METHANOL USE TRAINING MANUAL

to

DEPARTMENT OF TRANSPORTATION / UMTA
Office of Technical Assistance and Saftety

(Revised)
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16. Abstract (Limit: 200 words)

The Urban Mass Transportation Administration (UMTA) Alternative Fuels Initiative (AFI) and the Environmental Protection Agency (EPA) 1991 regulations on transit bus exhaust emissions has resulted in a number of alternative fueled transit bus demonstrations. There were approximately 60 buses in revenue service using neat methanol fuel (M-100) in 1989. Since the chemical and physical properties of methanol are significantly different than for diesel fuel, a training program was needed. The purpose of this program was to inform transit employees of the characteristics of methanol and to instruct them in the proper use and handling of the new fuel in various transit operations. The training manual has been used in training transit personnel at Seattle Metro, Riverside Transit Agency, Triboro, Southern California Rapid Transit District, and Denver-Regional Transportation District.

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Manual Contents

Preface

This manual on the handling and use of methanol fuel in transit was prepared in support of the UMTA Methanol Bus Program. This manual is for the use of transit personnel involved in the operation, servicing, and maintenance of methanol-fueled buses. The purpose of this manual is to answer questions about methanol, describe some of the properties of methanol, and explain the factors important to using it safely in a transit environment. The training manual can be and has been used in several ways. It was initially designed to be used for training sessions for transit employees in which individual copies of the manual were given to each employee and the contents reviewed and emphasized by an instructor. Alternatively, only the last portion of the manual, the "Changes in the Job" section, can be used as a handout, with the first portion of the manual being used as a reference guide for the instructor. Or for those transit properties which prefer to develop their own training materials, the entire manual may be used solely as a reference.

A companion audio-visual slide-tape program was also developed which reviews and reinforces the same material as that contained in the printed manual. This slide-tape presentation was customized for each transit property's facilities; actual experience showed that this customization was an important factor in winning employee interest in and acceptance of the contents.

These training materials have been used in conjunction with methanol bus demonstrations at Seattle Metro in Seattle, Washington; at Riverside Transit Agency in Riverside, California; at Triboro Coach Corporation in New York, New York; at Southern California Rapid Transit District in Los Angeles, California and at the Regional Transportation District in Denver, Colorado.

The contents of this manual are primarily directed towards M-100 or neat methanol because this is the methanol fuel composition which has gained the greatest acceptance as fuel for the heavy-duty

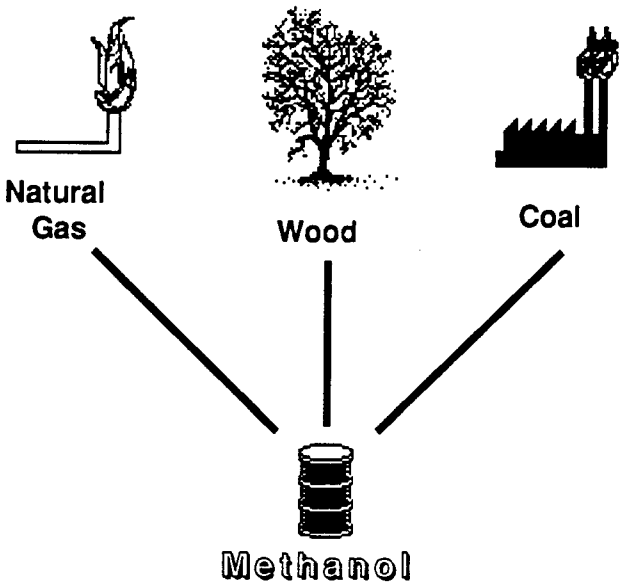
engines used in transit application. In this manual, the background and properties of methanol fuel are reviewed first. When appropriate, differences between gasoline, diesel fuel, and methanol are examined. Next, safety procedures and equipment are outlined. It is important that those people who work with methanol-fueled buses recognize that there are significant differences in the way these fuels are handled. Finally, this manual covers changes in bus operations and maintenance with methanol-fueled buses. The use of methanol fuel requires a few important changes in some jobs. Those experienced with diesel buses must remain constantly aware that they are dealing with a new and different fuel.

