. COMPOSITION AND INFORMATION ON HAZARDOUS INGREDIENTS

Component	CAS Number	EC Number (EINECS)	Nominal Concentration (%)
Gasoline	8006-61-9	232-349-1	100
Components[(a)]			
Toluene	108-88-3	203-625-9	0 – 15
t-Amyl-methyl ether[(b)]	994-05-8	213-611-4	17
Benzene	71-43-2	200-753-7	0 – 5

[(a)] This material is a complex mixture that has not been tested as a whole. Concentrations of the components are listed as required by OSHA, 29 CFR 1910.1200 (g)(2)(i)(C)(1), for MSDS information with hazardous components (1 % or greater) and carcinogens (0.1 % or greater).

[(b)] t-Amyl-methyl ether is not present in the ampoule labeled "Gasoline Blank".

EC Classification

Gasoline: T, Carc. Cat. 2, Muta Cat. 2, Xn
Toluene: F, Repr. Cat. 3, Xn, Xi
t-Amyl-methyl ether: F, Xn
Benzene: F, Carc. Cat. 1, Muta. Cat. 2, T, Xn, Xi

EC Risk Phrases (R No): 11, 22, 36/38, 45, 46, 48/23/24/25, 48/20, 63, 65, 67

EC Safety Phrases (S No): 9, 16, 23, 33, 36/37, 45, 46, 53, 62

EC Risk/Safety Phrases: See Section 15, "Regulatory Information".

4. FIRST AID MEASURES

Inhalation: If adverse effects occur, remove to uncontaminated area. If not breathing, give artificial respiration by qualified personnel. Seek immediate medical attention.

Skin Contact: Rinse affected area with soap and water for at least 15 minutes. Seek medical assistance if necessary.

Eye Contact: Immediately flush eyes, including under the eyelids, with copious amounts of water for at least 15 minutes. Seek immediate medical attention.

Ingestion: Contact local position control center or physician immediately. Never make an unconscious person vomit or drink fluids. If vomiting occurs, keep head lower than hips to help prevent aspiration. If person is unconscious, turn head to side. Get help immediately.

5. FIRE FIGHTING MEASURES

Fire and Explosion Hazards: Severe fire hazard. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back. Vapor/air mixtures are explosive.

Extinguishing Media: Regular dry chemical, carbon dioxide, fine water spray, and regular foam.

Fire Fighting: Avoid inhalation of combustion by-products.

Flash Point: –45 °C (–49 °F)
Method Used: Estimate.

Autoignition Temperature: 280 °C to 456 °C (536 °F to 853 °F)

Flammability Limits in Air

UPPER (Volume %): 7.6
LOWER (Volume %): 1.2

6. ACCIDENTAL RELEASE MEASURES

Occupational Release: Absorb with sand or other non-combustible material and collect in appropriate container for proper disposal. Subject to California Safe Drinking Water and Toxic Enforcement Act 1986 (Proposition 65). Keep out of water supplies and sewers.

Disposal: Refer to Section 13, "Disposal Considerations".

7. HANDLING AND STORAGE

Storage: Store and handle in accordance with all current regulations and standards.

Safe Handling Precautions: See Section 8, "Exposure Controls and Personal Protection".

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

Exposure Limits: There are no specific occupational limits established for gasoline. The following limits are for the individual components.

Exposure Limits			
Components	**OSHA (PEL)**	**ACGIH (TLV)**	**NIOSH (REL)**
Benzene	0.5 ppm Action level 1 ppm TWA[(a)] 5 ppm STEL (15 min) 25 ppm Ceiling	0.5 ppm TWA 2.5 ppm STEL Skin[(b)]	0.1 ppm TWA 1 ppm STEL 500 ppm IDLH
Toluene	200 ppm TWA 300 ppm Ceiling	20 ppm TWA	100 ppm TWA (375 mg/m^3 TWA) 150 ppm STEL (560 mg/m^3 STEL) 500 ppm IDLH
t-Amyl-methyl ether	No occupational limits established.	20 ppm TWA	No occupational limits established.

