

Methanol Drum Transport, Handling, and Storage

INTRODUCTION

Totes, drums (55 gallon), and cans (5 gallon, and 1 gallon) are used to transport, store, and dispense methanol in a wide variety of circumstances by low volume users. Non-bulk transport and storage of hazardous material are regulated activities in the U.S. and some other countries. Failure to adhere to applicable regulations may be punishable by fines and imprisonment. Requirements are specific to the country and the circumstances; however requirements will generally consist of the following; shipping papers, container labeling, transport vehicle placarding, driver training and licensing, and availability of emergency repines equipment. If you are not a designated hazardous materials carrier, then it may be against the law to transport methanol in totes, drums, and cans.



Do not transport methanol in your personal vehicle. Do not store methanol totes, drums, or cans indoors or in your home. Storage requires precautions for flammable loading, fire-safe storage, ventilation, spill containment, spill cleanup, and fire suppression.

Never use mouth suction to siphon-transfer methanol. Methanol liquid and vapor are toxic to humans. Exposure is cumulative and may result in harm if vapor or liquid are inhaled, ingested, or contacted with skin for extended periods of time.

Methanol (CAS: 67-56-1, NIOSH: PC-1400000, DOT: 1230, UN-1230, NA-1230) is classified by the International Code Council (ICC) and the National Fire Protection Agency (NFPA) under the *Uniform Fire Code* as a “IB Flammable Liquid” and by the United Nations as a “1993 Class 3 Flammable Liquid.” NFPA and Department of Transportation (DOT) rank Flammability as a 3 primary hazard, and toxicity, as a 6.1 ranked secondary hazard. Guidelines for handling IB flammable liquids are provided by codes and standards published by ICC, NFPA, and the International Fire Code.

ICC and NFPA guidelines are recommended as ‘best practices,’ but are not mandatory unless deemed so by national, or local authority. Within the United States, local authority generally rests with the local Fire Marshal. Mandatory regulations have been developed within the United States by the Occupational Safety and Health Administration (OSHA), an agency of the federal government. Specific safe handling practices are given under three separate regulations for various industries, circumstances, and work environments:

- General Industry: 29 Code of Federal Regulations (CFR) 1910.106
- Construction Industry: 29CFR1926.152
- Shipyard Industry: 29CFR1915.36).

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Guidelines for international transportation of flammable liquids are available from the following bodies:

- International Maritime Organization, *International Maritime Dangerous Goods (IMDG) Code* (volumes, 1, 2, and Supplement)
- International Air Transport Association (IATA), *Dangerous Goods Regulations*
- Intergovernmental Organization for International Carriage by Rail, *Regulations concerning the International Carriage of Dangerous Goods by Rail*.

Transportation within the United States is governed by the Department of Transportation (DOT), an agency of the federal government. DOT regulations are available in 49CFR which can be accessed on the internet or purchased in book format at a nominal cost over the internet.

Drums, totes, and cans are transported, stored, and handled by the vast majority of methanol users. This discussion focuses on 5-gallon and 55-gallon quantities packaged in metal containers.

Plastic containers are not recommended for long-time storage or shipment of methanol because the solvent properties of methanol may degrade the plastic, causing the containers to lose structural integrity.

STORAGE OF METHANOL-CONTAINING TOTES, DRUMS, AND CANS

Guidance for safe storage of methanol is provided by ICC, NFPA, and the International Fire Code. ICC and NFPA guidelines are available in:

- NFPA 1, *Uniform Fire Code*.
- NFPA 30, *Flammable and Combustible Liquids Code*.

Methanol storage areas should be curbed with a compatible material such as concrete, ventilated to prevent accumulation of vapors, and drained to a safe location which is remote from the storage area. Storage areas should be equipped with vapor, and heat detector/alarms. Because methanol burns with a transparent, non-luminous blue flame, combustion will likely not be detected by standard smoke detectors, and luminous-type flame detectors. Carbon monoxide and carbon dioxide detectors may serve in place of smoke detectors and luminous flame detectors. First responders use infra-red detection methods to determine if combustion is occurring. It is recommended that this type of detector be installed and alarmed to monitor methanol tote, drum, and can storage areas. Detection should be redundant with detectors positioned at right angles to one another.

If more than several drums are stored, then consideration should be given to automatic fire suppression using either fine water mist spray, or alcohol resistant fire-fighting foam (AR-FFF). Storage of multiple containers is subject to limitations on stacking height, and container density loading. Refer to the listed codes to obtain guidance, which is specific to your circumstance.