Prospective users of the material should note that the "Changes in the Job" section is necessarily somewhat specific to the actual coach and transit property facilities. This is intentional: information and attitude transfer becomes less effective as specifics are replaced by generalities. It does mean, however, that this section of the manual may have to be considered by other potential users as an example rather than merely being used as is.

The support of the UMTA Office of Technical Assistance and Safety and especially the leadership and technical direction of Vincent R. DeMarco, Program Manager for the Methanol Bus Program, is gratefully acknowledged. The authors also wish to acknowledge that the helpful assistance of several reviewers in industry and government has added significantly to the content and usefulness of this manual.

General Background on Methanol

What is Methanol?



Methanol is a **flammable liquid** generally used as a fuel or solvent. Methanol has no color and is **clear** like water. While methanol has a faint alcohol-like odor, it is highly **toxic** (poisonous) and cannot be made nonpoisonous.

Methanol is generally made from natural gas but can be made from any substance that contains carbon, such as coal or wood.

√ **Methanol is called "M-100" or "neat" methanol if it contains few impurities and is not mixed with another fuel.**

√ **Methanol is not gasohol. Gasohol is gasoline that contains 1% to 10% methanol or ethanol.**

Methanol is used in the production of:

- √ paint and varnishes
- √ solvents
- √ windshield washer fluid
- √ gasoline de-icer additive
- √ fuel for racing cars, and boats

Why Use Methanol?

Methanol is a promising alternative to diesel fuel because...

1. **Methanol exhaust contains fewer pollutants than diesel exhaust (especially soot and smoke).**
2. **Without soot in the exhaust, buses can have catalytic converters.** (*Catalytic converters eliminate carbon monoxide and unburned fuel from the exhaust. They also reduce odor*).
3. **Methanol is easily produced from natural gas.**
4. **In the interest of energy security, methanol can be made from abundant domestic supplies of coal.**

Handling methanol requires many of the same precautions already observed for diesel fuel. However, a few extra safety precautions like those used for gasoline are required.

What is the future of Methanol in Transportation?

Methanol is considered the leading contender to replace diesel fuel in buses. While it requires a few more safety precautions than diesel fuel, it burns cleaner and doesn't produce soot or smoke.

Characteristics of Methanol

Physical Properties
appearance ***performance***
odor reactivity
density solubility

Fire Properties
flame visibility
flammability
fuel volatility
flash point
ignition limits

ignition sources
sparks
hot surfaces
open flames
auto ignition
threat of fire from spills
flame spread rate
threat of fire in tanks

Health Properties
toxicity
methods of exposure
inhalation
absorption
ingestion
symptoms of exposure
exposure to exhaust
human toxicity rules

Physical Properties of Methanol

Appearance

Methanol is clear - it has no color. It looks like water.

Odor

Methanol has a faint alcohol-like odor to it. However, it is difficult to smell. If the smell of methanol is strong, continued exposure would be dangerous.

Density

The density of methanol vapor is 1.1 times the density of air. This means that it is "heavier" than air and will tend to settle in low areas (like maintenance pits).

Performance

Quantity of fuel - Because methanol has a relatively low heat value, a methanol powered engine requires about double the fuel of a diesel or gasoline powered engine to cover the same distance. Methanol fueled buses would have double the fuel tank capacity of conventional buses.

Volume of fuel for a given distance

Characteristics of Methanol

Physical Properties		***Fire Properties***		Health Properties
appearance	performance	***flame visibility***	ignition sources	toxicity
odor	***reactivity***	flammability	sparks	methods of exposure
density	***solubility***	fuel volatility	hot surfaces	inhalation
		flash point	open flames	absorption
		ignition limits	auto ignition	ingestion
			threat of fire from spills	symptoms of exposure
			flame spread rate	exposure to exhaust
			threat of fire in tanks	human toxicity rules

Reactivity

Methanol is more chemically reactive than diesel fuel or gasoline. This could mean more corrosion of some metals and certain plastics. For example, methanol will corrode aluminum. Use only approved replacement parts.