[(a)] Cancer hazard, Flammable, See 29 CFR 1910.128; a 10 ppm TWA applies to industry segments exempt from the benzene standard (29 CFR 1910.128).

[(b)] Potential significant contribution to overall exposure by the cutaneous route.

Ventilation: Provide local exhaust or process enclosure ventilation system. Ensure compliance with applicable exposure limits.

Respirator: If workplace conditions warrant a respirator, a respiratory protection program that meets OSHA 29 CFR 1910.134 must be followed. Refer to NIOSH 24 CFR 84 for applicable certified respirators.

Eye Protection: Wear safety goggles. An eyewash station and drench shower should be readily available near the handling and use areas.

Personal Protection: In accordance with OSHA 29 CFR 1910.132, subpart I, wear appropriate Personal Protective Equipment (PPE) to minimize exposure to this material.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance and Odor: Clear, colorless to amber liquid; gasoline odor (0.25 ppm threshold)
Molecular Formula: Not applicable.
Molar Mass: Not applicable.
Density: 5.6 to 6.5 lbs/gal
Specific Gravity (water = 1): 0.7 to 0.8 at 15.6 °C
Percent volatile (%): 100
Boiling Point: 27 °C to 225 °C (81 °F to 437 °F)

Vapor Pressure:	330 mmHg to 775 mmHg at 37.8 °C
Vapor Density (air = 1):	>1
Melting Point:	Not available.
Water Solubility:	Approximately 10 %
Solvent Solubility:	Soluble in absolute alcohol, ether, chloroform, and benzene
pH:	Not available.

10. STABILITY AND REACTIVITY

Stability: X Stable _____ Unstable

Stable at normal temperatures and pressure.

Conditions to Avoid: Avoid heat, flames, sparks, and other sources of ignition. Containers may rupture or explode if exposed to heat. Keep out of water supplies and sewers.

Incompatible Materials: Oxidizing materials, acids, bases, halocarbons, metals, metal salts, halogens, peroxides, metal oxides, combustible materials.

Fire/Explosion Information: See Section 5, "Fire Fighting Measures".

Hazardous Decomposition: Oxides of carbon.

Hazardous Polymerization: _____ Will Occur X Will Not Occur

11. TOXICOLOGICAL INFORMATION

Route of Entry: X Inhalation X Skin X Ingestion

Toxicity data and endpoints listed by Registry of Toxic Effects of Chemical Substances (RTECS).

Components	**Toxicity Data**	
Gasoline	Rat, Inhalation LC_{50}:	300 g/m^3 (5 min)
	Rat, Oral LD_{50}:	13 600 mg/kg
	Mutagenic:	No data available.
	Reproductive:	No data available.
	Tumorigenic:	Rat, Inhalation, TCLo: 2056 ppm (6 h); 1501 ppm (78 week)
Toluene	Rat, Oral LD_{50}:	636 mg/kg
	Rat, Inhalation LC_{50}:	12.5 mg/L (4 h); >26700 ppm (1 h); 49 g/m^3 (4 h)
	Rabbit, Dermal LD_{50}:	8390 mg/kg
	Rat, Dermal LD_{50}:	12 124 mg/kg; 14100 µL/kg
	Mutagenic:	Human, TC: 252 µg/L (19 years); Mouse, TD: 433 µg/kg (24 h)
	Reproductive:	Rat, Inhalation, TCLo: 1500 ppm (6 to 20 d pregnant)
	Tumorigenic:	No data available.
t-Amyl-methyl ether	Rat, Oral LD_{50}:	1602 mg/kg
	Rat, Inhalation LC_{50}:	>5400 mg/m^3 (4 h)
	Rabbit, Dermal LD_{50}:	>3160 mg/kg
	Mutagenic:	Hamster: 313 000 ug/L (4 h) (+S9)
	Reproductive:	Rat, Inhalation, TCLo: 1500 ppm (mulitgeneration)
		Rat, Inhalation, TCLo: 3500 ppm (6 h; 6 to 19 d pregnant)
	Tumorigenic:	No data available.
Benzene	Rat, Oral LD_{50}:	1800 mg/kg
	Rat, Inhalation LC_{50}:	13 050 ppm-14 380 ppm (4 h)
	Mutagenic:	Human, TC: 252 µg/L (19 years); Mouse, TD: 433 µg/kg (24 h)
	Reproductive:	Rat, Inhalation, TCLo: 150 ppm (24 h; 7 to 14 d pregnant)
	Tumorigenic:	Human, Inhalation, TC: 10 mg/m^3 (11 y); 150 ppm (15 min)
		Human, Inhalation, TCLo: 10 ppm (8 h)

