

## **APPENDIX Q**

### **Crude Oil Material Safety Data Sheets**

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## **CRUDE OIL MATERIAL SAFETY DATA SHEETS**

For planning purposes, the attached Material Safety Data Sheets (MSDS) identify the chemical composition and maximum volumes of those chemicals that would be present in the dilbit or Bakken crude in the event of a release. These MSDS do not represent the actual product that would flow through the proposed Keystone XL pipeline.

In the event of a release, the specific MSDS and exact composition of the product shipped (and released) would be provided to emergency responders, including any federal, state, or local agencies involved in spill response actions, within 1 hour of the release (see Section 4.13.6.2, Safety and Spill Response, for emergency procedures). Keystone would maintain a point of contact (and procedure to contact this point of contact with this hour timeframe) for requests for MSDS and the identification of the exact product composition (both crude and diluents) shipped in the pipeline (when a release occurs) who would be authorized to release the MSDS and chemical composition information (as described above) to first responders.

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# Material Safety Data Sheet

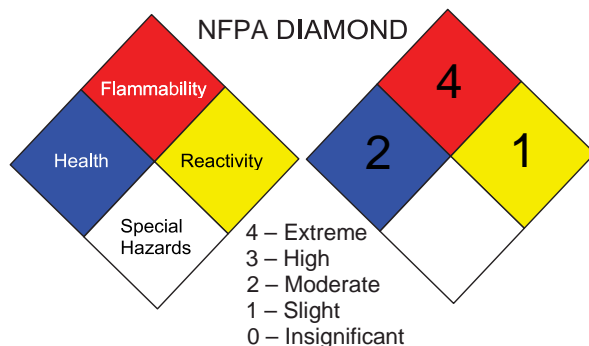
**FOR INFORMATIONAL/PLANNING PURPOSES ONLY – NOT FOR USE  
THIS DOES NOT REPRESENT AN ACTUAL FORMULATION  
Bakken Crude Oil**

## 1 – CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Manufacturer/Supplier: Various  
Product Name: Bakken Crude Oil

Synonyms: Hydrocarbons of Petroleum  
Bakken Oil  
Bakken Light

General Information: 780-420-5306  
Emergency Telephone Number: N/A  
Date Prepared: 11/22/2013



## 2 – PRODUCT COMPOSITION: INFORMATION ON INGREDIENTS

REPRESENTATIONAL Bakken Sweet Crude with 40% volatile fraction

| Component              | CAS Number | Maximum % *<br>by vol./vol.<br>(estimated) | Occupational Exposure Limits<br>(ppm) |       |                       |
|------------------------|------------|--|---------------------------------------|-------|-----------------------|
|                        |            |  | OSHA                                  | ACGIH | NIOSH                 |
| Petroleum hydrocarbons | 68919-39-1 | 100  | N/A                                   | N/A   | N/A                   |
| Benzene                | 71-43-2    | 1.2  | 1                                     | 0.5   | 0.1                   |
| Toluene                | 108-88-3   | 1.2  | 100                                   | 20    | 100                   |
| Ethylbenzene           | 100-41-4   | 1.2  | 100                                   | 20    | 100                   |
| Xylenes                | 1330-20-7  | 1.2  | 100                                   | 100   | 100                   |
| n-butane               | 106-97-8   | 6.9  | 800                                   | 1000  | 800                   |
| n-pentane              | 109-66-0   | 5.7  | 600                                   | 600   | 120                   |
| n-heptane              | 142-82-5   | 7.8  | 500                                   | 400   | 85                    |
| n-hexane               | 110-54-3   | 4.5  | 50                                    | 50    | 50                    |
| n-octane               | 111-65-9   | 6.9  | 500                                   | 300   | 75                    |
| n-nonane               | 111-84-2   | 3.3  | None                                  | 200   | 200                   |
| Hydrogen sulfide       | 7783-06-4  | <0.01                                      | 20 <sup>Ceiling</sup>                 | 1     | 10 <sup>Ceiling</sup> |

\* Values reflect reasonable potential maximums  
N/A - Not available

## 3 – HAZARDS IDENTIFICATION

**Routes of Entry:** Skin contact, skin absorption, eye contact, inhalation, ingestion

**Overview:** Flammable liquid and vapor. Liquid and vapor may cause irritation or burns to eyes, nose, and throat. Inhalation of vapor may cause dizziness and drowsiness. Possible cancer hazard (benzene). Possible asphyxiation hazard (hydrogen sulfide and ethane). Wear personal protective equipment appropriate for the task.

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Bakken Crude Oil**

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**Flammability:** Flammable liquid and vapor. Keep away from heat, sparks, flames, or other sources of ignition (such as static electricity, pilot lights, mechanical/electrical equipment).

**Stability:** Stable under normal conditions. Avoid all sources of ignition.

## POTENTIAL HEALTH EFFECTS

### Acute Effects

**Ingestion:** Ingestion may result in nausea, vomiting, diarrhea and central nervous system depression.

Aspiration of liquid into the lungs must be avoided as even small quantities in the lungs can produce chemical pneumonitis, pulmonary edema/hemorrhage, and even death.

**Skin Contact:** Prolonged and repeated contact may cause defatting and drying of the skin and can lead to irritation and/or dermatitis. Exposure to hot material may cause thermal burns.

**Eye Contact:** Liquid or vapor contact may cause mild eye irritation, including stinging, watering, redness, and swelling. Hydrogen sulfide (H<sub>2</sub>S) may cause burning or tearing and visual disturbances at repeated exposures above the TLV.

**Inhalation:** Prolonged or excessive exposure may cause irritation to the nose, throat, lungs, and respiratory tract and may lead to headache, nausea, drowsiness, fatigue, pneumonitis, pulmonary edema, CNS depression, coma, and respiratory arrest.

### Chronic Effects

Skin and eye irritation. May affect the respiratory and central nervous systems.