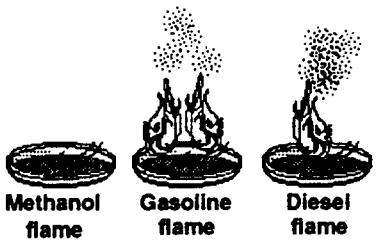
Solubility

Unlike gasoline or diesel fuel, methanol will mix with water. Methanol mixed with water is still flammable up to about five parts water to one part methanol.

Fire Properties of Methanol

Flame visibility Unlike gasoline, methanol burns with **low flame luminosity**.

In daylight, it may be difficult to even SEE a methanol fire. Heat waves coming from the fire may be the only way to see a methanol fire in the daylight.



Flammability

Flammability is the ability of a fuel to burn.

Before a fuel can burn, 3 things must occur.

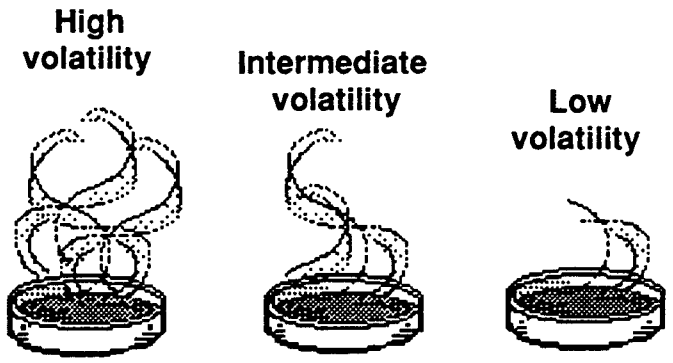
First — **The fuel must be able to evaporate (vaporize). How easily a fuel vaporizes is called FUEL VOLATILITY.**

Second — **The vaporized fuel must be mixed with air in the proper proportion. The points at which the mixture is too lean or too rich to burn are called the IGNITION LIMITS. In between is called the IGNITION RANGE.**

Third — **There must be an IGNITION SOURCE.**

Fuel Volatility

Fuel volatility is a measure of how easy it is for a fuel to "vaporize"or evaporate (the first requirement above) and mix with air around the fuel. These examples illustrate the difference between the fuel volatility of gasoline, methanol, and diesel fuel.



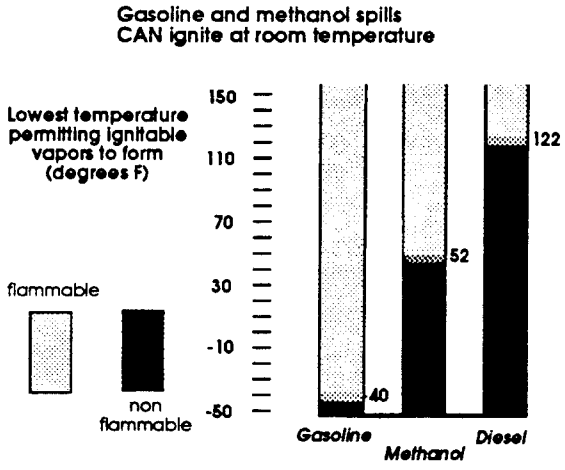
Characteristics of Methanol

Physical Properties
- appearance
- odor
- density
- performance
- reactivity
- solubility

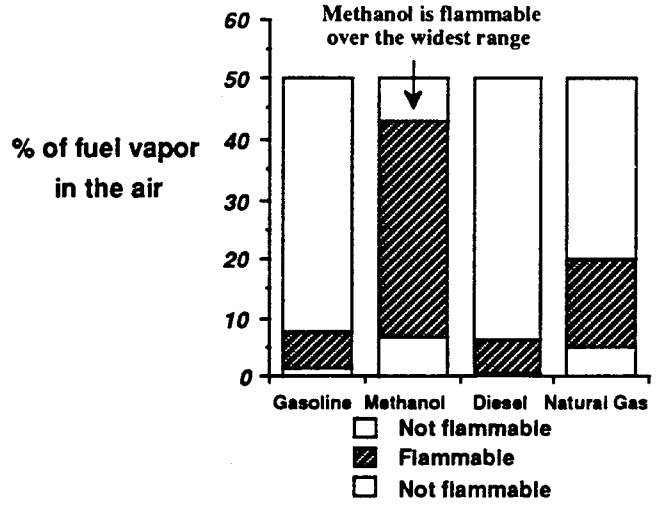
Fire Properties
- flame visibility
- flammability
  - fuel volatility
  - ***flash point***
  - ***ignition limits***
- ignition sources
  - sparks
  - hot surfaces
  - open flames
  - auto ignition
- threat of fire from spills
  - flame spread rate
  - threat of fire in tanks

