

Safe Handling and Storage of

1-Butene

April 1, 2008

Operational Excellence Policy

We will strive each day to conduct our business in a safe, secure, injury-free, and environmentally responsible manner. We are committed to comply with all laws and regulations. We will strive to make optimal use of the resources we consume and minimize emissions and waste. We will strive to limit the risks of our products throughout their lifecycle. We are committed to reducing risks in our operations to safeguard our employees and the communities where we operate. We will openly communicate our results and welcome the input of regulatory agencies, our communities, our customers, and other interested stakeholders.

We will accomplish this by integrating environmental, health, safety, security, reliability, and quality into our management processes using our Operational Excellence System (OE). OE will be used worldwide to: set goals for improvement, provide alignment of activities and resources, assess and manage risks, gain stakeholder input, and rigorously audit our performance against operational objectives and compliance requirements.

A handwritten signature in blue ink, appearing to read "G. C. Garland".

G. C. Garland

President & CEO

Chevron Phillips Chemical Company LLC

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PRODUCT STEWARDSHIP

Chevron Phillips Chemical Company LP (“Chevron Phillips Chemical Company”) is committed to being a good Product Steward of the products we produce. We want anyone who comes in contact with one of our products to have access to information that will help them to understand its potential risk and how to use it safely. The thrust of our Product Stewardship program is the implementation of an Operation Excellence Management System (OEMS) initiative, which makes health, safety and environmental protection an integral part of our products. Successful implementation of this system must include a shared responsibility of all those who come in contact with a product throughout its life cycle. Chevron Phillips Chemical Company will continue to work with customers and others to help ensure that all who use and handle our products follow safe and environmentally sound practices.

The information contained in this technical bulletin is not intended to, nor does it, amend or replace the Chevron Phillips Chemical Company Material Safety Data Sheet (MSDS) for 1-Butene (#PE0015). The most current MSDS can be obtained from Chevron Phillips Chemical Company by calling (800) 852-5530 and should be carefully examined prior to working with this product.

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INTRODUCTION

Gulf Oil Chemicals commercialized the first production of alpha olefins in 1965, under the name of Gulftene[®] alpha olefins. Today, alpha olefin products are produced and marketed by Chevron Phillips Chemical Company (CPCChem). CPCChem produces approximately 180 million pounds of 1-butene per year from its Cedar Bayou, TX facility.

Primarily, 1-butene is sold for use as a comonomer in the manufacture of polyethylene resins. It is also used to produce polybutenes, alcohols, aldehydes, alkylate gasoline, epoxides, mercaptans, metal alkyls and other derivatives.

NOTE:

THIS BROCHURE DOES NOT AMEND OR REPLACE OFFICIAL PUBLICATIONS, SAFETY REGULATIONS NOW IN USE, MATERIAL SAFETY DATA SHEETS OR COMMERCIAL TERMS OF SALE. CHEVRON PHILLIPS CHEMICAL COMPANY MAKES NO GUARANTEE OF THE ACCURACY OF THE CONTENTS OF THIS BROCHURE OR ANY WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, WITH RESPECT TO THE USE OF THIS INFORMATION OR ITS APPLICABILITY. THE USER ASSUMES ALL RISK AND LIABILITY ASSOCIATED WITH THE INFORMATION IN THIS BROCHURE.

PART 1

SPECIFICATIONS, PROPERTIES AND TEST METHODS

1-BUTENE (C₄H₈) SALES SPECIFICATION

<u>Property</u>	<u>Method</u>	<u>Minimum</u>
1-Butene, wt. % C ₄ min.	GLC	99.0
Carbon Number, wt. % C ₄ min.	GLC	99.8
Carbon Number, wt. % >C ₄ max.	GLC	0.05
cis- and trans-2-Butene, wt. % max	GLC	0.34
Paraffin, wt. % max.	GLC	0.34
Water, ppm by wt, max.	Ametek 5800	10
Diene, ppm by wt.	GLC	Note 1

Notes: (1) Run and Record
Revision Date February 2008

TYPICAL PROPERTIES

API gravity at 15.6°C (60°F) ⁽¹⁾	104.14
Autoignition temperature: °C (°F)	384 (723)
Boiling Point at 1 atm. ⁽¹⁾ : °C (°F)	-6.26 (20.73)
Coefficient of Expansion at 15.6°C (60°F), per °F ⁽¹⁾	0.001160
Critical Pressure ⁽¹⁾ : psia	583.00
Critical Temperature ⁽¹⁾ : °C (°F)	146.44 (295.59)
Critical Volume ⁽¹⁾ : ft ³ /lb	0.0685
Density of liquid at 15.6°C (60°F) ⁽¹⁾ : lb/gal	5.006
Flammability limits (volume % in air mix) ⁽¹⁾	Lower= 1.60 Upper= 9.30
Flash Point, TCC: °C (°F)	-80 (-112)
Freezing point at 1 atm. ⁽¹⁾ : °C (°F)	-185.35 (-301.63)
Heat Capacity at 15.6°C (60°F) and Constant Pressure of Gas, Ideal State ⁽¹⁾ : BTU/lb/°F	0.3554
Heat Capacity at 15.6°C (60°F) and Constant Pressure of Liquid at 1 atm. ⁽¹⁾ : BTU/lb/°F	0.5359
Heat of Vaporization at Normal Boiling Point, 1 atm. ⁽¹⁾ : BTU/lb	171.98
Molecular weight ⁽¹⁾	56.11
Octane: Research ⁽¹⁾	97.4
Motor ⁽¹⁾	80.8
Octanol/water partition coefficient (log K _{OW}) ⁽²⁾	1.32 - 2.4
Odor	Slightly aromatic
Physical state at room temperature	Colorless gas or liquid
Reactivity	May react with strong oxidizing agents, such as chlorates, nitrates, peroxides, etc.