### Special Toxic Effects

n-Hexane (CAS 110-54-3):

Target Organs – Excess exposure to n-hexane can result in peripheral neuropathies. The initial symptoms are symmetrical sensory numbness and paresthesia of distal portions of the extremities. Motor weakness is typically observed in muscles of the toes and fingers but may also involve muscles of the arms, thighs, and forearms. The onset of these symptoms may be delayed for several months to a year after the beginning of exposure. The neurotoxic properties of n-hexane are potentiated by exposure to methyl ethyl ketone and methyl isobutyl ketone. Prolonged exposure to high concentrations of n-hexane (>1,000 ppm) has resulted in decreased sperm count and degenerative changes in the testes of rats but not those of mice.

Benzene (CAS 71-43-2):

Carcinogenicity: Benzene is a known animal carcinogen and is known to produce leukemia in humans. Benzene has been identified as a human carcinogen by NTP, IARC, and OSHA.

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## 4 – FIRST AID MEASURES

**Ingestion:** Do not induce vomiting or give anything by mouth because this material can enter the lungs and cause severe damage. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration.

**Skin Contact:** Wipe material from skin and remove contaminated clothing. Cleanse affected areas thoroughly by washing with mild soap and water and, if necessary, a waterless skin cleanser. If irritation or redness develops, seek medical attention.

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**Bakken Crude Oil**

**Eye Contact:** Move victim away from exposure and into fresh air. Flush eyes with clean water for 15 minutes, with eyelids held open. If irritation persists, seek medical attention.

**Inhalation:** Ensure own safety. If respiratory symptoms or other symptoms of exposure develop, move victim away from source of exposure and into fresh air. If symptoms persist, seek immediate medical attention. If victim is not breathing, clear airway and immediately begin artificial respiration. If breathing difficulties develop, qualified personnel should administer oxygen. Seek immediate medical attention.

**Notes to Physician:** Epinephrine and other sympathomimetic drugs may initiate cardiac arrhythmias in persons exposed to high concentrations of this material (e.g., in enclosed spaces or with deliberate abuse). The use of other drugs with less arrhythmogenic potential should be considered. If sympathomimetic drugs are administered, observe for development of cardiac arrhythmias.

## 5 – FIRE FIGHTING MEASURES

|                               |   |                             |                 |
|-------------------------------|---|-----------------------------|-----------------|
| Flash point °C:               | < 22  | Lower explosive limit %v/v: | 0.8 (estimated) |
| Auto ignition temperature °C: | Not established                                 | Upper explosive limit %v/v: | Not established |
| Combustion products:          | Carbon monoxide, sulfur oxides, nitrogen oxides |                             |                 |

**Overview:** Material will ignite at normal temperature. Foam, carbon dioxide (CO<sub>2</sub>), dry chemical can be used as a mean to extinguish fire. Explosive accumulation can build in areas of poor ventilation. Use water spray to cool fire-exposed containers, and to disperse vapors if spill has not ignited.

**Basic Fire Fighting Procedures:** For fires beyond the incipient stage, emergency responders in the immediate hazard area should wear bunker gear. When the potential chemical hazard is unknown, in enclosed or confined spaces or when explicitly required by DOT, a self-contained breathing apparatus should be worn. In addition, wear other appropriate protective equipment as conditions warrant. Isolate immediate hazard area, keep unauthorized personnel out. Stop spill/release if it can be done with minimal risk. Move undamaged containers from immediate hazard area if it can be done with minimal risk. Water spray may be useful in minimizing or dispersing vapors. Cool equipment exposed to fire with water, if it can be done with minimal risk. Avoid spreading burning liquid with water used for cooling purposes.

**Extinguishing Media:** Any extinguisher capable of handling Class B fires is recommended, including extinguishing media such as CO<sub>2</sub>, dry chemical, foam, or water as a fog. Water spray is recommended to cool or protect exposed materials or structures. Water may be ineffective for extinguishment, unless used under favorable conditions by experienced fire fighters. Carbon dioxide can displace oxygen. Use caution when applying carbon dioxide in confined spaces. Firefighting should be attempted only by those who are adequately trained and equipped with proper personal protective equipment.

**Unusual Fire and Explosion Hazards:** This material is flammable and may be ignited by heat, sparks, flames or other sources of ignition (such as static electricity, pilot lights, or mechanical/electrical equipment). Vapors may travel considerable distances to a source of ignition where they can ignite, flash back, or explode. May create vapor/air explosion hazard indoors, outdoors, or in sewers. Vapors are heavier than air and can accumulate in low areas. If container is not properly cooled, it can rupture in the heat of a fire.

## 6 – EXPOSURE CONTROLS AND PERSONAL PROTECTION

**Eye Protection:** Safety glasses or goggles are recommended when there is a possibility of splashing or spraying.

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**Skin Protection:** The use of gloves (nitrile or neoprene) is advised to prevent skin contact and possible irritation. Depending on conditions, the use of an apron, chemical protective clothing, and rubber boots may be necessary. When hot material is present, wear thermal resistant gloves, arm protection, and face shield.

**Respiratory Protection:** A NIOSH-certified air purifying respirator with an organic vapor cartridge may be used under conditions where airborne concentrations of hydrocarbons are expected to exceed exposure limits. Protection provided by air purifying respirators is limited. Use a positive pressure air supplied respirator if there is a potential for an uncontrolled release, exposure levels are not known or any other circumstances where air purifying respirators may not provide adequate protection. A respiratory protection program that meets U.S. OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements must be followed when workplace conditions warrant a respirator's use.

**Engineering Controls:** If current ventilation practices are not adequate to maintain airborne concentrations below the established exposure limits, additional ventilation or exhaust systems may be required. Where explosive mixtures may be present, electrical systems safe for such locations must be used (see appropriate electrical codes).

**Hygiene Measures:** Wash hands and face after handling and before eating, drinking, or smoking. Take off contaminated clothing and wash before re-use.