Health Effects: See Section 2, "Hazards Identification" for potential health effects.

Target Organs: Central nervous system, nervous system, liver, immune system (blood).

Medical Conditions Aggravated by Exposure: The following system disorders may be affected: central nervous, kidney, liver, blood, nervous, eye, metabolic, immune, allergies, respiratory, and skin.

12. ECOLOGICAL INFORMATION

Components	Ecotoxicity Data	
Gasoline	Fish:	Rainbow trout (*Oncorhynchus mykiss*) LC_{50}: 56 g/L (96 h)
	Algae:	Green algae *(Pseudokirchneriella subcapitata*) EC_{50}: 4700 mg/L (72 h)
Toluene	Fish:	Rainbow trout (*Oncorhynchus mykiss*) LC_{50}: 5.8 mg/L (96 h) [semi-static]
		Fathead minnow (*Pimephales promelas*) LC_{50}: 12.6 mg/L (96 h) [static]
	Algae:	Green algae *(Pseudokirchneriella subcapitata*) EC_{50}: 12.5 mg/L (72 h) [static]
	Invertebrate:	Freshwater water flea (*Daphnia magna*) EC_{50}: 11.5 mg/L (48 h)
t-Amyl-methyl ether	No data available.	
Benzene	Fish:	Rainbow trout (*Oncorhynchus mykiss*) LC_{50}: 5.3 mg/L (96 h) [flow-through]
	Algae:	Green algae *(Pseudokirchneriella subcapitata*) EC_{50}: 29 mg/L (72 h)
	Invertebrate:	Freshwater water flea (*Daphnia magna*) EC_{50}: 10 mg/L (48 h)

13. DISPOSAL CONSIDERATIONS

Waste Disposal: Dispose of waste in accordance with all applicable federal, state, and local regulations. Subject to disposal regulations, U.S. EPA 40 CFR 262, Hazardous Waste Number D001. Hazardous waste number: D018. Dispose of in accordance with U.S. EPA 40 CFR 262 for concentrations at or above the regulatory level (0.5 mg/L).

Toluene waste number U220

Benzene waste number U019 (ignitable waste); 0.5 mg/L regulatory level.

14. TRANSPORTATION INFORMATION

U.S. DOT and IATA: Gasoline, Hazard Class 3, UN1203, Packing Group II.

15. REGULATORY INFORMATION

U.S. Regulations

CERCLA Sections 102a/103 (40 CFR 302.4):

Gasoline and t-amyl-methyl ether are not regulated.

Toluene [1000 lb final RQ (454 kg)].

Benzene [10 lb final RQ (4.54 kg) received an adjusted RQ of 10 lbs based on potential carcinogenicity in a August 14, 1989 final rule]

SARA Title III Section 302 (40 CFR 355.30): Gasoline, t-amyl-methyl ether, toluene, and benzene are not regulated.

SARA Title III Section 304 (40 CFR 355.40): Gasoline, t-amyl-methyl ether, toluene, and benzene are not regulated.

SARA Title III Section 313 (40 CFR 372.65):

Gasoline and t-amyl-methyl ether are not regulated.