RECOMMENDED TEST METHODS

The following ASTM methods are recommended for the analysis of 1-butene:

1. ASTM D 1016 Standard Test Method for Purity of Hydrocarbons from Freezing Points
2. ASTM D 1070 Standard Test Methods for Relative Density (Specific Gravity) of Gaseous Fuels
3. ASTM D 1657 Standard Test Method for Density or Relative Density of Light Hydrocarbons by Pressure Hydrometer
4. ASTM D 2504 Standard Test Method for Noncondensable Gases in C₂ and Lighter Hydrocarbon Products by Gas Chromatography
5. ASTM D 2505 Standard Test Method for Ethylene, Other Hydrocarbons, and Carbon Dioxide in High-Purity Ethylene by Gas Chromatography
6. ASTM D 3120 Standard Test Method for Trace Quantities of Sulfur in Light Liquid Petroleum Hydrocarbons by Oxidative Microcoulometry
7. ASTM D 4051 Standard Practice for Preparation of Low-Pressure Gas Blends
8. ASTM D 4178 Standard Practice for Calibrating Moisture Analyzers
9. ASTM D 4929 Standard Test Methods for Determination of Organic Chloride Content in Crude Oil
10. ASTM F 307 Standard Practice for Sampling Pressurized Gas for Gas Analysis

PART 2

SAMPLING AND HANDLING

TRAINING

In any workplace, training should be conducted before sampling and handling operations of 1-butene are undertaken. Several commercial websites provide access to the Code of Federal Regulations, NIOSH and OSHA databases, which may help in answering questions and setting up safety programs. All workers potentially exposed to 1-butene shall be provided with information and training in accordance with the requirements of OSHA Hazard Communication Standard 29 CFR 1910.1200. The training program shall include the following:

1. Properties and health hazards of 1-butene.
2. Engineering controls and work practices associated with the job assignment.
3. Emergency procedures for leaks, spills, fires, etc. that include the use of personal protective equipment.
4. Measures to be taken to protect personnel from 1-butene exposure.

Other recommended training topics include:

1. Safe work and good housekeeping practices.
2. The importance of respirators, their effectiveness, and the health hazards affected by nonuse.
3. Proper protective equipment required for safe use and handling.
4. Signs and symptoms of 1-butene exposure and action to be taken.
5. The care that must be taken when using, handling, storing, or transporting 1-butene.

6. The availability of written 1-butene usage, health hazard, and training program information.

It is recommended that this training program should be part of a worker's initial training and scheduled at least annually thereafter.

RECOMMENDED PRACTICE FOR SAMPLING

This information is provided for use in establishing sampling and handling procedures. This information should only be utilized in conjunction with an existing health and safety program and cannot be used as a substitute for expert safety and medical advice.

SAMPLING PRECAUTIONS:

Vapor cloud formation from 1-butene liquid or vapor leaks and subsequent contact with an ignition source can cause an explosion. Petroleum gases such as 1-butene are heavier than air and can travel along the ground toward distant ignition sources, which may cause an explosive flashback. Therefore, take extreme care to prevent leakage when sampling 1-butene.

Gaseous 1-butene is extremely flammable and it is usually contained as a liquid under pressure. In liquid form, 1-butene may cause eye and skin irritations or injuries. Therefore, the proper personal protective equipment including gloves, chemical goggles and a face shield should be used when sampling and handling 1-butene.

SAMPLE CONTAINERS:

Clean sample containers by purging with nitrogen and then by flushing with product before taking samples. Cleaning with detergent/water solutions, steam or acetone is not recommended.

Samples can be collected in sample cylinders, floating piston cylinders or cylindrical containers. Sample cylinders are used for high-pressure liquid samples. Quarter-inch valves are typically used on each end of the cylinder. However, 3/8-inch needle valves have also been used. One of the ends should have an OSHA specified safety relief valve. If the samples are to be transported within the United States, the sample containers must meet the specifications of and be prepared for shipment according to the Hazardous Materials Regulations of the Department of Transportation (DOT).

Label sample containers with the sample source, sample date, container identification, sample pressure and temperature, ambient temperature, type of analysis required and the sampling method used. If the sample will be transported, it must be labeled according to DOT regulations.

Inspection, repair and testing of DOT approved cylinders must be performed by trained personnel at a DOT authorized facility. When performing maintenance on floating piston cylinders, special care should be taken when disassembling the cylinder. If either of the end caps are removed while the cylinder is under pressure, the end caps and the piston can be ejected with enough force to cause serious injury to personnel or damage to nearby equipment. When disassembling floating piston cylinders, the following steps should be followed:

1. Clamp the cylinder to a steady work surface.
2. Depressurize both ends of the cylinder to atmospheric pressure before removing the end caps. Ensure that venting is done to a proper recovery source.
3. Clear the area at either end of the cylinder before loosening the end plug.
4. Use a mechanical plunger to dislodge the piston from the cylinders. Do not use fluid pressure.

When filling sample containers with 1-butene, maintain allowances to safely handle thermal expansion. Calculate the total capacity of the

sample containers in order to safely contain the product in its normal and expanded states. If provisions are not made for thermal expansion and the temperature rises, liquid leakage through the pressure relief valves will occur, resulting in a fire hazard.

SAMPLING METHODS:

ASTM D 1265, "Standard Practice for Sampling Liquefied Petroleum (LP) Gases (Manual Method)" and ASTM D 3700, "Standard Practice for Obtaining LPG Samples Using a Floating Piston Cylinder" provide recommended 1-butene sampling procedures. ASTM D 1265 describes procedures for taking liquid samples while ASTM D 3700 lists procedures for both liquid and gas phase sampling.

Emphasis should be placed on obtaining samples that are representative of the product to be tested. If the samples are not valid, analysis results will be useless regardless of the care and accuracy taken during the laboratory testing.

Once the sample has been collected, check the sample container for leaks by using Snoop[®] leak detector or by immersing the container in a water bath. If a leak is detected, discard the sample. See the Disposal section in PART 4 of this brochure for more information.

NOTE:

WHEN WORKING WITH 1-BUTENE, WEAR APPROVED RESPIRATORY EQUIPMENT UNLESS VENTILATION AND / OR OTHER ENGINEERING CONTROLS ARE ADEQUATE TO MAINTAIN A MINIMAL OXYGEN CONTENT OF 19.5% BY VOLUME UNDER ATMOSPHERIC PRESSURE.