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## 7 – ACCIDENTAL RELEASE MEASURES

**Personal Precautions:** Appropriately trained personnel should respond to uncontrolled release. Avoid direct contact with material; use the personal protective equipment specified in SDS for a specific spill event because the characteristics could vary for those herein. Stay upwind of release; isolate the immediate hazard area; and keep unnecessary and unprotected people away. Use water spray to cool containers. Eliminate all sources of ignition. Provide explosion-proof clearing ventilation, if possible.

**Environmental Precautions:** Prevent material from entering soil, waterways, drains, sewers, or confined areas.

**Spill Management:** Wear appropriate breathing apparatus (if applicable) and protective clothing. A vapor suppressing foam may be used to reduce vapors. Try to work upwind of spill. Dike and contain land spills; contain water spills by booming. For large spills remove by mechanical means such as vacuuming or pumping and place in containers. All equipment used when handling the product must be grounded. Recover and return free product to proper containers. Use suitable absorbent materials such as vermiculite, sands, soil, or clay to clean up residual liquids. Do not wash spills into sewers or other public water systems.

**Reporting:** Report spills to local or federal authorities as appropriate or required.

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## 8 – HANDLING AND STORAGE

The use of explosion-proof equipment is recommended and may be required (see appropriate fire codes). Do not enter confined spaces such as tanks or pits without following proper entry procedures. The use of appropriate respiratory protection is advised when concentrations exceed any established exposure limits.

Use appropriate grounding and bonding practices. Store recovered material and exposed PPE in properly closed containers that are appropriately labeled and in a cool well-ventilated area. Do not expose to heat, open flames, strong oxidizers, or other sources of ignition. Do not cut, drill, grind, or weld on empty containers since they may contain explosive residues.



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Harmful concentrations of hydrogen sulfide (H<sub>2</sub>S) gas can accumulate in excavations and low-lying areas as well as the vapor space of storage and bulk transport compartments. Stay upwind and vent open hatches before uploading.

Avoid skin contact. Exercise good personal hygiene including removal of soiled clothing and prompt washing with soap and water.

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## 9 – PHYSICAL AND CHEMICAL PROPERTIES

|                                   |                                 |
|-----------------------------------|---------------------------------|
| Appearance:                       | Clear to brown liquid           |
| Physical form:                    | Liquid                          |
| Substance type (pure/mixture):    | Mixture                         |
| Boiling temperature:              | <33°C                           |
| Melting temperature:              | Not determined                  |
| Vapor pressure:                   | about 380 mm Hg                 |
| Vapor density:                    | 1.0 - 3.9                       |
| Evaporation rate(ethyl ether =1): | >1                              |
| Specific gravity:                 | 0.82                            |
| Water solubility:                 | Negligible                      |
| pH:                               | Not determined                  |
| Viscosity:                        | 5.43 mm <sup>2</sup> /s         |
| Color:                            | Clear to brown                  |
| Odor:                             | Rotten egg, petroleum-like odor |
| Percent volatiles, (v/v)          | 15-40 (estimated)               |

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## 10 – STABILITY AND REACTIVITY

**Conditions to avoid:** Excessive heat, sources of ignition, sparks, open flames, and buildup of static electricity.

**Chemical stability:** Stable at <18°C (estimated), 760 mmHg pressure.

**Hazardous decomposition products:** Combustion produces carbon monoxide, aldehydes, aromatic and other hydrocarbons.

**Hazardous polymerization:** Will not occur.

**Incompatibility:** Strong oxidizers such as nitrates, chlorates, peroxides.

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## 11 – TOXICOLOGICAL INFORMATION– CHRONIC AND ACUTE HEALTH HAZARDS

This product contains benzene at a level of 1.2% v/v. Repeated or prolonged exposure to benzene at concentrations in excess of the TLV may cause serious injury to blood-forming organs. Significant chronic exposure to benzene vapor has been reported to produce various blood disorders ranging from aplastic anemia to certain forms of leukemia (cancer) in humans. Benzene produced tumors in rats and mice in lifetime chronic toxicity studies, but the response has not been consistent across species, strain, sex, or route of exposure. Animal studies on benzene have demonstrated immune toxicity, chromosomal aberrations, testicular effects, and alterations in reproductive cycles and embryo/fetotoxicity, but not teratogenicity.

Hydrogen sulfide gas (H<sub>2</sub>S) is toxic by inhalation. Prolonged breathing of 50 to 100 ppm H<sub>2</sub>S vapors can produce eye and respiratory tract irritation. Higher concentration (250 to 600 ppm) for 15 to 30 minutes

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can produce headache, dizziness, nervousness, nausea, and pulmonary edema or bronchial pneumonia. Concentrations of >1,000 ppm will cause immediate unconsciousness and death through respiratory paralysis. Rats and mice exposed to 80 ppm H<sub>2</sub>S, 6 hr/day, 5 days/week for 10 weeks did not produce any toxicity except for irritation of nasal passages. H<sub>2</sub>S did not affect reproduction and development (birth defects or neurotoxicity) in rats exposed to concentrations of 75 to 80 ppm or 150 ppm H<sub>2</sub>S, respectively. Over the years, a number of acute cases of H<sub>2</sub>S poisoning have been reported. Complete and rapid recovery is the general rule. However, if the exposure was sufficiently intense and sustained, causing cerebral hypoxia (lack of oxygen to the brain), neurologic effects such as amnesia, intention tremors, or brain damage are possible.

This product may contain hexane. Studies in laboratory animals have produced systemic toxicity in blood, spleen, and lungs. Fetotoxicity has been observed at hexane concentrations that produced maternal toxicity. Long-term exposure to high concentrations of hexane has been shown to cause testicular effects and nervous system damage.

This product may contain xylenes. Gross overexposure or severe poisoning incidents in humans to xylenes has been reported to cause lung, liver, kidney, heart, and brain damage as well as neurologic disturbances. Laboratory animals exposed to high dose of xylenes showed evidence of effects in the liver, kidneys, lungs, spleen, heart, and adrenals. Exposure of pregnant rats, mice, and rabbits during gestation to significant concentrations of xylenes produced maternal, fetal, and developmental toxicity (skeletal retardation, cleft palate, and wavy ribs) generally at maternally toxic doses. These types of fetotoxic effects have been associated with maternal toxicity. Repeated inhalation of high xylene concentrations has shown impairment of performance abilities (behavioral tests) in animals and humans. Xylenes produced a mild frequency hearing loss in rats subchronically exposed to high concentrations of xylenes.