Health Properties
- toxicity
- methods of exposure
  - inhalation
  - absorption
  - ingestion
- symptoms of exposure
- exposure to exhaust
- human toxicity rules

Note: The **Flash Point** is the lowest temperature where there are sufficient fuel vapors above a pool of fuel to allow for ignition. At temperatures below the "flash point," no ignition will occur because not enough fuel will evaporate. For gasoline, methanol, and diesel fuel the flash points are:



Ignition Limits Even after a fuel vaporizes and mixes with air, there are limits to its flammability. It must be mixed with air in the proper proportions (the second requirement) in order to burn. For example, the amount of vaporized fuel in the air may be too little and the fuel/air mixture is too lean to burn. On the other hand, there may be too much fuel vapor in the air. The mixture would then be too rich to burn. The chart on the left compares the ignition limits (too lean to burn or too rich to burn) of methanol, gasoline, diesel fuel, and natural gas.



Physical Properties
appearance performance
odor reactivity
density solubility

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flame visibility
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fuel volatility
flash point
ignition limits

Ignition sources
sparks
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toxicity
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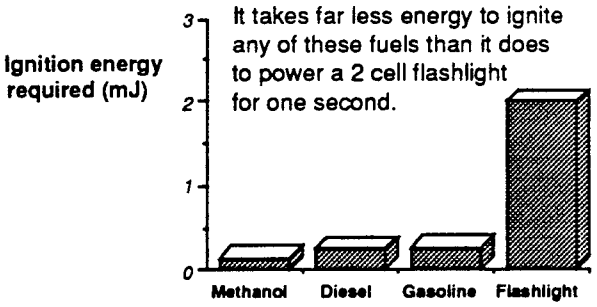
human toxicity rules

Ignition Sources

A source of ignition is the third requirement for fuel to burn. Ignition of the vapors could result from contact with 1) sparks, 2) hot surfaces, 3) open flames, or 4) autoignition. Sparks and hot surfaces are common sources of ignition in internal combustion engines.

1) **Sparks** - Sparks may be caused by either electrical equipment or static electricity. This chart illustrates the difference in the amount of spark necessary to cause ignition.

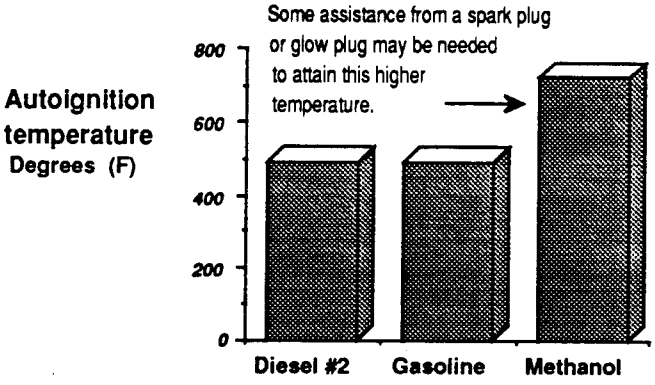


2) **Hot surfaces** - Methanol, diesel fuel, and gasoline can all ignite if exposed to hot surfaces above aproximately 220 C (430 F). This is a temperature found on some engine exhaust components.

3) **Open flames** - Any mixture of fuel vapor and air that is within the ignition limits mentioned above will ignite if exposed to an open flame.