REFERENCE DOCUMENTS:

ASTM D 1265 –
Standard Practice for Sampling Liquefied Petroleum (LP) Gases (Manual Method)

ASTM D 3700 –
Standard Practice for Obtaining LPG Samples Using a Floating Piston Cylinder

STATIC ELECTRICITY AND GROUNDING

Static electricity can cause serious incidents such as fires and explosions unless certain precautions are observed. Petroleum gases such as 1-butene are heavier than air and can travel along the ground toward distant ignition sources, which may cause an explosive flashback.

Key operations which have the potential of generating a flammable atmosphere and/or static charge include tank and container filling, splash filling, tank cleaning, sampling, gauging, switch loading, filtering, mixing/agitation and vacuum truck operations. To minimize the hazard of static electricity during these operations, bonding and grounding may be necessary but may not by themselves be sufficient. For more information, refer to OSHA Standard 29 CFR 1910.110: "Storage and Handling of Liquefied Petroleum Gases", National Fire Protection Association (NFPA) 77, "Recommended Practice on Static Electricity", and/or the American Petroleum Institute (API) Recommended Practice 2003, "Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents"

Submerged filling is recommended for all flammable liquids. The inlet line should discharge at a depth no greater than the diameter of the fill pipe from the bottom of the tank in order to minimize static charge accumulation during filling. The fill pipe should be connected electrically to the tank to eliminate uncontrolled electrical discharge.

WARNING:

Personnel wearing rubber-soled shoes, particularly on certain composition floors made of good insulating materials, may pick up considerable static electricity.

AUTO-REFRIGERATION

Drains may become plugged and valves may become inoperable because of the formation of ice due to expanding vapors or vaporizing liquids (auto-refrigeration). Frozen valves may be thawed by washing with an environmentally acceptable low freezing, high-flash liquid such as propylene glycol.

PRODUCT LOADING AND UNLOADING REQUIREMENTS

Chevron Phillips Chemical Company uses vessels, rail tank cars, and tank trucks to transport 1-butene. See the Accidental Release Measures section in PART 4 of this brochure for information in the case of a transportation incident.

WHEN LOADING OR UNLOADING A MARINE VESSEL:

Vessel shipments are regulated by the U. S. Coast Guard. Requirements for vessel shipments of hazardous materials, such as 1-butene, are defined in 46 CFR, Parts 153-154 and 49 CFR, Part 176.

Inspect all equipment prior to each shipment to ensure that safety systems, tanks, piping and valves, and loading and unloading systems are in sound operating condition and free from defects. Safety features such as emergency isolation and disconnect systems on loading arm fittings lower the risk of occupational exposure on marine vessels.

Gaseous 1-butene is very flammable, forming explosive mixtures in air. When loading or unloading 1-butene, the operator must take special precautions to avoid contact with any source of ignition. Shut down any equipment that may be an ignition source. Plan and control the loading and unloading of 1-butene in order to limit personnel exposure and environmental releases.

The general procedure used for the loading and unloading process is dictated by site layout and the standards in that location. Clean carbon steel pressure tanks (bullet tanks) are acceptable for storing 1-butene when transported by vessels. The tanks should be constructed in accordance with DOT specifications and the ASME code for Unfired Pressure Vessels. ChevronTexaco Shipping carefully selects ships in order to ensure that product quality is not negatively affected during transport.

Use qualified personnel to inspect, clean and repair containers in which 1-butene is shipped, providing them with the most up-to-date MSDS. These personnel should ensure that the

necessary facilities are available to dispose of residual product in an acceptable manner.

WHEN LOADING OR UNLOADING TANK CARS OR TANK TRUCKS:

Liquefied 1-butene is shipped in pressurized rail tank cars and tank trucks. Rail tank cars are loaded and unloaded from the top and usually contain about 30,000 gallons of product. Tank trucks are ordinarily loaded and unloaded through the bottom loading/unloading valve and are often equipped with self-unloading pumps. Perform a pre-trip mechanical inspection on rail tank cars and tank trucks prior to each shipment.

Requirements for shipments of hazardous materials, such as 1-butene, by rail and by public highway are defined in 49 CFR, Parts 173, 174, and 177-180. Perform loading and/or unloading operations in accordance with the current regulations of the Department of Transportation (DOT). Significant operational considerations include:

1. Secure area and inform personnel in the area of the operation being performed.
2. Post caution signs during loading, unloading and disconnecting operations.
3. Prevent rail cars and trucks from moving by chocking wheels.
4. Bond and/or ground rail cars/trucks and all loading/unloading equipment to prevent the risk of explosion due to static electricity accumulation.
5. Remove any possible sources of ignition from the area.
6. Test all connections to ensure they are free of leaks before loading or unloading operations begin. Screw-type connections may be used between the rail car or truck and the loading/unloading arms and hoses. The use of "quick-disconnect" fittings is not recommended.
7. Maintain positive pressure to keep air out of the headspace.

8. Use an inert gas, such as nitrogen, or use the 1-butene head pressure for pressuring the product from the car/truck.

Use qualified personnel to clean, inspect, and repair rail tank cars and tank trucks. Cleaning facilities provided by the shipper or unloader should be capable of disposing of the product residue in a responsible manner. Refer to current ISGOTT and USCG rules.

SAFETY REFERENCES

The following publications are excellent references for product handling, safety and fire control:

NFPA 10 –

Standard for Portable Fire Extinguishers

NFPA 11 –

Standard for Low-, Medium-, and High-Expansion Foam Systems

NFPA 68 –

Venting of Deflagrations

NFPA 70 –

National Electrical Code®

NFPA 77 –

Recommended Practice on Static Electricity

NFPA 325 –

Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids

NFPA 780 –

Lightning Protection Systems

API RP 2003 –

Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents

PART 3

STORAGE DESIGN RECOMMENDATIONS

Storage of 1-butene is usually in liquid form under pressure. Take special precaution when storing 1-butene because at ambient conditions it is a flammable gas that forms explosive mixtures in air. If stored in appropriate containers at ambient temperatures, 1-butene is relatively harmless.