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## 12 – DISPOSAL INFORMATION

Material should be properly containerized for disposal and must be disposed with care and in full compliance with federal, state, and local regulations. Larger empty containers, such as drums, should be returned to the distributor or to a drum reconditioner. To assure proper disposal of smaller empty containers, consult with state and local regulations and disposal authorities. This product, if it must be discarded, may meet the criteria of a hazardous waste as defined by USEPA RCRA (40 CFR 261), or other state and local regulations. If this product is classified as a hazardous waste, federal law requires disposal at a licensed hazardous waste disposal facility. This product could also contain benzene at >0.5 ppm and could exhibit the characteristic of “toxicity” (D018) as determined by the toxicity characteristic leaching procedure (TCLP). This material could become a hazardous waste if mixed or contaminated with a hazardous waste or other substance(s). It is the responsibility of the user to consult federal, state, and local waste regulations to determine appropriate disposal options.

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## 13 – ENVIRONMENTAL INFORMATION

Keep all sources of ignition and hot metal surfaces away from spill/release. The use of explosion-proof equipment is recommended. Stay upwind and away from spill/release. Notify persons downwind of spill/release, isolate immediate hazard area and keep unauthorized personnel out. Product may release large amounts of flammable vapors (e.g., methane, ethane, and propane) at or below ambient temperature depending on source and process conditions. Stop spill/release if it can be done with minimal risk. Wear appropriate protective equipment including respiratory equipment as conditions warrant. Prevent spilled material from entering sewers, storm drains, other unauthorized treatment drainage systems, and natural waterways. Use foam on spills to minimize vapors. Spilled material may be absorbed into an appropriate absorbent material.

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**Bakken Crude Oil**

Notify fire authorities and appropriate federal, state (provincial) and local agencies. Immediate cleanup of any spill is recommended. If spill of any amount into navigable waters, notify appropriate federal, state, and local agencies.

Sara Title III Information: This material contains the following chemicals subject to the reporting requirements of SARA 313 and 40 CFR 372:

| Chemical | CAS No.  | Weight %  |
|----------|----------|-----------|
| Toluene  | 108-88-3 | 0 – 3%    |
| n-hexane | 110-54-3 | up to 11% |
| Benzene  | 71-43-2  | 0 – 3%    |

## 14 – REGULATORY INFORMATION

**USA:** All of the components of this product are on the Toxic Substances Control Act (TSCA) Chemical Inventory.

**USEPA Reportable Quantity:** The estimated reportable quantity (RQ) for this material is based on the weight % shown below:

- RQ based on benzene: The RQ for benzene is 10 pounds, which equals 46 gallons of crude oil. The RQ is based on 3 wt. % benzene.
- RQ based on n-hexane: The RQ for n-hexane is 5,000 pounds, which equals 8,300 gallons of crude oil. The RQ is based on 11 wt. % n-hexane.
- RQ based on toluene: The RQ for toluene is 1,000 pounds, which equals 4,600 gallons of crude. The RQ is based on 3 wt. % toluene.

## 15 – SPECIAL PRECAUTIONS AND SUPPLEMENTAL INFORMATION

Before working on or in pipe, fittings, or tanks which contain or have contained this material, refer to OSHA regulations, ANSI Z49.1, and other governmental and industrial references pertaining to cleaning, repairing, welding, or other contemplated operations.

## 16 – TRANSPORTATION REQUIREMENTS

General Transportation Information:

DOT proper shipping name (49 CFR 172.101): Petroleum crude oil  
DOT hazard classes (49 CFR 172.101): 3  
UN/NA code (49 CFR 172.101): UN1267  
Packing group (49 CFR 172.101): I or II  
Bill of lading description (49 CFR 172.202): Petroleum crude oil  
DOT labels required (49 CFR 172.101): Flammable liquid  
Prepared by: N/A

# Material Safety Data Sheet

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*Bakken Crude Oil*

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## DISCLAIMER

The information presented herein is based on data considered to be accurate as of the date of preparation of this Material Safety Data Sheet (MSDS). However, MSDSs may not be used as a commercial specification sheet of manufacturer or seller, and no warranty or representation, express or implied, is made as to the accuracy or completeness of the foregoing data and safety information, nor is any authorization given or implied to practice any patented invention without a license. In addition, no responsibility can be assumed by vendor for any damage or injury resulting from abnormal use, from any failure to adhere to recommended practices, or from any hazards inherent in the nature of the product.