Toluene (1.0 % de minimis concentration).

Benzene (0.1 % de minimis concentration).

OSHA Process Safety (29 CFR 1910.119): Gasoline, t-amyl-methyl ether, toluene, and benzene are not regulated.

SARA Title III Sections 311/312 Hazardous Categories (40 CFR 370.21):

ACUTE HEALTH:	Yes
CHRONIC HEALTH:	Yes
FIRE:	Yes
REACTIVE:	No
PRESSURE:	No

State Regulations:

California Proposition 65:

Warning: This material contains a chemical (benzene) known to the state of California to cause cancer.

Warning: This material contains chemicals (toluene, benzene, t-amyl-methyl ether) known to the state of California to cause reproductive/developmental effects.

Canadian Regulations:

WHMIS Information: Not provided for this material.

European Regulations

EC Classification

Gasoline: T – Toxic, Carc. Cat. 2, Xn – Harmful, Muta Cat. 2
Toluene: F – Flammable, Xn – Harmful, Repr. Cat. 3, Xi – Irritant
t-Amyl-methyl ether: F – Flammable, Xn – Harmful
Benzene: F – Flammable, T – Toxic, Carc. Cat. 1, Xn – Harmful, Muta. Cat. 2, Xi – Irritant

EC Risk Phrases (R No):

R11 – Highly flammable.
R22 – Harmful if swallowed.
R36/38 – Irritating to eyes and skin.
R45 – May cause cancer.
R46 – May cause heritable genetic damage.
R48/23/24/25 – Toxic: danger of serious damage to health by prolonged exposure through inhalation, in contact with skin, and if swallowed.
R48/20 – Harmful: danger of serious damage to health by prolonged exposure through inhalation.
R63 – Possible risk of harm to the unborn child.
R65 – Harmful: may cause lung damage if swallowed.
R67 – Vapours may cause drowsiness or dizziness.

EC Safety Phrases (S No):

S9 – Keep container in well-ventilated place.
S16 – Keep away from sources of ignition – No smoking.
S23 – Do not breathe vapours.
S33 – Take precautionary measures against static discharges.
S36/37 – Wear suitable protective clothing and gloves.
S45 – In case of accident or if you feel unwell, seek medical advice immediately (show label where possible).
S46 – If swallowed, seek medical advice immediately and show this container or label.
S53 – Avoid exposure – obtain special instructions before use.
S62 – If swallowed, do not induce vomiting; seek medical advice immediately and show this container or label.

National Inventory Status

U.S. Inventory (TSCA): Listed.
TSCA 12(b), Export Notification: Not listed.

16. OTHER INFORMATION

Sources: ChemADVISOR, Inc., MSDS, *Gasoline, Unleaded, Oxygenated*, 14 March 2012.

ChemADVISOR, Inc., MSDS, *Tertiary-Amyl Methyl Ether*, 20 December 2011.

EC; European Chemical Substance Information System (ESIS), *Benzene, CAS No. 71-43-2,* available at http://esis.jrc.ec.europa.eu/index.php?PGM=cla (accessed July 2012).

EC; ESIS, *tert-amyl methyl ether, CAS No. 994-05-8,* available at http://esis.jrc.ec.europa.eu/index.php?PGM=cla (accessed July 2012).

EC; ESIS, *Toluene, CAS No. 108-88-3,* available at http://esis.jrc.ec.europa.eu/index.php?PGM=cla (accessed July 2012).

EC; ESIS, *Gasoline, CAS No. 8006-61-9,* available at http://esis.jrc.ec.europa.eu/index.php?PGM=cla (accessed July 2012).

ConocoPhillips, MSDS, *Unbranded Conventional Gasoline*, SDS Number: 724020, 14 June 2011.

ConocoPhillips, MSDS, *Unbranded Conventional Gasoline Reformulated with Ethanol*, SDS Number: 724060, 14 June 2011.