STORAGE TANKS

Design storage tanks for 1-butene in accordance with the ASME Code for Unfired Pressure Vessels and/or API Standard 620, "Design and Construction of Large, Welded, Low-Pressure Storage Tanks" (15 psig or less, -270°F to 200°F). Storage facilities should also adhere to 29 CFR 1910.110, "Storage and Handling of Liquefied Petroleum Gases." Design tanks and associated piping to prevent the possibility of brittle fracture by using welded carbon or alloy steels. Underground storage tanks are not recommended because of the difficulty of locating leaks. However, some states require underground storage tanks. The storage site is also an important consideration. When deciding where to store 1-butene, give thought to property lines, nearby buildings, adjacent operations, and possible ignition sources. Do not locate the storage site near any sources of heat or ignition, such as steam pipes. Ensure that nearby electrical equipment is explosion proof.

Construct tank supports from solid masonry, concrete or steel. If using steel, protect it from fire exposure. Electrically connect all parts of the storage system to one another and to a common ground in a way that will prevent the accumulation of static electrical charges. Enclose storage vessels within fire banks that can retain 100% of the tank's volume. Additionally, equip these vessels with pressure relief valves that are connected to a flare system and are set no higher than the design pressure of the vessel. Totally enclose all gauging devices and remove all air when placing new or existing equipment into service. This can be done by water flooding the equipment, then

displacing the water with an inert gas (or 1-butene vapors) or by displacing the air by purging the equipment with an inert gas. Residual oxygen should be less than 500 ppm by volume before putting the equipment in service.

Locate the storage tank inlet at the bottom of the tank. Should a top inlet be desired, extend the fill pipe to a depth no greater than the diameter of the fill pipe from the bottom of the tank in order to minimize static charge accumulating during filling. Connect the fill pipe electrically to both the tank flange and the transfer pipeline. The purpose of this electrical connection is to dissipate any static charge which builds up during filling.

When filling storage vessels with 1-butene, maintain allowances to safely handle thermal expansion. Calculate the total capacity of the storage vessels in order to safely contain the product in its normal and expanded states. If provisions are not made for thermal expansion and the temperature rises, liquid leakage through the pressure relief valves will occur, resulting in a fire hazard.

Specific bulk storage designs must conform to Insurance Underwriter's codes and local fire and building regulations. Critical design, placement, installation and maintenance requirements are usually addressed in these codes and regulations and must be followed. Tanks should be periodically inspected for leaks and serviced in accordance with API Standard 653, "Tank Inspection, Repair, Alteration, and Reconstruction."

Never permit workers to enter an empty tank which has been used for 1-butene until the requirements of the OSHA Confined Space Standard (29 CFR 1910.146) and the Safe Entry Recommendation of API Standard 2015 have been met, including but not limited to required concentrations for oxygen and limitations on concentrations of 1-butene.

API AND ANSI DESIGN REFERENCES

API Petroleum Institute
1220 L Street NW
Washington, DC 20005

Part I – Design:

API RP 520: *Sizing, Selection, and Installation of Pressure-relieving Devices in Refineries*

Part II – Installation:

API Standard 653: *Tank Inspection, Repair, Alteration, and Reconstruction*

API RP 2003: *Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents*

API Standard 2015: *Requirements for Safe Entry and Cleaning of Petroleum Storage Tanks*

American National Standards Institute
25 West 43rd Street, 4th Floor
New York, New York 10036

ANSI B31: *Interpretations of Code for Pressure Piping*

PARTICULATE MATTER

Shipments of 1-butene should be free of particulate matter. However, some particulate matter may originate from outside contamination via the receiving-transfer system.

Avoid particulate matter in 1-butene by:

1. Paying careful attention to cleanliness.
2. Filtering the product to remove particulate matter before use.

FILTERS

Since small amounts of foreign matter may enter storage tanks and transport vessels from various sources, it is recommended to locate filters upstream of meters at the loading terminals. Filters will help to prevent the

meters from plugging and producing inaccurate measurements. Inspect filter cartridges periodically. Clean or replace filters as needed.

HOSES

Hard piping is preferred to the use of hoses where possible and practical. Articulated arms are preferred over flexible hoses for loading and unloading operations because hoses are a potential source of leaks and/or failures. However, if flexible hoses are used, they should have a bursting pressure of at least 317 psia, which is five times the vapor pressure of 1-butene at 100°F. When not in use, do not leave flexible hoses under pressure. Articulated arms and flexible hoses must be inspected frequently, and upon any evidence of damage immediate replacement is recommended. If any problems are observed during transfer operations, shut down the operation immediately and report the problem. Replace the equipment before resuming operations. Use screw-type or flange-type connections between the transport equipment and the unloading arms and hoses. The use of “quick-disconnect” connections is not recommended.

PUMPS

For most 1-butene handling, centrifugal pumps with tandem mechanical seals perform satisfactorily. The pump manufacturer can recommend the proper type of pump if the following parameters are known: 1) flow rate, 2) size and length of suction and discharge lines, 3) suction and discharge pressures, and 4) range of product temperatures during transfer. Install a drain valve at the lowest point in the system so that the pump and all piping can be completely drained before any maintenance work is done. Totally enclosed fan cooled (TEFC) motors are recommended as well as the use of explosion-proof motors. The pump seals must be capable of meeting EPA emission standards, which requires tandem or double seals.

The following practices are recommended to minimize the possibility of pump leakage:

1. Mechanical seals in conformance with API Standard 682.
2. Pumps in conformance with API Standard 610.
3. Pumps designed so that pump bearings will be able to carry thrust at no flow. Selection of non-metallic (PEEK) wear rings to minimize damage if the pump runs dry should be considered.
4. The pump shaft should be highly polished.
5. Pumps should not be subjected to forces beyond specified pump tolerances.
6. Vibration monitoring with automatic shutdown devices.

VALVES

Upon purchasing valves for 1-butene service, ensure that all valve seats, packing and gaskets are rated for this type of service. Gate valves or fire-safe ball valves are recommended for use in loading and unloading operations. Soft-seated valves are useful in minimizing leakage. However, all valves must be rated fire-safe, providing a metal seat backup for the valve stem seal.

Never use cast iron or non-ferrous valves or fittings. To provide for isolation in an emergency, locate valves as close to storage facilities as possible. Refer to 29 CFR 1910.110, "Storage and Handling of Liquefied Petroleum Gases," for more detailed information.