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## ABBREVIATIONS

ACGIH American Conference of Governmental Industrial Hygienists

CAS Chemical Abstract Service

CFR Code of Federal Regulations

IARC International Agency for Research on Cancer

NIOSH National Institute for Occupational Safety and Health

NTP National Toxicology Program

OSHA Occupational Safety and Health Administration

SARA Superfund Amendments and Reauthorization Act

TLV threshold limit value

TSCA Toxic Substance Control Act

# Material Safety Data Sheet

FOR INFORMATIONAL/PLANNING PURPOSES ONLY – NOT FOR USE

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Diluted Bitumen

## 1 – CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Manufacturer/Supplier: Various

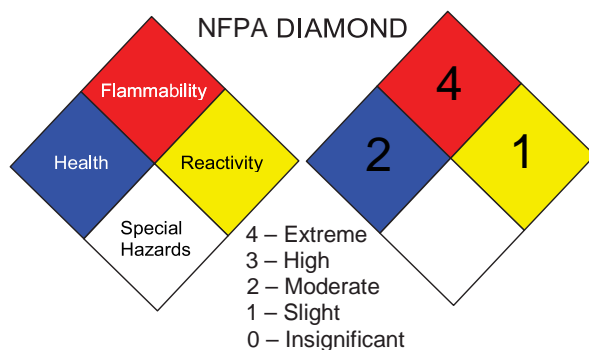
Product Name: Diluted bitumen

Synonyms: Diluted bitumen (DILBIT)  
with 60% diluent mix

General Information: 780-420-5306

Emergency Telephone Number: N/A

Date Prepared: 11/22/2013



## 2 – PRODUCT COMPOSITION: INFORMATION ON INGREDIENTS

REPRESENTATIONAL Diluted bitumen with 60% light naphtha as diluent

| Component                               | CAS Number | Maximum % *<br>by vol./vol.<br>(estimated) | Occupational Exposure Limits<br>(ppm) |       |                       |
|---|------------|--|---------------------------------------|-------|-----------------------|
|   |            |  | OSHA                                  | ACGIH | NIOSH                 |
| Bitumen                                 | 8052-42-4  | 40   | N/A                                   | N/A   | N/A                   |
| Diluent (light naphtha) <sup>1</sup>    | 8032-32-4  | 60   | N/A                                   | 400   | 100                   |
| Light naphtha: benzene                  | 71-43-2    | 1.9  | 1                                     | 0.5   | 0.1                   |
| Light naphtha: toluene                  | 108-88-3   | 7.6  | 100                                   | 20    | 100                   |
| Light naphtha: ethylbenzene             | 100-41-4   | 2.7  | 100                                   | 20    | 100                   |
| Light naphtha: xylenes                  | 1330-20-7  | 13.4                                       | 100                                   | 100   | 100                   |
| Light naphtha: n-hexane                 | 110-54-3   | 13.4                                       | 50                                    | 50    | 50                    |
| Light naphtha: cyclohexane              | 110-82-7   | 7.6  | 300                                   | 100   | 300                   |
| Light naphtha: heptane<br>(and isomers) | 142-82-5   | 5.7  | 500                                   | 400   | 85                    |
| Light naphtha: pentane                  | 109-66-0   | 7.6  | 600                                   | 600   | 120                   |
| Nickel                                  | 7440-02-0  | 57.4 ppm                                   | 500                                   | 300   | 75                    |
| Vanadium                                | 7440-62-2  | 137.7 ppm                                  | None                                  | 200   | 200                   |
| Sulfur <sup>2</sup>                     | 7704-34-9  | 3.49                                       | 20 <sup>Ceiling 2</sup>               | 1     | 10 <sup>Ceiling</sup> |

<sup>1</sup> General composition ranges shown and vary greatly by source.

<sup>2</sup> Exposure limit is for hydrogen sulfide.

\* Values reflect reasonable potential maximums.

N/A = Not available

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Diluted Bitumen

REPRESENTATIONAL Diluted bitumen with 60% natural gas condensate as diluent

| Component                                     | CAS Number | Maximum % *<br>by vol./vol.<br>(estimated) | Occupational Exposure Limits<br>(ppm) |       |                       |
|---|------------|--|---------------------------------------|-------|-----------------------|
|   |            |  | OSHA                                  | ACGIH | NIOSH                 |
| Bitumen                                       | 8052-42-4  | 40   | N/A                                   | N/A   | N/A                   |
| Diluent (natural gas condensate) <sup>1</sup> |            | 60   | N/A                                   | N/A   | N/A                   |
| Propane                                       | 74-98-6    | 19.8                                       | 1,000                                 | 2,500 | 1,000                 |
| Ethane  | 74-84-0    | 19.8                                       | N/A                                   | N/A   | N/A                   |
| n-pentane                                     | 109-66-0   | 8.3  | 600                                   | 600   | 120                   |
| n-hexane                                      | 110-54-3   | 4.3  | 50                                    | 50    | 50                    |
| Heptane (and isomers)                         | 142-82-5   | 3.3  | 500                                   | 400   | 85                    |
| Octane  | 111-65-9   | 3.3  | 500                                   | 75    | 300                   |
| Other hydrocarbons<br>(including BTEX)        | N/A        | 1.7  | 1                                     | 0.5   | 0.1                   |
| Nickel  | 7440-02-0  | 57.4 ppm                                   | 500                                   | 300   | 75                    |
| Vanadium                                      | 7440-62-2  | 137.7 ppm                                  | None                                  | 200   | 200                   |
| Sulfur <sup>2</sup>                           | 7704-34-9  | 3.49                                       | 20 <sup>Ceiling</sup>                 | 1     | 10 <sup>Ceiling</sup> |

<sup>1</sup> General composition ranges shown and vary greatly by source.

<sup>2</sup> Exposure limit is for hydrogen sulfide.

\* Values reflect reasonable potential maximums.

N/A = Not available.

## 3 – HAZARDS IDENTIFICATION

**Routes of Entry:** Skin contact, skin absorption, eye contact, inhalation, ingestion

**Overview:** Flammable liquid and vapor. Liquid and vapor may cause irritation or burns to eyes, nose, and throat. Inhalation of vapor may cause dizziness and drowsiness. Possible cancer hazard (benzene). Possible asphyxiation hazard (hydrogen sulfide and ethane). Wear personal protective equipment appropriate for the task.

**Flammability:** Flammable liquid and vapor. Keep away from heat, sparks, flames, or other sources of ignition (such as static electricity, pilot lights, mechanical/electrical equipment).

**Stability:** Stable under normal conditions. Avoid all sources of ignition.

## POTENTIAL HEALTH EFFECTS

### Acute Effects

**Ingestion:** Ingestion may result in throat burning, gastrointestinal irritation, abdominal pain, nausea, vomiting, and diarrhea. Aspiration of liquid into the lungs must be avoided as even small quantities in the lungs can produce chemical pneumonitis and even death.

**Skin Contact:** Low toxicity through skin contact. Exposure to hot material may cause thermal burns. Signs of irritation include localized redness, swelling, and itching. Prolonged and repeated contact may cause drying of the skin and can lead to irritation and/or dermatitis.

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*Diluted Bitumen*

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**Eye Contact:** Hot splashes may cause mild eye irritation to eye damage. Exposure commonly includes stinging, watering, redness, swelling, light sensitivity. Hydrogen sulfide (H<sub>2</sub>S) may cause burning or tearing and visual disturbances at repeated exposures above the TLV.