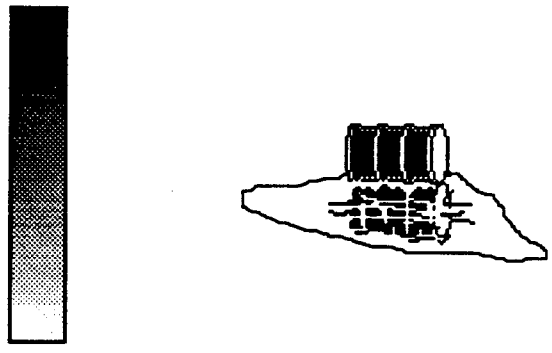
Physical Properties		Fire Properties	Health Properties	
appearance	performance	flame visibility	ignition sources	toxicity
odor	reactivity	flammability	sparks	methods of exposure
density	solubility	fuel volatility	hot surfaces	inhalation
		flash point	open flames	absorption
		ignition limits	***auto ignition***	ingestion
			threat of fire from spills	symptoms of exposure
			flame spread rate	exposure to exhaust
			threat of fire in tanks	human toxicity rules

4) **Autoignition** - Autoignition means that if the temperature of the fuel/air mixture is high enough, it will ignite itself. Extreme pressure can cause high enough temperature for autoignition. This occurs, for example, inside the cylinders of a diesel engine where high pressure causes ignition without a spark. This graph illustrates the autoignition temperatures required for diesel, gasoline, and methanol.



The Threat of Fire from Spills

The threat of fire from spills of gasoline, diesel fuel, and methanol varies. For "spills" that would occur outside a tank, (open air ignition) the potential for fire is much greater for methanol than for diesel fuel.



Flame Spread Rate

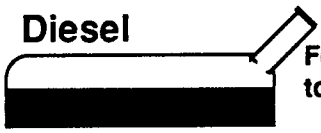
The flame spread rate is the speed with which a flame spreads over a pool of "spilled" fuel. The flame spread rate of methanol is about the same as gasoline. Both gasoline and methanol spread much more rapidly than diesel fuel flame.

The Threat of Fire in Tanks

If there was no flow of outside air to mix with the fuel vapors, a "closed air" situation would exist. A fuel tank is a closed air situation. As illustrated here, gasoline is **less** dangerous because the fuel/air mixture is too rich to burn. Diesel vapors are too lean to burn. However, methanol vapors are potentially explosive because the fuel/air mixture is within the ignition limits. For this reason, flame arresters are used on methanol tank vents.

Fuel/air mixture is too rich to burn

Fuel/air mixture is within ignition limits and WILL BURN



Fuel/air mixture is too lean to burn

Physical Properties		Fire Properties		Health Properties
appearance	performance	flame visibility	ignition sources	***toxicity***
odor	reactivity	flammability	sparks	***methods of exposure***
density	solubility	fuel volatility	hot surfaces	***inhalation***
		flash point	open flames	***absorption***
		ignition limits	auto ignition	***ingestion***
			threat of fire from spills	symptoms of exposure
			flame spread rate	exposure to exhaust
			threat of fire in tanks	human toxicity rules

Health Properties of Methanol

Toxicity Methanol is toxic and cannot be made nontoxic. It can be harmful to an individual's health. Methanol is toxic both as a liquid and as a vapor. To be able to smell methanol means that a person is probably being exposed to vapors at an unhealthy level.

Methods of Exposure Exposure to methanol can occur by:

- ➤ Inhalation (breathing it),
- ➤ Skin absorption (getting it on the skin or clothing),
- ➤ Ingestion (accidently swallowing it).

Inhalation - Methanol vapors can be present during fueling or repair work. Methanol is widely used in industry and the frequency of serious inhalation problems is low. However, as a general rule – if the smell of methanol is **constant**, there is reason for concern.

Absorption - Good practice for handling almost any fuel requires that skin contact be kept to a minimum. Methanol can be absorbed through the skin. As a precautionary measure, methanol, or any fuel spilled on the skin should be immediately washed off with soap and water. If clothes are wet with methanol, then they should be changed.

Ingestion - Drinking methanol or any fuel is a serious health hazard. As little as a mouthful can cause death. Smaller amounts can cause blindness.

NOTE: Methanol poisoning is treatable if prompt medical attention is sought.

Symptoms of Exposure

A individual's reaction to methanol exposure can vary.