PIPING & FITTINGS

The following are recommended practices in engineering pipelines for 1-butene:

1. Do not use screwed connections for joining pipe sections; the use of flanges and welds is recommended to join the pipe sections. To avoid the potential for leaks, keep the amount of flanged connections to a minimum.
2. Piping and fittings must meet the requirements of the National Code of Standards, such as ANSI B31, "Interpretations of Code for Pressure

Piping." To provide for isolation in an emergency, locate isolation valves as close to the storage facilities as possible. Use relief valves to protect pipelines from over-pressure that can be blocked in by closing isolation valves at each end.

3. Pressure test all newly installed pipelines by an approved method (such as hydro testing) before use.

INCOMPATIBLE MATERIALS

Some materials should not be used with 1-butene. Polyvinyl chloride (PVC), neoprene, nitrile rubber, silicon rubber, butyl rubber, natural rubber, EPR (ethylene/propylene rubber), and Buna-N[®] are **NOT** recommended materials for use with 1-butene. Compatible materials include Viton[®], Duraflow[®], and Kalrez[®].

Strong oxidizing agents such as chlorates, nitrates and peroxides may react with 1-butene. Therefore, avoid contact with these types of materials.

INSULATION

To provide personnel protection and/or conservation of energy, 1-butene pipelines may be insulated. The insulation will help to regulate the product's temperature, but it can make it difficult to determine if the pipeline has a leak or if corrosion is present. Insulation may consist of various materials depending on the temperature of the product. Some examples would be fiberglass or urethane foam.

Allowances for the adequate thermal pressure relief of the product must be considered with the use of insulation. If provisions for thermal expansion are not made and the temperature increases, the pressurized 1-butene liquid will leak out of the system through the pressure relief valves. This will present a fire/explosion hazard. Care should be taken in the design of the thermal control system and the type of insulation used so that the possibility of overheating will not be an issue.

VAPOR CONTROL SYSTEMS

With the implementation of the Clean Air Act by federal and local governments, 1-butene

terminals must control evaporative emissions from loading, unloading and storage operations.

Vapor emissions may be controlled during loading/unloading operations by the use of a vapor recovery line. A vapor recovery line is used to connect the transport vehicle to the storage tank. The displaced vapors are then recovered into the tank through this line.

A "Refrigeration System" may also be used to control vapor emissions. The vapors are directed through a steel pipe to a refrigeration compressor where they are compressed and cooled into a liquid. The vessels used in this system must all comply with the ASME Section VIII Boiler and Pressure Vessel Code.

PART 4

HEALTH, ENVIRONMENT, FIRE AND ACCIDENTAL RELEASE INFORMATION

Although 1-butene is considered to present potential health and flammability hazards, this material can be handled safely if proper precautions are practiced.

The Material Safety Data Sheet (MSDS) for 1-butene is available from Chevron Phillips Chemical Company to help customers further satisfy safe handling and disposal needs as well as OSHA Hazard Communication Standard requirements. Request and study this information prior to working with this product. Please call Chevron Phillips Chemical Company at 800-852-5530 to request the MSDS for 1-butene.

NOTE:

The following information is not intended to, nor does it, amend or replace the MSDS for 1-butene. The most current MSDS should be carefully examined prior to working with this product.

HEALTH HAZARDS AND FIRST AID

EYE CONTACT: Gaseous 1-butene is not expected to cause eye irritation. However, because liquid 1-butene evaporates quickly, it can have a severe chilling effect on eyes and can cause local freezing of tissues (frostbite). Signs and symptoms of frostbite may include pain, tearing, reddening, swelling and impaired vision. **First Aid:** Flush eyes immediately with fresh water for at least 15 minutes while holding the eyelids open. After initial flushing, remove contact lenses, if worn. Get immediate medical attention.

SKIN CONTACT: Gaseous 1-butene is not expected to be irritating to the skin. However, because liquid 1-butene evaporates quickly, it can have a severe chilling effect on skin and can cause local freezing of tissues (frostbite). Signs and symptoms of frostbite may include pain, itching, discoloration, swelling and blistering. If absorbed through the skin, 1-butene is not expected to be harmful to

internal organs. **First Aid:** Soak contact area in tepid water to alleviate the immediate effects and get medical attention.

INGESTION: At ambient conditions 1-butene is a gas and cannot usually be swallowed. However, if the material is swallowed, it is not expected to be harmful. **First Aid:** No specific first aid measures are required.

INHALATION: Prolonged and repeated breathing of 1-butene at low concentrations is believed to produce no adverse health effects. By displacing air, 1-butene acts as a simple asphyxiant and thus reduces oxygen available for breathing. Exposure to very high levels of 1-butene may cause central nervous system effects such as rapid breathing, uncoordination, rapid fatigue, excessive salivation, disorientation, headache, nausea, and vomiting. Convulsions, loss of consciousness, coma, and/or death may occur if exposure to high concentrations continues. **First Aid:** If any signs or symptoms occur, move the person to fresh air. If breathing has stopped, apply artificial respiration. If breathing is difficult, give oxygen and get immediate medical attention.

ECOTOXICITY/ENVIRONMENTAL FATE

Since 1-butene is a gas at ambient temperatures, it is not expected to be harmful to aquatic life or to cause adverse effects to the environment. It is not expected to bioaccumulate in organisms and food chains.

FIRE INFORMATION

Gaseous 1-butene is extremely flammable and a fire hazard. The liquid form very quickly evaporates, even at low temperatures, and forms vapors that can catch fire and burn with explosive violence. The colorless, invisible vapor spreads easily and can be ignited by many sources such as pilot lights, welding

equipment, and electrical motors and switches.

For fires involving 1-butene, immediately withdraw all personnel from the fire area. Isolate the area and deny unnecessary entry. Sounds from venting safety relief devices can be very loud. Do not enter any enclosed or confined fire space without proper protective equipment. This should include self-contained breathing apparatus (SCBA) to protect against the hazardous effects of normal products of combustion or oxygen deficiency. Normal combustion forms carbon dioxide and water vapor while incomplete combustion can produce carbon monoxide.

DO NOT EXTINGUISH. STOP THE FLOW OF FUEL AND ALLOW THE FIRE TO BURN OUT. If flames are accidentally extinguished, explosive re-ignition may occur. Eliminate ignition sources. Keep personnel away. Once fuel flow has stopped, small fires may be extinguished with water fog or fine spray, carbon dioxide, dry chemical, or foam.

