

Safe Handling and Use

Cyclopentane
Isopentane
n-Pentane
Customized Blends



Arkema Inc.
DFL – Foams, Solvents and Aerosols
2000 Market Street
Philadelphia, PA 19103

Phone: 800.343.7940
Fax: 215.419.7199

In case of emergency:
call CHEMTREC at 1.800.424.9300

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SECTION 1

Introduction



Arkema is the world's leading supplier of blowing agents to the rigid foam industry.

In addition to supplying fluorinated blowing agents, we also provide other key blowing agents. Our product line now includes cyclopentane, isopentane, normal pentane, and cyclopentane blends. We categorize these products as HYDROCARBONS and will make reference to them in this manner in this brochure.

Arkema Inc. is committed to providing high quality, consistent products and has been ISO 9002 certified at the following locations: Calvert City, Kentucky, Philadelphia Customer Service is ISO 9001 and Pierre-Benite, France. The Calvert City, Kentucky plant was recently recommended for ISO 14001 certified.

Due to the flammable nature of hydrocarbons, Arkema Inc. has chosen to provide literature information which may be helpful during the handling and storage of these products.

This technical guidance manual is for general informational purposes only. As every situation is unique, and hydrocarbons are hazardous if not handled appropriately, you must consult qualified technical and engineering personnel to evaluate your specific situation and answer any specific questions you may have.

The Material Safety Data Sheet (MSDS) for the specific material should also be consulted for additional health, safety, and environmental information.

Arkema Inc. disclaims all warranties, either expressed or implied, assumes no responsibility for the accuracy or completeness of the data contained herein, and will not be liable for any personal injury, property damage, environmental harm or legal noncompliance that may result from reliance upon this document or your management of the listed products.

This document and its references are intended for use in the United States. Regulatory references in this brochure are intended to comply with U.S. regulatory agencies.

SECTION 2

Products and Safety Data



Cyclopentane, n-Pentane and Isopentane are light hydrocarbon liquids with relatively low boiling points and flash points. These liquids will vaporize very easily. *The primary hazard for these liquids is flammability.* Pentanes are classified as a DOT Hazard Class flammable liquid.¹

Pentanes will burn and therefore require special precautions against fire and explosion. Pentanes are volatile liquids and give off invisible vapors. Either the liquid or vapor may settle in low areas or travel some distance along the ground or surface to ignition sources where they may ignite or explode. See Table 2.1 for physical property data for our available pentanes.

Table 2.1
Product Physical Property & Safety Data

	Cyclopentane	Isopentane	n-Pentane	70%/30% Cyclopentane/ Isopentane Blend	80%/20% Cyclopentane/ Isopentane Blend	85%/15% n-Pentane/ Isopentane Blend
CAS#	287-92-3	78-78-4	109-66-0	287-92-3/ 78-78-4	287-92-3/ 78-78-4	109-66-0/ 78-78-4
Molecular formula	C ₅ H ₁₀	i-C ₅ H ₁₂	n-C ₅ H ₁₂	C ₅ H ₁₀ / i-C ₅ H ₁₂	C ₅ H ₁₀ / i-C ₅ H ₁₂	n-C ₅ H ₁₂ / i-C ₅ H ₁₂
Physical form	Colorless liquid	Colorless liquid	Colorless liquid	Colorless liquid	Colorless liquid	Colorless liquid
Molecular weight	70.13	72.15	72.15	NE	NE	NE
Flash points °C, ASTMD 3828	<-30	<-30	<-30	<-26	<-29	<-30, estimated
Flammable limits, %	1.1 – 8.7	1.4 – 9.5	1.3 – 8.0	NE	NE	NE
Boiling point, °C	49	28	36	28 – 49	28 – 49	28 – 49
Specific gravity	0.74	0.62	0.63	0.70	0.71	0.63*
Vapor pressure	360hPa@15°C	3.20psig@70°C	1.1 bar@37.8°C	0.90@38°C, bar	0.90@38°C, bar	1.13@38°C, bar
Exposure limits	ACGIH 600 ppm	ACGIH 600 ppm	ACGIH 600 ppm/ 770 mg/m ³ ; OSHA 1000 ppm/ 2950 mg/m ³	See pure components	See pure components	See pure components

¹ The hazard category assigned to a material under definitions in the 49 CFR 172.101 DOT Hazardous Material Table and 49 CFR 173. DOT Hazard Class 3 Flammable Liquid-A liquid having a flash point of not more than 60.5°C (141°F) as determined by an approved closed cup method.