Tote and drum containers must be stored outside, not within a structure, unless placed in a liquid storage room or warehouse meeting the requirements for flammable liquids storage buildings. Five-gallon and 1-gallon containers may be stored within a building provided they are contained in a fire-safe cabinet which is grounded, and vented to an outside safe location which includes an explosion suppression device.

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SHIPMENT OF TOTES, DRUMS, 5-GALLON CANS, AND 1-GALLON CONTAINERS

Guidance for shipment of methanol via the U.S. Postal Service is contained in United States Postal Service Publication 52, *343 Flammable and Combustible Liquids (Hazard Class 3)*.

Transportation of drum quantities (8 to 119 gallon quantities of methanol) is regulated by multiple agencies and organizations. The regulatory authority depends on:

- Method of transport (truck, rail, air, or sea-going vessel).
- Capacity of individual containers, the number of containers which comprise a single shipment.
- Whether shipment is domestic within U.S.-controlled territory or outside of U.S. controlled territory.

Shipping oversight is the responsibility of the following regulatory bodies:

- Within the United States, the U.S. Department of Transportation (DOT), *Hazardous Material Regulations 49 CFR 100-199 and Emergency Response Guide Book*
- United Nations Location Codes (UN/LOCODES), *UN Recommendations on Transport of Dangerous Goods (i.e., the so-called UN-Orange Book)*
- International Maritime Organization (IMO), *International Maritime Dangerous Goods Code (IMDG)*, Volumes 1 and 2, plus a supplement
- International Civil Aviation Organization (ICAO): *Technical Instructions for the Safe Transport of Dangerous Goods by Air*
- International Air Transportation Association (IATA), *Dangerous Goods Regulations (DGR) 3.3*.

Road, rail, airborne, and water transport of hazardous materials is controlled by DOT for goods shipped within the United States. Regulatory revisions are made almost continuously; verify that you are using current versions of the regulations.

DOT restricts aircraft transportation of Class 3 flammables (e.g., methanol) to a maximum of 1 liter on passenger aircraft and 60 liters on cargo aircraft, irrespective of the shipping company: Fed-X, UPS, etc. Drum quantities are not considered to be air transportable. Refer to 49CFR172.101, "Hazardous Materials Table" for specific information regarding shipment of methanol. Refer to 49CFR173.202 for non-bulk packaging requirements on passenger and cargo aircraft.

CONTAINER SPECIFICATIONS FOR TRANSPORTING AND STORING METHANOL

Class IB Flammable Liquids are equivalent to DOT-designated PG II Flammable Liquids. Non-bulk volumes of PG II Flammable Liquids between 8 and 119 gallons are required to be packaged in DOT performance-oriented packaging identified using the United Nations identification system. Specifications for drums are established and published by Oak Ridge National Laboratory. A copy of these specifications can be obtained by contacting Oak Ridge National Laboratory, Packaging Operations Manager, Bldg. 7001, MS 6288 P.O. Box 2008, 1 Bethel Valley Road Oak Ridge, Tennessee 37831-6288. Totes, drums, and cans are available which just meet, and which exceed published specifications. Those which exceed specifications offer the potential cost-benefit of testing and re-using the containers.

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Standards for DOT designated packaging requirements for drum drop, stacking, and vibration testing are as follows:

- Drop
 - American Society of Testing and Materials (ASTM) D-5276, *Standard Test Method for Drop Test of Loaded Containers by Free Fall*
 - International Organization for Standardization (ISO) 2248, *Packaging – Complete, Filled Transport Packages – Vertical Impact Test By Dropping*
- Stacking
 - ASTM D-4577, *Standard Test Method for Compression Resistance of a Container Under Constant Load*
 - ISO 2234, *Packaging – Complete, Filled Transport Packages – Stacking Tests using Static Load*
- Vibration
 - ASTM D-999, *Standard Test Method for Vibration Testing of Shipping Containers*
 - ISO 2247, *Packaging – Complete, Filled transport Packages – Vibration Test at Fixed Low Frequency*

Packaging may be re-used provided it is cleaned, refurbished, re-tested, and found to be compliant.

SHIPPING REGULATIONS

Shipping requirements for hazardous materials are rigorous and complex. Failure to comply with DOT regulations can result in civil penalties consisting of monetary fines of \$50,000 per occurrence and criminal penalties of 5-years' imprisonment.

If you are not comfortable interpreting regulations for identifying, labeling, packaging, and shipping hazardous materials, then consider obtaining professional guidance from a qualified professional who is knowledgeable about your specific circumstances.