**Inhalation:** Prolonged or excessive exposure may cause irritation to the nose, throat, lungs, and respiratory tract and may lead to headache, nausea, drowsiness, fatigue, peculiar skin sensations, digestive upset, pulmonary edema, CNS depression, coma, and respiratory arrest.

## Chronic Effects

Skin and eye irritation. May affect the respiratory and central nervous systems.

## Special Toxic Effects

n-Hexane (CAS 110-54-3):

Target Organs – Excess exposure to n-hexane can result in peripheral neuropathies. The initial symptoms are symmetrical sensory numbness and paresthesia of distal portions of the extremities. Motor weakness is typically observed in muscles of the toes and fingers but may also involve muscles of the arms, thighs, and forearms. The onset of these symptoms may be delayed for several months to a year after the beginning of exposure. The neurotoxic properties of n-hexane are potentiated by exposure to methyl ethyl ketone and methyl isobutyl ketone. Prolonged exposure to high concentrations of n-hexane (>1,000 ppm) has resulted in decreased sperm count and degenerative changes in the testes of rats but not those of mice.

Benzene (CAS 71-43-2):

Carcinogenicity: Benzene is a known animal carcinogen and is known to produce leukemia in humans. Benzene has been identified as a human carcinogen by NTP, IARC, and OSHA.

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## 4 – FIRST AID MEASURES

**Ingestion:** Do not induce vomiting or give anything by mouth because this material can enter the lungs and cause severe damage. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration.

**Skin Contact:** Wipe material from skin and remove contaminated clothing including shoes. Cleanse affected areas thoroughly by washing with mild soap and water and, if necessary, a waterless skin cleanser. If irritation or redness develops, seek medical attention. For hot material, immediately immerse in or flush affected area with large amounts of cold water to dissipate heat. Cover with clean cotton sheeting or gauze and get prompt medical attention.

**Eye Contact:** Move victim away from exposure and into fresh air. Flush eyes with clean water for 15 minutes, with eyelids held open. If irritation persists, seek medical attention.

**Inhalation:** Ensure own safety. If respiratory symptoms or other symptoms of exposure develop, move victim away from source of exposure and into fresh air. If symptoms persist, seek immediate medical attention. If victim is not breathing, clear airway and immediately begin artificial respiration. If breathing difficulties develop, qualified personnel should administer oxygen. Seek immediate medical attention.

**Notes to Physician:** Epinephrine and other sympathomimetic drugs may initiate cardiac arrhythmias in persons exposed to high concentrations of this material (e.g., in enclosed spaces or with deliberate abuse). The use of other drugs with less arrhythmogenic potential should be considered. If sympathomimetic drugs are administered, observe for development of cardiac arrhythmias.

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*Diluted Bitumen*

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## 5 – FIRE FIGHTING MEASURES

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|                               |  |                             |                 |
|-------------------------------|--|-----------------------------|-----------------|
| Flash point °C:               | < 35   | Lower explosive limit %v/v: | 0.8 (estimated) |
| Auto ignition temperature °C: | 250 (estimated)                                | Upper explosive limit %v/v: | Not established |
| Combustion products:          | Carbon monoxide, carbon dioxide, sulfur oxides |                             |                 |

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**Overview:** Material will ignite at normal temperature. Foam, carbon dioxide (CO<sub>2</sub>), dry chemical can be used as a mean to extinguish fire. Explosive accumulation can build in areas of poor ventilation. Use water spray to cool fire-exposed containers, and to disperse vapors if spill has not ignited.

**Basic Fire Fighting Procedures:** Long-duration fires involving diluent stored in tanks may result in a boil-over. The contents of the tank may be expelled beyond the containment dikes or ditches. All personnel should be kept back a safe distance when a boil-over is anticipated (reference NFPA 11). For fires beyond the incipient stage, emergency responders in the immediate hazard area should wear bunker gear. When the potential chemical hazard is unknown, in enclosed or confined spaces or when explicitly required by DOT, a self-contained breathing apparatus should be worn. In addition, wear other appropriate protective equipment as conditions warrant. Isolate immediate hazard area, keep unauthorized personnel out. Stop spill/release if it can be done with minimal risk. Move undamaged containers from immediate hazard area if it can be done with minimal risk. Water spray may be useful in minimizing or dispersing vapors. Cool equipment exposed to fire with water, if it can be done with minimal risk. Avoid spreading burning liquid with water used for cooling purposes.

**Extinguishing Media:** Any extinguisher capable of handling Class B fires is recommended, including extinguishing media such as CO<sub>2</sub>, dry chemical, foam, or water as a fog. Water spray is recommended to cool or protect exposed materials or structures. Water may be ineffective for extinguishment, unless used under favorable conditions by experienced fire fighters. Carbon dioxide can displace oxygen. Use caution when applying carbon dioxide in confined spaces. Firefighting should be attempted only by those who are adequately trained and equipped with proper personal protective equipment.

**Unusual Fire and Explosion Hazards:** This material is flammable and may be ignited by heat, sparks, flames or other sources of ignition (such as static electricity, pilot lights, or mechanical/electrical equipment). Vapors may travel considerable distances to a source of ignition where they can ignite, flash back, or explode. May create vapor/air explosion hazard indoors, outdoors, or in sewers. Vapors are heavier than air and can accumulate in low areas. If container is not properly cooled, it can rupture in the heat of a fire.

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## 6 – EXPOSURE CONTROLS AND PERSONAL PROTECTION

**Eye Protection:** Safety glasses or goggles are recommended when there is a possibility of splashing or spraying.

**Skin Protection:** The use of gloves (nitrile or neoprene) is advised to prevent skin contact and possible irritation. Depending on conditions, the use of an apron or chemical protective and flame resistant clothing and rubber boots may be necessary. When hot material is present, wear thermal resistant gloves, arm protection, and face shield.