DOT 49 CFR 173.120 (a)

NE: Not Established

* estimated

SECTION 3

Worker Protection and First Aid



SKIN

To reduce the potential of a burn hazard, all employees who handle or work around this material should wear Flame Retardant Clothing (FRC), such as Nomex® protective clothing or Indura® flame resistant fabrics.

Repeated or prolonged skin contact will dry and defat skin, resulting in irritation and dermatitis. Skin contact should be limited by using a chemical resistant glove, such as Neoprene or nitrile rubber. A glove manufacturer representative should be consulted for actual glove selection, as it depends upon working requirements and conditions.

If On Skin: Immediately flush with plenty of water. Remove contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Destroy contaminated shoes.

EYE

Safety glasses with side shields should be worn to prevent accidental contact with the eyes.

If In Eyes: Immediately flush with plenty of water for at least 15 minutes. Get immediate medical attention.

RESPIRATORY PROTECTION

Exposure to pentane vapor by inhalation may cause respiratory and eye irritation, dizziness, drowsiness, and central nervous system depression. Work areas should be adequately ventilated to ensure exposures are below limits. See Table 3.1 for exposure limits.

If ventilation is inadequate, an organic vapor respirator may be required (consult a professional industrial hygienist).

If Inhaled: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get immediate medical attention.

Table 3.1 Exposure Limits

	ACGIH TLV TWA ²	OSHA PEL TWA ³
n-Pentane	600 ppm	1000 ppm
Isopentane	600 ppm	Not Listed
Cyclopentane	600 ppm	Not Listed

INGESTION

Do NOT siphon the material by mouth. Do NOT eat or drink around material. Material that is ingested can be aspirated in the lungs causing chemical pneumonitis, pulmonary edema, and hemorrhage.

If Swallowed: Do NOT induce vomiting. Give water to drink. Get medical attention immediately. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON.

For medical assistance contact The Rocky Mountain Poison Control Center at 1.303.623.5716.

ENVIRONMENTAL FATE

Pentanes are highly volatile hydrocarbons. As a volatile organic chemical, VOC, material partitions rapidly from soil or groundwater into the atmosphere. It is not expected to bioaccumulate.

Photolysis, hydrolysis and bio-concentration of pentanes are NOT expected to be important environmental fate processes⁴.

² 2003 Threshold Limit Values for Chemical Substances and Physical Agents, American Conference of Governmental Industrial Hygienists (ACGIH).

³ OSHA PEL TWA, 29 CFR 1910.1000 Appendix Z1

⁴ Hazardous Substances Databank

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Indura® is a registered trademark belonging to Westex, Inc.

SECTION 4

Fire/Static Prevention

Static electricity can cause fires and explosions unless certain precautions are observed. Pentanes and other similar hydrocarbons have a high volume resistivity and can pick up and hold a static charge during transfer operations.

Do not use product around open flames or sparking equipment such as switches and motors. Prohibit smoking and lighters in any area where the product is stored, transported, or used.

Do not use electronic devices (including but not limited to cellular phones, computers, calculators, pagers, etc.) in or around any operation involving pentanes or pentane storage areas unless the devices are certified intrinsically safe by an approved national testing agency and comply with the safety standards required by the National Electrical Code Areas of Classification and/or local laws and regulations. Electrical equipment and fittings must comply with National Electrical Codes and local fire prevention regulations for this class of product.

The flow-rate with which the product is transferred affects the amount of static charge generated. Key operations which have the potential of generating a flammable atmosphere

and/or static include tank and container filling and dispensing, tank cleaning, sampling, gauging, as well as other operations. Be sure to allow dissipation of charges in the liquid. An empty container can retain residue as a liquid or vapor and create a hazardous condition. Keep the container tightly closed. The flammability limit for the product should be noted.

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

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 1910.106⁵, "Flammable and Combustible Liquids," National Fire Protection Association (NFPA) 77, "Recommended Practice on Static Electricity"⁶ and/or the American Petroleum Institute (API) Recommended Practice 2003, "Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents."⁷

Make provisions for fire and emergency routes.

IN CASE OF FIRE

The listed products have very low flash points. A pentane fire can be treated essentially the same as a gasoline fire. However in case of an emergency, contact your local fire authority.