It is unsafe to transport drum or even 5-gallon cans of methanol in the trunk of a car, even if the trunk remains open. Transportation of methanol requires special hazard and incident response training. Transporting vehicles must be placarded, and drivers must have government required papers authorizing transport.

CONTROLLING STATIC ACCUMULATION AND SPARK DISCHARGE

Liquids which have conductivity less than 50 picosiemens per meter are charge accumulators; that is, these liquids tend to accumulate static charge as a result of fluid handling in un-bonded and un-grounded fuel containment systems. Liquids which have electrical conductivity greater than 50 picosiemens per meter are not considered to be charge accumulators. The conductivity of gasoline is less than 500 picosiemens; the conductivity of methanol is substantially greater than 50 picosiemens.

Methanol is a polar material; gasoline, and most other common transportation fuels are non-polar materials. The flash temperature, ignition energy, and lower flammability limit of methanol compared to gasoline cause methanol to be less easily ignited than gasoline in many commonly-encountered circumstances. This is also true for ignition resulting from accumulation and subsequent discharge of static electricity. Charge accumulation and discharge is less likely for methanol than for gasoline, Jet, kerosene, low sulfur diesel, and other low sulfur distillates. Electrical

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conductivity of gasoline is 25 picosiemens per meter, which is typical for petroleum derived distillate fuels. Gasoline accumulates static electricity.

By comparison, the electrical conductivity of methanol is 7×10^6 picosiemens per meter, and that of good quality drinking water (also a polar compound) is 5×10^8 picosiemens per meter. Neither methanol nor water are charge accumulators. However, methanol may accumulate static charge under abnormal circumstances. Always make provisions to bond and ground methanol containers with electrical resistance less than 10 ohms ($R_{\text{bond or ground}} \leq 10$ ohms). Neat (pure) methanol does not normally have a high risk of charge accumulation, static discharge, and static spark ignition. Possible exceptions to this occur when large transient ground currents are present due to lightning strikes, nearby high voltage power lines, and other sources of ground current.

As a matter of good practice, bonding, grounding and turbulence quelling, and liquid stilling during handling procedures should be followed in the event the methanol is a blended fuel, or is contaminated with hydrocarbon and therefore has an unexpectedly low electrical conductivity. Methanol burns with a non-luminous flame which may be difficult to detect during daytime hours, and methanol vapor has a very wide flammability range (7 v% to 36 v%).

DRUM HANDLING AND LIQUID TRANSFER

The difficulty of drum handling increases proportionally to the size and weight of the drum. Five gallon cans are relatively easy to handle without mechanical assistance, provided the cans are moved and handled one-at-a-time.

Fifty-five gallon drums contain less than 55 gallons of liquid in order to allow space for fluid volume expansion. A 55 gallon drum filled to 80% capacity with methanol weights approximately 300 lbs. In order to move a full drum, it is necessary to use a mechanical means such as a barrel hoist or fork lift. If no mechanical means is available, then individual drums can be moved by tipping the drum on its side, and rolling it to a designated curbed storage area.

If it is necessary to remove a measured quantity of methanol from the drum without using mechanical means such as low pressure inerting, or a siphon, then it is possible to lay the drum on its side, and roll the drum into a slanted position with some form of a prop such as a short section of board under the bunged end of the drum. Position the drum with the small bung in a 12 o'clock position, and verify that the drum is chocked in a stable position. The drum and the receiving container must be bonded and grounded.

In the 12 o'clock position, the small bung is now in the vapor space of the drum. Replace the bung with a threaded, alcohol compatible hose. Be careful not to breathe the escaping vapors, which are toxic, and may be flammable. Methanol can be removed from the drum in a controlled manner by carefully rolling the drum to the side so the small bung is in the 1 o'clock position, slightly below the liquid level within the drum. Methanol will now flow out of the drum in a controlled manner. Flow can be terminated by returning the drum to the 12 o'clock position. Replace the transfer hose with the bung, and return the drum to an upright position. Extreme care must be taken to not drop or otherwise damage totes, drums, cans, and 1-gallon containers during handling.

Methanol is toxic, especially when breathed or ingested. Siphon transfer of methanol must never be started by mouth-suction. Ingestion of tea-spoon-sized quantities are known to cause blindness. Inhalation of methanol vapor, even in small amounts over short periods of time, is known to produce acute health effects in some individuals. Methanol is toxic. Do not breathe the vapor, ingest the liquid, or allow bare skin to contact the liquid.