**Respiratory Protection:** A NIOSH-certified air purifying respirator with an organic vapor cartridge may be used under conditions where airborne concentrations of hydrocarbons are expected to exceed exposure limits. Protection provided by air purifying respirators is limited. Use a positive pressure air supplied respirator if there is a potential for an uncontrolled release, exposure levels are not known or any other circumstances where air purifying respirators may not provide adequate



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protection. A respiratory protection program that meets U.S. OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements must be followed when workplace conditions warrant a respirator's use.

**Engineering Controls:** If current ventilation practices are not adequate to maintain airborne concentrations below the established exposure limits, additional ventilation or exhaust systems may be required. Where explosive mixtures may be present, electrical systems safe for such locations must be used (see appropriate electrical codes).

**Hygiene Measures:** Wash hands and face after handling and before eating, drinking, or smoking. Take off contaminated clothing and wash before re-use.

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## 7 – ACCIDENTAL RELEASE MEASURES

**Personal Precautions:** Appropriately trained personnel should respond to uncontrolled release. Avoid direct contact with material; use the personal protective equipment specified in SDS for a specific spill event because the characteristics could vary for those herein. Stay upwind of release; isolate the immediate hazard area; and keep unnecessary and unprotected people away. Use water spray to cool containers. Eliminate all sources of ignition. Provide explosion-proof clearing ventilation, if possible.

**Environmental Precautions:** Prevent material from entering soil, waterways, drains, sewers, or confined areas.

**Spill Management:** Wear appropriate breathing apparatus (if applicable) and protective clothing. A vapor suppressing foam may be used to reduce vapors. Try to work upwind of spill. Dike and contain land spills; contain water spills by booming. For large spills remove by mechanical means such as vacuuming or pumping and place in containers. All equipment used when handling the product must be grounded. Recover and return free product to proper containers. Use suitable absorbent materials such as vermiculite, sands, soil, or clay to clean up residual liquids. Do not wash spills into sewers or other public water systems.

**Reporting:** Report spills to local or federal authorities as appropriate or required.

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## 8 – HANDLING AND STORAGE

The use of explosion-proof equipment is recommended and may be required (see appropriate fire codes). Do not enter confined spaces such as tanks or pits without following proper entry procedures. Using appropriate respiratory protection is advised when concentrations exceed any established exposure limits.

Use appropriate grounding and bonding practices. Store recovered material and exposed PPE in properly closed containers that are appropriately labeled and in a cool well-ventilated area. Do not expose to heat, open flames, strong oxidizers, or other sources of ignition. Do not cut, drill, grind, or weld on empty containers since they may contain explosive residues.

Harmful concentrations of hydrogen sulfide (H<sub>2</sub>S) gas can accumulate in excavations and low-lying areas as well as the vapor space of storage and bulk transport compartments. Stay upwind and vent open hatches before uploading.

Avoid skin contact. Exercise good personal hygiene including removal of soiled clothing and prompt washing with soap and water.

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## 9 – PHYSICAL AND CHEMICAL PROPERTIES

|                                |  |
|--------------------------------|--|
| Appearance:                    | Petroleum / amber to black color                     |
| Physical form:                 | Liquid   |
| Substance type (pure/mixture): | Mixture  |
| Boiling temperature:           | >34°C  |
| Melting temperature:           | Not determined                                       |
| Vapor pressure:                | > 150 mm Hg  |
| Vapor density:                 | >1   |
| Evaporation rate:              | Not available  |
| Specific gravity:              | < 1  |
| Water solubility:              | Not measured   |
| pH:                            | Not determined                                       |
| Viscosity:                     | Estimated at 70 centistokes at 40°C                  |
| Color:                         | Amber to black                                       |
| Odor:                          | Petroleum odor and associated smell of “rotten eggs” |

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## 10 – STABILITY AND REACTIVITY

**Conditions to avoid:** Excessive heat, sources of ignition, sparks, open flames, and buildup of static electricity.

**Chemical stability:** Stable

**Hazardous decomposition products:** Oxides of carbon, hydrogen sulfide

**Hazardous polymerization:** Will not occur.

**Incompatibility:** Heat, ignition sources, oxidizing agents

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## 11 – TOXICOLOGICAL INFORMATION – CHRONIC AND ACUTE HEALTH HAZARDS

This product contains benzene at a level of up to 1.9% v/v. Repeated or prolonged exposure to benzene at concentrations in excess of the TLV may cause serious injury to blood-forming organs. Significant chronic exposure to benzene vapor has been reported to produce various blood disorders ranging from aplastic anemia to certain forms of leukemia (cancer) in humans. Benzene produced tumors in rats and mice in lifetime chronic toxicity studies, but the response has not been consistent across species, strain, sex, or route of exposure. Animal studies on benzene have demonstrated immune toxicity, chromosomal aberrations, testicular effects, and alterations in reproductive cycles and embryo/fetotoxicity, but not teratogenicity.

Hydrogen sulfide gas (H<sub>2</sub>S) is toxic by inhalation. Prolonged breathing of 50 to 100 ppm H<sub>2</sub>S vapors can produce eye and respiratory tract irritation. Higher concentration (250 to 600 ppm) for 15 to 30 minutes can produce headache, dizziness, nervousness, nausea, and pulmonary edema or bronchial pneumonia. Concentrations of >1,000 ppm will cause immediate unconsciousness and death through respiratory paralysis. Rats and mice exposed to 80 ppm H<sub>2</sub>S, 6 hr/day, 5 days/week for 10 weeks did not produce any toxicity except for irritation of nasal passages. H<sub>2</sub>S did not affect reproduction and development (birth defects or neurotoxicity) in rats exposed to concentrations of 75 to 80 ppm or 150 ppm H<sub>2</sub>S, respectively. Over the years a number of acute cases of H<sub>2</sub>S poisoning have been reported. Complete and rapid recovery is the general rule. However, if the exposure was sufficiently intense and sustained causing cerebral hypoxia (lack of oxygen to the brain), neurologic effects such as amnesia, intention tremors, or brain damage are possible.