For Small Fires: Avoid inhalation of vapors. Use a BC rated dry chemical, CO₂, or halon extinguisher. Use of water spray may NOT be effective in extinguishing a pentane-based fire.

For Large Fires: Use approved fire fighting suppression. Do NOT use straight streams. Do NOT spray water directly on fire — product will float on water and could re-ignite on surface of water. Fight fires from a maximum distance or use unmanned hose holders or monitor nozzles. If this is impossible, withdraw from the area and let the fire burn.

Cool non-involved containers by flooding with large quantities of water until well after the fire is out. Use a water spray for dissipating vapors and cooling exposures. Contain or treat all runoff materials.

Avoid inhalation of vapors. Wear MSHA/NIOSH/NFPA approved self-contained breathing apparatus or equivalent and full NFPA-compliant protective gear (Bunker gear). Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.

⁵ Code of Federal Regulations (CFR) may be obtained on line at: <http://www.gpoaccess.gov/cfr/index.html>

⁶ National Fire Protection Association, NFPA 77, "Recommended Practice on Static Electricity"

⁷ American Petroleum Institute (API) Recommended Practice 2003, "Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents."

SECTION 5

Storage



The design of storage tanks must conform to the principles of good engineering practice. Storage tanks should be fabricated with welded steel construction. Underground storage tanks are not recommended, unless equipped with corrosion prevention measures, such as cathodic protection and linings, and equipped with a leak detection system.

Pressure tanks built according to the American Society of Mechanical Engineers code (ASME) are preferred over atmospheric tanks if pentanes are to be stored at or near its boiling point. In the case of atmospheric tanks, provisions must be made for inbreathing (vacuum relief) and outbreathing (pressure relief) in the form of a combination pressure/vacuum relief valve with its size based on the vent rates established by NFPA 30, Flammable & Combustible Liquids Code.⁸ Vents should be routed to an approved type of vapor recovery, or flare system.

Open vents should not be used with pentanes since the flash point is below 100°F. When designing vents, the minimum for venting that should be used is contained in NFPA 30, Flammable & Combustible Liquid Code. For inbreathing, vacuum relief API 2000 should be used.

Diking, drainage, and tank supports should be designed to conform with local regulations. A rule of thumb commonly used for determining the size of customer storage facilities suggests that storage facilities be 1½ times the size of shipments received. Some facilities may require larger inventories due to seasonal transportation problems. Depending on the amount stored, and type of tank used to store the pentanes, the facility may be required to comply with the Process Safety Management standard or the EPA's Risk Management Plan requirements.

The storage tank inlet should be located at the bottom of the tank. The fill pipe should be connected to both the tank flange and the transfer pipeline. This should be electrically grounded. The purpose of this electrical connection is to dissipate any static charge which builds up during filling.

Excess flow check valves should be installed on the outlet suction piping in the event of a pipe failure. Fusible links located on the fill and suction valves that would operate "fail safe closed" in the event of a fire should also be utilized. Hydrocarbon detectors located around the storage area should be

⁸ National Fire Protection Association, NFPA 30, Flammable & Combustible Liquids Code.



considered as well as high level alarms and high level shutdown interlocks for filling operations. Also consider a dual relief valve (RV) system with rupture disks located under the relief valves to prevent leaking and snuffing steam piped to RV's in the event of an RV fire. A water deluge to cool the tank in a fire situation should be at an application rate of no less than .25 gpm/per square foot. Fire-proofing material should be applied to the tank support structures.

Tanks should be periodically inspected for leaks and serviced in accordance with the principles of API Standard 653⁹.

Should a loss of product occur, secondary containment capacity should be at least the volume that the tank can contain of this product. The secondary containment requirements, as well as tank layout and spacing requirements, should be in accordance with NFPA 30. Rotating equipment such as pumps should be kept outside of the secondary containment area. If only one tank exists, secondary containment should allow for the volume of the tank plus 10%. If there are multiple tanks, secondary containment should accommodate the volume of the largest tank.

While pentanes may be safely stored at ambient temperatures, they should be stored in a cool, well-ventilated area, away from any ignition sources such as flame, sparks and static electricity. Ensure that all storage and handling equipment is properly rated, grounded and installed to satisfy electrical classification requirements. Static electricity may accumulate and create a fire hazard.