Behavior in Fire: Vapors are heavier than air and may travel considerable distances to a source of ignition and flash back. Containers may explode in fire. In a fire situation, conditions can develop which could lead to explosions and further fire propagation. For an unignited vapor cloud, use water spray to knock down and control dispersion of the vapors.

Use water spray to cool the fire affected zone and containers exposed to the fire until the fire is out and danger of re-ignition has passed. Heated containers can cause vapor pressure build-up, which could result in container failure and/or weakening. Discoloration of the containers can be an indication of this effect.

In addition, the expansion of the liquefied 1-butene gas in closed containers that are exposed to fire can lead to a phenomenon called Boiling Liquid Expanding Vapor Explosions (BLEVE). Liquefied 1-butene gas is stored under pressure. Therefore, rapid vaporization of a portion of the liquid 1-butene can occur should the container fail, causing the pressure to be rapidly reduced to atmospheric pressure. The result of such a

scenario can be a “pressure release explosion,” characterized by the extremely rapid mixing of 1-butene vapor and air, causing a fireball ignition by the fire that initially caused the BLEVE.

Static electricity can also accumulate and create a fire hazard. In accordance with applicable codes and regulations, fixed equipment must be grounded. Additionally, employ appropriate bonding and grounding measures during transfer operations.

Flash Point: -80°C (-112°F)

Autoignition Temperature: 384°C (723°F)

NFPA Flammability
Hazard Rating: 4

Flammable Limits in Air: 1.6 - 9.3 vol. %

Burning Rate: 8.8 mm/min.

PERSONAL PROTECTIVE EQUIPMENT

Do not get this material in eyes. Eye contact can be avoided by wearing chemical goggles or a face shield at all times. Do not get on skin or on clothing. Contact with skin and clothing can be avoided by wearing protective clothing when handling 1-butene. Selection of protective clothing may include gloves, apron, boots, and complete facial protection and will depend on the type of operations being conducted. Users should determine if protective clothing is adequate based on physical requirements and other substances present. Suggested materials for protective gloves include Viton or PVA (avoid contact with water; PVA gloves deteriorate in water) plus an inner liner of acrylic or wool for frostbite protection.

Inhalation of 1-butene can be hazardous. Wear approved respiratory equipment when working with this material unless ventilation or other engineering controls are adequate to maintain a minimum oxygen content of 19.5% by volume under normal atmospheric pressure.

SAFETY REFERENCES:

- ANSI Z41.1 Protective Footwear
- ANSI Z87.1 Practice for Occupational and Educational Eye and Face Protection
- ANSI Z88.2 Practices for Respiratory Protection
- ANSI Z89.1 Protective Headwear for Industrial Workers
- ANSI Z358.1 Emergency Eyewash and Shower Equipment
- 29 CFR 1910.132 Personnel Protective Equipment General Requirements
- 29 CFR 1910.133 Personnel Protective Equipment Eye and Face Protection

RESPIRATORY PROTECTION:

The American Conference of Governmental Industrial Hygienists (ACGIH) classifies 1-butene as a simple asphyxiant. It is a cryogenic fluid when contained under high pressures. When released to the atmosphere, 1-butene immediately vaporizes. Under both conditions, 1-butene is extremely flammable and hazardous. The OSHA Hazard Communication Standard requires the work site to have an MSDS (Material Safety Data Sheet) for 1-butene and a "Company Chemical Inventory Sheet" that lists the 1-butene product as a hazardous chemical used at that particular site. These precautions are required to ensure worker safety.

The Lower Explosive Limit (LEL) for 1-butene is equal to 16,000 ppm. Exposure at this concentration level would prove to be extremely hazardous to personnel in the affected area due to the lack of air and the high flammability risks. Lower concentrations of this chemical may also be dangerous if conditions include the following:

1. If the concentration is less than 10% of the LEL (1,600 ppm) work may proceed but steps should be taken to monitor the

presence of 1-butene and the effects it has on personnel.

2. If the concentration exceeds 10% of the LEL (1,600 ppm), the work area should be evacuated immediately. At this point, a hydrocarbon-like odor may be noticed; personnel should still be able to breathe without an SCBA (Self-Contained Breathing Apparatus). Nonetheless, all personnel should evacuate the premises due to the explosion/fire hazard (especially in confined work spaces). Authorized personnel should locate and contain the source. The entire area must be completely ventilated before workers may return to that area.
3. If the concentration reaches 50% of the LEL (8,000 ppm), the exposure level is classified as an explosive "simple asphyxiant." Entry into an area with this level of concentration exposure should be prohibited because the risks of explosion and fire are too high (respirators will NOT provide protection from asphyxiation). If entrance is absolutely required, allow only authorized trained personnel to enter the area with the assistance of a Self-Contained Breathing Apparatus (SCBA) supplied with a full-face piece in positive-pressure mode. Use of an air-supplying suit that is attached to an air supply line is also permitted. If either one of the above respiratory protection devices is used, OSHA requires that the worker be tested and fitted annually for the effectiveness of their personal protective respiratory equipment and clothing.

ACCIDENTAL RELEASE MEASURES

If a transportation incident involving 1-butene does occur, the Chemical Transportation Emergency Center (CHEMTREC) should be contacted for immediate assistance. CHEMTREC is a public service organization established by the American Chemistry Council to provide assistance in hazardous material incidents. **FOR A CHEMICAL EMERGENCY CALL CHEMTREC AT (800) 424-9300 toll free in the United States, Canada, Puerto Rico, and the Virgin Islands. For emergency calls outside the United States call (703) 527-3887.**

CHEMTREC will provide the caller preliminary emergency assistance in the form of Material Safety Data Sheet (MSDS) information. In all cases once CHEMTREC determines the incident involves a Chevron Phillips Chemical material, CHEMTREC will immediately contact the on-call Chevron Phillips Chemical Company Crisis Management Team (CMT) member at 1-866-4HAZMAT (442-9628). The contacted Chevron Phillips Chemical CMT member will then be responsible for coordinating an appropriate response to the transportation incident. In addition, if the CMT member determines that the incident involves exposure or potential health effects, the on-call Chevron Phillips Chemical toxicologist will also be contacted.