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This product may contain hexane. Studies in laboratory animals have produced systemic toxicity in blood, spleen, and lungs. Fetotoxicity has been observed at hexane concentrations that produced maternal toxicity. Long-term exposure to high concentrations of hexane has been shown to cause testicular effects and nervous system damage.

This product may contain xylenes. Gross overexposure or severe poisoning incidents in humans to xylenes has been reported to cause lung, liver, kidney, heart, and brain damage as well as neurologic disturbances. Laboratory animals exposed to high dose of xylenes showed evidence of effects in the liver, kidneys, lungs, spleen, heart, and adrenals. Exposure of pregnant rats, mice, and rabbits during gestation to significant concentrations of xylenes produced maternal, fetal, and developmental toxicity (skeletal retardation, cleft palate, and wavy ribs) generally at maternally toxic doses. These types of fetotoxic effects have been associated with maternal toxicity. Repeated inhalation of high xylene concentrations has shown impairment of performance abilities (behavioral tests) in animals and humans. Xylenes produced a mild frequency hearing loss in rats subchronically exposed to high concentrations of xylenes.

## 12 – DISPOSAL INFORMATION

Material should be properly containerized for disposal and must be disposed with care and in full compliance with federal, state, and local regulations. Larger empty containers, such as drums, should be returned to the distributor or to a drum reconditioner. To assure proper disposal of smaller empty containers, consult with state and local regulations and disposal authorities. This product, if it must be discarded, may meet the criteria of a hazardous waste as defined by USEPA RCRA (40 CFR 261), or other state and local regulations. If this product is classified as a hazardous waste, federal law requires disposal at a licensed hazardous waste disposal facility. This product could also contain benzene at >0.5 ppm and could exhibit the characteristic of “toxicity” (D018) as determined by the toxicity characteristic leaching procedure (TCLP). This material could become a hazardous waste if mixed or contaminated with a hazardous waste or other substance(s). It is the responsibility of the user to consult federal, state, and local waste regulations to determine appropriate disposal options.

## 13 – ENVIRONMENTAL INFORMATION

Keep all sources of ignition and hot metal surfaces away from spill/release. The use of explosion-proof equipment is recommended. Stay upwind and away from spill/release. Notify persons downwind of spill/release, isolate immediate hazard area and keep unauthorized personnel out. Product may release large amounts of flammable vapors (e.g., methane, ethane, and propane) at or below ambient temperature depending on source and process conditions. Stop spill/release if it can be done with minimal risk. Wear appropriate protective equipment including respiratory equipment as conditions warrant. Prevent spilled material from entering sewers, storm drains, other unauthorized treatment drainage systems, and natural waterways. Use foam on spills to minimize vapors. Spilled material may be absorbed into an appropriate absorbent material.

Notify fire authorities and appropriate federal, state (provincial) and local agencies. Immediate cleanup of any spill is recommended. If spill of any amount into navigable waters, notify appropriate federal, state, and local agencies.

Sara Title III Information: This material contains the following chemicals subject to the reporting requirements of SARA 313 and 40 CFR 372:

| <b>Chemical</b> | <b>CAS No.</b> | <b>Weight %</b> |
|-----------------|----------------|-----------------|
| Benzene         | 71-43-2        | 0 – 5%          |
| n-hexane        | 110-54-3       | up to 35%       |
| Toluene         | 108-88-3       | 0 – 22%         |

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## 14 – REGULATORY INFORMATION

**USA:** All of the components of this product are on the Toxic Substances Control Act (TSCA) Chemical Inventory.

**USEPA Reportable Quantity:** The estimated reportable quantity (RQ) for this material is based on the weight % shown below:

- RQ based on benzene: The RQ for benzene is 10 pounds, which equals 27 gallons of crude oil. The RQ is based on 5 wt. % benzene.
  - RQ based on n-hexane: The RQ for n-hexane is 5,000 pounds, which equals 2,600 gallons of crude oil. The RQ is based on 35 wt. % n-hexane.
  - RQ based on toluene: The RQ for toluene is 1,000 pounds, which equals 630 gallons of crude. The RQ is based on 22 wt. % toluene.
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## 15 – SPECIAL PRECAUTIONS AND SUPPLEMENTAL INFORMATION

Before working on or in pipe, fittings, or tanks which contain or have contained this material, refer to OSHA regulations, ANSI Z49.1, and other governmental and industrial references pertaining to cleaning, repairing, welding, or other contemplated operations.

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## 16 – TRANSPORTATION REQUIREMENTS

General Transportation Information:

|  |                     |
|--|---------------------|
| DOT proper shipping name (49 CFR 172.101):   | Petroleum crude oil |
| DOT hazard classes (49 CFR 172.101):         | 3                   |
| UN/NA code (49 CFR 172.101):                 | UN1267              |
| Packing group (49 CFR 172.101):              | II                  |
| Bill of lading description (49 CFR 172.202): | Petroleum crude oil |
| DOT labels required (49 CFR 172.101):        | Flammable liquid    |
| Prepared by:                                 | N/A                 |

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## **DISCLAIMER**

The information presented herein is based on data considered to be accurate as of the date of preparation of this Material Safety Data Sheet (MSDS). However, MSDSs may not be used as a commercial specification sheet of manufacturer or seller, and no warranty or representation, express or implied, is made as to the accuracy or completeness of the foregoing data and safety information, nor is any authorization given or implied to practice any patented invention without a license. In addition, no responsibility can be assumed by vendor for any damage or injury resulting from abnormal use, from any failure to adhere to recommended practices, or from any hazards inherent in the nature of the product.

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## **ABBREVIATIONS**

ACGIH American Conference of Governmental Industrial Hygienists

CAS Chemical Abstract Service

CFR Code of Federal Regulations

IARC International Agency for Research on Cancer

NIOSH National Institute for Occupational Safety and Health

NTP National Toxicology Program

OSHA Occupational Safety and Health Administration

SARA Superfund Amendments and Reauthorization Act

TLV threshold limit value

TSCA Toxic Substance Control Act

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