All storage containers, including containers such as drums, cylinders and IBC's, must be bonded and grounded during filling and emptying operations. You must consult qualified technical and engineering personnel to evaluate your specific situation. Store away from oxidizers and reactive materials. Keep container tightly closed. Observe all federal, state and local regulations and National Fire Protection Association (NFPA) Codes which pertain to the specific local conditions of storage and use, including OSHA 29 CFR 1910.106 and NFPA 30, 70, 77, and 497.

An outside or detached storage is preferable. The storage area should be equipped with an automatic sprinkler system.

Empty containers retain residue (liquid and/or vapor) and can be dangerous. Do NOT pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, static electricity, or other sources of ignition. They may explode and cause injury or death.

⁹ API Standard 653, Tank Inspection, Repair, Alteration, and Reconstruction.

SECTION 6

Spillage/Disposal



In case of a spill or leak, flammability is the primary concern.

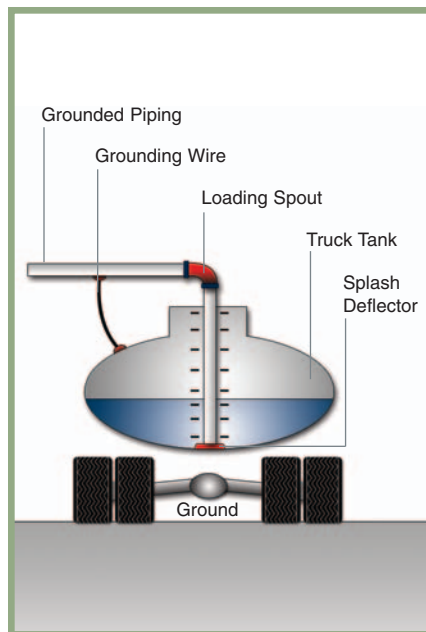
Eliminate all sources of ignition in the vicinity of a spill or released vapors. Isolate the area. Permit only trained personnel wearing full protective clothing and equipment to enter the spill area. Terminate the leak immediately, if possible. Prevent its entry into sewers, basements or confined areas; dike if needed.

Using non-sparking tools, collect the contaminated soil, debris, clothing, etc., into a DOT-approved drum for disposal. Flush the spill area thoroughly with water and wash all contaminated equipment. All flushing and wash water must be contained and prevented from entering a waterway. Ventilate the area to disperse vapors.

Consult a regulatory specialist to determine appropriate state or local reporting requirements, for assistance in waste characterization and/or hazardous waste disposal and other requirements listed in pertinent environmental permits.

SECTION 7

Handling Bulk Deliveries



Hydrocarbons can easily accumulate static electricity, thereby causing sparking and fire.

Systems must comply with Department of Transportation Regulations 49 CFR 173.243 and 172.101.

Loading and unloading facilities should be at least 25 feet from other buildings and warehouses. When using compressed gas for transferring, refer to NFPA 30, Paragraph 5-4.1.4, which allows the use of inert gas for Class 1 flammable liquids. In addition, provide grounding and bonding facilities for protection from static sparks while loading and unloading. Static electricity can be produced by agitating hydrocarbon liquids. Agitation can lead to an accumulation of positive and negative charges that can discharge as sparks. The sparks then become an ignition source for vapor/air mixtures.

To eliminate any potential charge between the truck and the loading rack, make sure that the truck is immediately grounded once positioned on the loading rack. Be sure that the tank is level before loading/unloading to avoid flooding of

the relief valve. Before loading/unloading a bulk delivery, always check the storage tank to insure that it has sufficient available space. Monitor the tank level at all times during filling and be prepared to stop the flow immediately, if necessary. High level alarms and shutdown are recommended to be installed.

Avoid splash filling. It is not recommended that the discharging hydrocarbon be allowed to splash through the vapor space. Static charges can accumulate. Samples should not be taken through the dome immediately after filling (Refer to NFPA 77). This precaution is necessary due to the potential of sparks which could occur between the sample dipper and the liquid of the surface. After filling the tank, allow for the reduction of the static charge on the liquid before withdrawing the spout.

Truck racks should have adequate fire protection to comply with local, state, and federal regulations. Hydrocarbons which are to be transported by rail require compliance with DOT 49 CFR 174.

Operators should be trained to assure proper handling of hydrocarbons.

SECTION 8

Auxiliary Equipment and Instrumentation



MAINTENANCE AND INSPECTIONS

The volatile properties of hydrocarbons make maintenance and inspection procedures especially critical. Personnel should routinely check for possible leaks from filters, hoses, valves, pump fittings, and storage tanks. You must consult qualified technical and engineering personnel to evaluate your specific situation.