Eliminate all sources of ignition in the vicinity of released vapor or a spill. Stop the source of the release and, in the case of large spills, warn the public of downwind explosion hazards. If this material is released into a work area, evacuate the area immediately. Personnel entering the contaminated area to correct the problem or to determine whether it is safe to resume normal activities must comply with all personal protection precautions (see the section on Personal Protective Equipment for more information). Contact local environmental or health authorities to notify them of the release or spill and for information on approved disposal of this material.

Certain geographical areas have air pollution restrictions concerning the use of materials in work situations that may release volatile components to the atmosphere. Study air pollution regulations to determine if 1-butene is regulated in the area where it is to be used.

LEAKS:

Under atmospheric conditions, 1-butene is a highly flammable gas. Liquified 1-butene produces a visible vapor cloud or fog when it is escaping in a situation such as a leak or spill. When a vapor cloud forms, an explosion can occur. The vapor cloud is the result of liquid vaporization which condenses water vapor from air. It should be noted that the vapor cloud is only an approximate indicator of the 1-butene gas area. The invisible ignitable 1-butene/air mixture can extend several feet

beyond the visible fog area. If the concentration of 1-butene in air surrounding the leak has not been determined, assume the worst case. Evacuate personnel from the area and recommend that fire fighters and safety officials on the scene use the highest level of respiratory and protective clothing. Immediately isolate the impacted area in all directions (150 to 350 feet).

Ground all equipment that is used when handling 1-butene. Stay upwind and avoid low areas such as ditches, sewers, or basements; 1-butene vapors are heavier than air and will settle in low or confined spaces. Pressurized 1-butene evaporates rapidly causing the skin to freeze upon contact. The frozen skin is to be treated as a burn and attended to by a qualified doctor. Thermal protective clothing will secure the worker from exposure to the cryogenic liquid. Before attempting to stop the leak, be sure that the flow has been stopped and that all sources of ignition are eliminated.

DISPOSAL

Carry out all disposal procedures in strict conformance with federal, state, and local regulations when dealing with laboratory-sized and larger quantities of 1-butene. Laboratory and sample storage facilities should have the appropriate personal protective equipment on hand and testing and handling procedures should be available and well understood by all laboratory and operating personnel.

Contaminated product may be used in gasoline blending. A safe method for in-plant disposal of 1-butene is controlled incineration at a remote site and with remote control of the ignition source to protect personnel and property. Where the disposal of large quantities is involved, the help of a reliable, competent specialist that has proper equipment and trained personnel to safely handle and dispose of the product is recommended. There are several chemical disposal companies specializing in the safe transportation and disposal of hazardous materials such as 1-butene. Contact Chevron Phillips Chemical Company's Technical Service Group at 1-800-852-5531 if additional assistance is required.

PART 5

TRANSPORTATION INFORMATION AND REGULATORY PROFILE

TRANSPORTATION INFORMATION

LABEL:

CPChem containers are labeled in accordance with applicable OSHA and DOT requirements.

OCCUPATIONAL EXPOSURE LIMITS FOR 1-BUTENE:

OSHA Permissible Exposure Limits (PELs):

- Time-Weighted Average (TWA) = **1000 ppm (as Liquefied Petroleum Gas)**
- Short-Term Exposure Limit (STEL) = **No exposure limits have been established**

OSHA Action Level = **No exposure limits have been established**

ACGIH Threshold Limit Value = **1000 ppm (as Liquefied Petroleum Gas)**

CHEMICAL DESIGNATIONS FOR 1-BUTENE:

- | | |
|----------------------------|---|
| 1. CG Compatibility Class: | Olefins |
| 2. Formula: | CH ₂ = CH-CH ₂ -CH ₃ |
| 3. IMO UN Designation: | UN1012 |
| 4. IMO Hazard Class: | 2.1 (Flammable Gas) |
| 5. DOT ID Number: | UN1012 |
| 6. DOT Hazard Class: | 2.1 (Flammable Gas) |
| 7. CAS Registry Number: | 106-98-9 |

INTERNATIONAL MARITIME ORGANIZATION (IMO):

Proper Shipping Name:	1-BUTYLENE
Hazard Class:	2.1 (Flammable Gas)
UN Number:	UN1012
Transportation Hazard Label/Placard Symbol:	Flammable Gas, non-odorized
Pollution Category:	"Gas"; therefore "Unassigned" category (there is no pollution category)
European Behavior Classification:	G (Gas - A substance that exists as a gas at ambient temperature)

SHIPPING INFORMATION:

- | | |
|-------------------------|----------------|
| 1. Grades of Purity: | 99% |
| 2. Storage Temperature: | Ambient |
| 3. Inert Atmosphere: | No requirement |
| 4. Venting: | Safety Relief |



HAZARD CLASSIFICATIONS

Code of Federal Regulations (49 CFR): Flammable gas

NFPA Hazard Classification:

<u>Category</u>	<u>Classification</u>
Health Hazard (Blue)	1
Flammability (Red)	4
Reactivity (Yellow)	0

(0=Least, 1=Slight, 2=Moderate, 3=High, 4=Extreme)

Various restrictions apply to the preceding classifications. Please refer to the specific regulation for details concerning classification requirements. Refer to 46 CFR, Parts 150-154, and 49 CFR, Part 173 for Coast Guard regulations governing the transport of 1-butene.

REGULATORY PROFILE

ODCs: Contains Class 1 or Class 2 Ozone Depleting Chemicals (ODCs)?: **NO**

TSCA: Is this product or its components subject to any of the following TSCA requirements of 40 CFR, Part:

707	Export Notification (12b)	NO
712	Chemical Information Reporting (8a)	NO
716	Health & Safety Data Reporting (8d)	NO
721	Significant New Use (5e)	NO
723.50	Low Volume Exemption	NO
720.36	R&D Exemption	NO
720.38	Test Marketing Exemption	NO
723.25	Polymer Exemption	NO
790	Health and/or Environmental Effects Testing (4e)	NO

Is this material distributed under limitations of a 5(e) or 5(f) Consent Order?: **NO**
 Have there been any Section 8(e) submissions for this material?: **NO**

INTERNATIONAL REGISTRATION: Are all components of this material listed on the following international inventories?