FILTERS

As small amounts of foreign matter may enter storage tanks from various sources, a filter in the transfer piping between the tank and processing equipment is recommended. A cartridge-type filter with a fine or medium replaceable cartridge is suggested. The filter must be compatible with the process. Filter cartridges should be inspected and renewed periodically.

HOSES

Hard piping is preferred to the use of hoses where possible and practical.

If hoses are needed for loading or unloading operations, they should be flexible and chemical-resistant. A satisfactory type is Goodyear rough-bore style WH-7 with Viton® tube or the equivalent. Multi-layered polypropylene is also recommended.

U.S. Coast Guard regulations 33 CFR Parts 154.500 and 156.710 apply to hoses used for bulk transfers to and from tank vessels.

GASKETS

Viton® rubber, Teflon® resin, Grafoil® gasket, Garlock® gasket No.70201 or the equivalent is satisfactory for flanged connections at ambient conditions. Reinforced graphite composite gaskets may also be used.

PUMPS

Hydrocarbons can be transferred by pump or vacuum. For most pentane handling, centrifugal pumps with mechanical seals perform satisfactorily. The pump manufacturer can recommend the proper type of pump if the following four parameters are known: (1) flow in gallons per minute, (2) the size and length of suction and discharge lines, (3) the suction and discharge pressures, and (4) the temperature of the pentanes. A drain valve should be installed at the lowest point in the system so that the pump and all piping can be completely drained and washed before any maintenance work is done. Totally enclosed fan cooled (TEFC) motors are recommended; however, local fire and insurance codes should be consulted to determine if an explosion-proof motor must be used.

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Indura® is a registered trademark belonging to Westex, Inc.
Grafoil® is a registered trademark belonging to Union Carbide Corporation
Garlock® is a registered trademark belonging to Bank of America, N.A.

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

1. Mechanical seals in conformance with API 682¹⁰, 1st edition and tandem seals with barrier fluid.
2. Pumps in conformance with API 610¹¹, 8th edition, are recommended.
3. Pumps designed so that pump bearings will be able to carry thrust at no flow. Consider selecting non-metallic (PEEK) wear rings to minimize damage if the pumps run dry.
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 pump shutdown may be applicable in certain situations.
7. Pumps should be configured to allow for an easy and contained de-inventory process in the event maintenance needs to be performed on the pump.
3. A minimum of flanged connections should be used on pentane pipelines. Flanges should be avoided due to leak potential. Welded connections are recommended.
4. Pentane lines should not be buried due to the difficulty of checking for leakage.
5. All lines should be sloped so they can be completely drained for maintenance.
6. All newly installed pentane pipelines should be pressure-tested by an approved method before insulation is applied.
7. Bellows valves for two-inch and smaller are recommended to eliminate emissions from packing.
8. Consideration may be given to the installation of thermal relief valves between block valves to prevent process piping overpressure.
9. Nitrogen blanketing is recommended.
10. Procedures should be in place to regularly assure that grounding of equipment is intact.

PIPING

The following are recommended practices in engineering pipelines for pentanes.

1. Piping is normally of carbon steel although stainless steel may also be used.
2. Lines smaller than one inch should not be used.

VALVES

Ball valves with seats of Viton[®] rubber composition are satisfactory for pentane service under normal conditions. Gate valves are less satisfactory, but they are usually cheaper and may be used.

¹⁰API Standard 682 Shaft Sealing Systems for Centrifugal and Rotary Pumps

¹¹API Standard 610 Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries
Viton[®] is a registered trademark of E.I. du Pont de Nemours Company

UTILIZE THIS FORM WHEN PREPARING FOR PENTANE DELIVERIES FROM ARKEMA INC.

Arkema Inc. Delivery Instruction Form

Pentane Delivery Instructions

Ship To:	Customer name	Phone
	Address	
	State	Zip
Product Name:	Cyclopentane, Isopentane, n-Pentane blends	
Delivery Instructions:	Special instructions	
	Date, time, etc.	
Equipment: Electrical and Hose Connections	How many feet of hose needed: Electrical and Hose Connections	
	Electrical Adapters	
	Hose Connections	
	Tank Capacity	
	Tank Percent Gauge or Sight Glass	
Customer Contact:	Company	
	Name	Title Phone
Analysis and Arkema Inc. Weights to:	Customer contact or chemist contact	
Local Weights:	Local scale weight or Arkema Inc. weights	

SECTION 9

Safety Checklist for Hydrocarbons



- Remember, the primary hazard for pentanes is “flammability.” Handle it accordingly.
- Do not eat or drink around material.
- Avoid inhalation of vapors.
- Always use personal protection when handling this product.
- Make provisions for emergency routes, automatic sprinklers and fire-fighting measures.
- Effectively ventilate the work area.
- Take precautions against electrostatic discharge.
- Do not cut, weld, grind, or solder on or near containers.
- Keep product away from heat, sparks, static electricity, and other sources of ignition.
- Prohibit smoking and lighters where the product is stored, transported or used.
- Use only non-sparking tools for opening drums.
- Open vents should not be used. Avoid open handling.
- Store away from oxidizers and reactive materials.
- All storage containers must be bonded and grounded during filling and emptying.
- Provide grounding and bonding while loading and unloading.
- Store in a cool, well ventilated area.
- Prior to sampling, always allow time for the dissipation of static charges.
- Consider inert storage such as nitrogen blankets.
- Make sure electrical equipment and fittings comply with federal and local fire regulations.
- Routinely check for possible leaks from filters, hoses, valves, fittings, and storage containers.
- Dispose of waste in accordance with federal, state and local regulations.

For additional information

Consult the Material Safety Data Sheet (MSDS).

Consult your Occupational Safety and Health Representative and other qualified technical personnel.

Refer to other useful resources in Section 10 of this brochure.

SECTION 10

Other Useful Resources

ATOFINA Petrochemicals, Inc.

American Petroleum Institute,
Welded Steel Storage for Oil
Storage, Standard No. 620.

American Petroleum Institute,
Venting Atmospheric and Low
Pressure Storage Tanks, Standard
No. 2000.

American Society of Mechanical
Engineers, ASME Boiler and
Pressure Vessel Code, Code for
Unfired Pressure Vessels, Sec.VIII,
Div. 1.

National Fire Protection Association,
NFPA 13, Installation of Sprinkler
System.

National Fire Protection Association,
NFPA 15, Standard for Water Spray
Fixed System.

National Fire Protection Association,
NFPA 69, Explosion Prevention
Systems.

National Fire Protection Association,
NFPA 780, Lighting Protection
Code.

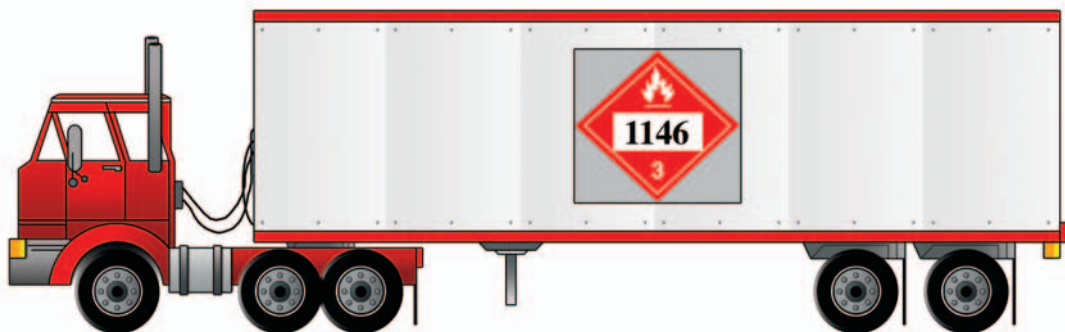
National Fire Protection Association,
NFPA 704, Identification of Fire
Hazards of Materials.

Occupational Safety and Health
Administration, OSHA Regulation
29 CFR 1910.

American National Standard
Institute, ANSI B31, Code for
Pressure Piping.

Underwriters Laboratories Inc.,
Standard for Steel Aboveground
Tanks for Flammable Liquids.

49 CFR – Parts 106, 107, 110, 130,
171-180, 209 and 397.



In Case of Emergency

Call CHEMTREC at
1.800.424.9300

For Medical Assistance

Call Rocky Mountain
Poison Control Center at
1.303.623.5716

Contact Us

Visit us online at:
www.ArkemaGroup.com

Arkema Inc.
DFL – Foams, Solvents and Aerosols
2000 Market Street
Philadelphia, PA 19103

Phone: 800.343.7940
Fax: 215.419.7199

Online: www.ArkemaGroup.com



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See MSDS for Health & Safety Considerations