TSCA	(United States)	YES	(CAS Reg. No. 106-98-9)
DSL	(Canada)	YES	
EINECS	(Europe)	YES	(No. 203-449-2)
METI	(Japan)	YES	(No. (2)-16)
AICS	(Australia)	YES	
ECL	(South Korea)	YES	
PICCS	(Philippines)	YES	
IECSC	(China)	YES	

FDA: Do FDA regulations permit use of this material as a direct or indirect food additive?

DIRECT: **NO**
 INDIRECT: **YES** As a comonomer of polyethylenes complying with provisions of 21 CFR 177.1520. Such polyethylene copolymers, butene homopolymers, or copolymers of butene and certain other monomers stipulated in 21 CFR 175.105(c)(5) may be eligible for use as components of adhesives in accordance with 21 CFR 177.105, provided any additional applicable constituent limitations are met.

HAZARDOUS METALS: Does the sum of the concentration levels of lead, cadmium, mercury, and hexavalent chromium present in this material exceed 100 ppm by weight?: **NO**

SARA 311 CATEGORIES:

- | | |
|---------------------------------------|------------|
| 1. Immediate (Acute) Health Effects: | YES |
| 2. Delayed (Chronic) Health Effects: | NO |
| 3. Fire Hazard: | YES |
| 4. Sudden Release of Pressure Hazard: | YES |
| 5. Reactivity Hazard: | NO |

RIGHT TO KNOW STATES: 1-Butene is found on Massachusetts, New Jersey, and Pennsylvania Right To Know lists.

ADDITIONAL REGULATORY INFORMATION:

Regulations do not list 1-butene as a(n):

1. California Prop. 65 carcinogen
2. California Prop. 65 reproductive hazard
3. CERCLA 302.4 chemical
4. DOT Marine Pollutant
5. EPA carcinogen
6. IARC carcinogen
7. NTP carcinogen
8. SARA 313 chemical

Regulations indicate that 1-butene does not have a:

1. Maximum contaminant level or goal
2. Reference dose of inhalation exposure
3. Reference dose for oral exposure
4. Federal reportable quantity

See CPChem MSDS #PE0015, Section 15, for additional regulatory information on 1-butene.

REVISION HISTORY

The following sections have been updated and should be reviewed by the user.

Part 1 1-Butene Specifications page 3

Previous version: "1-Butene 2006 Rev 0.doc".

PART 6

APPENDIX

GLOSSARY OF TERMS, ABBREVIATIONS, & ORGANIZATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
AIAG	Automotive Industry Action Group
AIHA	American Industrial Hygienists Association
AALA	American Association for Laboratory Accreditation
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASQC	American Society for Quality Control
ASTM	American Society for Testing and Materials
BABT	British Approvals Board of Communication
Bonding	The connection of two or more conductive objects by means of a conductor (most commonly a wire or metal plate).
BSI	British Standards Institute
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CAD	Computer-Aided Design
CANUTEC	Canadian Transport Emergency Centre
CEIC	Chevron Emergency Information Center
CE mark	Conformity European Union Mark
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CG	Coast Guard
CHEMTREC	Chemical Transportation Emergency Center

CMA	Chemical Manufacturers Association
Confined Space	An area that by design has limited openings for entry and exit. A confined space has unfavorable natural ventilation and is not intended for continuous worker occupancy.
CPC	Chemical Protective Clothing
DOT	Department of Transportation
EPA	Environmental Protection Agency
ESD	Electro Static Discharge
EU	European Union
FDA	Food & Drug Administration
Flash Point	The minimum temperature at which a liquid gives off vapor in sufficient concentrations to form an ignitable mixture with air near the surface of a liquid.
FMEA	Failure Mode Effect Analysis
GLP	Good Laboratory Practices
Grounding	The connection of one or more conductive objects to the ground, it is a specific form of bonding. Grounding is also referred to as earthing.
HAP	Hazardous Air Pollutant
HAZWOPER	Hazardous Waste Operations and Emergency Response
HON	Hazardous Organic NESHAP
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IDLH	Immediately Dangerous to Life and Health-- the airborne concentration of a toxic material from which one could escape within 30 minutes without any escape-impairing symptoms or irreversible health effects.
IEEE	Institute of Electrical and Electronics Engineers
IMDG	International Maritime Dangerous Goods
IMO	International Maritime Organization
IQA	Institute of Quality Assurance
ISGOTT	International Safety Guide for Oil Tanker and Terminals
ISO	International Organization of Standardization
LFL	Lower Flammability Limit
MACT	Maximum Achievable Control Technology

MIL	Military
MSDS	Material Safety Data Sheet
MSHA	Mine Safety and Health Administration
NACCB	National Accreditation Council for Certification Board
NDE	Nondestructive Evaluation
NDT	Nondestructive Testing
NEC	National Electrical Code
NESHAP	National Emission Standard for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NIST	National Institutes of Standards and Technology
NIOSH	National Institute for Occupational Safety and Health
NPDES	National Pollutant Discharge Elimination System
OEM	Original Equipment Manufacture
OSHA	Occupational Safety and Health Administration
PM	Preventative Maintenance
PPE	Personal Protective Equipment
ppm	parts per million
QA	Quality Assurance
QC	Quality Control
QMI	Quality Management Institute
RAB	Registrar Accreditation Board
RCRA	Resource Conservation and Recovery Act
RQ	Reportable Quantity
SARA	Superfund Amendment and Reauthorization Act
SCC	Standards Council of Canada
SPC	Statistical Process Control
SQC	Statistical Quality Control

STEL	Short Term Exposure Limit
TOC	Total Organic Carbon
TPQ	Threshold Planning Quantity - Under the Superfund Amendments Reauthorization Act (SARA Title III) Sections 302, 304, 4311/312, it is a chemical specific quantity, in pounds, that triggers certain reporting requirements.
TQC	Total Quality Control
TQM	Total Quality Management
TWA	Time-Weighted Average
UL	Underwriters Laboratory
Ullage	Amount by which a packaging falls short of being liquid full.
UN	United Nations
USCG	United States Coast Guard
Vapor Pressure	The pressure exerted by a volatile liquid while under defined equilibrium conditions. A common way to measure vapor pressure is in millimeters of mercury (mm Hg).
VOC	Volatile Organic Compound