The symptoms of methanol exposure may occur after a delay. This can present problems because a person exposed to methanol may be unaware that the exposure is serious and not seek treatment. Serious and untreated exposure can lead to blindness or death.

Symptoms of exposure may occur in three stages:

Stage	Symptoms
1	Headache, giddiness, nausea, gastric pain, coldness, or muscle weakness.
2	A period of 10 to 15 hours where no symptoms are felt.
3	Visual and central nervous system effects such as failing eyesight, nausea, dizziness, headache, and respiratory distress.

Exposure to Exhaust

A by-product of methanol engine exhaust is formaldehyde. A person can smell sharp formaldehyde odors well below harmful levels. At higher levels, formaldehyde exhaust can cause burning of the eyes, nose, and throat. It is wise not to stay in the vicinity of methanol exhaust if a formaldehyde smell is noticeable.

Physical Properties
appearance
odor
density
performance
reactivity
solubility

Fire Properties
flame visibility
flammability
fuel volatility
flash point
ignition limits

Health Properties
ignition sources
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toxicity
methods of exposure
inhalation
absorption
ingestion
symptoms of exposure
exposure to exhaust
human toxicity rules

HUMAN TOXICITY RULES

√ **Don't even think of drinking methanol. It is poisonous and cannot be made nonpoisonous. Even a mouthful can cause blindness or death.**

√ **If methanol is spilled on the body, wash it off immediately. Be careful that articles of clothing, such as shirts, pants or shoes, do not retain spilled methanol because it can be absorbed through the skin.**

√ **Do not breath methanol vapors for a long time. If you can smell methanol, the concentration is probably too high for prolonged breathing of the vapors.**

√ **It can take several days for methanol to be eliminated from the body. If you are exposed to an unusual amount of methanol, be extra careful to avoid additional exposure for the next 2-3 days.**

√ **Methanol exposure can be treated successfully if appropriate medical action is taken.**

Safety Equipment and Procedures

Fires

Methanol fires are particularly dangerous because they burn with an invisible flame in daylight. It is difficult to even estimate the size of the flame. On the other hand, the radiant heat from the fire is not as great as with a gasoline fire.

Heat waves over the fire area may be the first sign of the fire.

Where fires can occur

On the street.

Fires could happen as the result of a ruptured fuel tank accompanied by sparks caused by a collision with another vehicle, a fixed object, or damage from running over road obstacles or debris.

A fuel leak in or around the engine could be ignited by hot surfaces of the engine or by electrical sparks.

In the fueling or maintenance area.

Methanol or methanol vapors can collect in the bottom of maintenance pits. If exposed to an ignition source, the vapors could ignite.

Around storage tanks.

Leaks around storage tanks will create a risk of fire if exposed to an ignition source.

Extinguishing Fires

The following methods may be used to extinguish methanol fires. They are presented in their order of preference. Extinguishers are appropriate for small fires. Larger fires require notification of the fire department.

Dry powder extinguishers

ABC-rated dry chemical extinguishers have been found to be the most effective against methanol fires.

Halon extinguishers

Halon fire extinguishers are also effective against methanol fires. Although not as effective as the ABC-rated dry-chemical extinguishers, halon has the advantage of not leaving a residue.

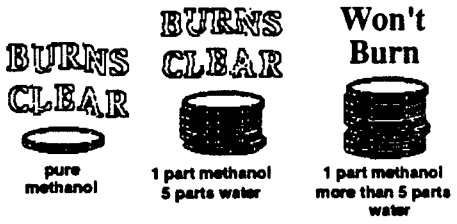
CO_2 extinguishers

CO_2 extinguishers may be used on methanol fires. However, because CO_2 extinguishers have a limited range, they are less effective and more difficult to use.

ARF foam extinguishers

For larger fires, alcohol resistant foam (ARF) is appropriate. Methanol will destroy non-ARF foam.

Water Since methanol and water will mix, methanol can be extinguished with water. However, methanol will still burn with mixtures of up to 5 parts water per 1 part methanol. Nearby materials, equipment, and containers can be cooled with streams of water.



Note: If water is used, a water-fog-type nozzle is required. Straight streams of water will tend to spread the flames.

FIRE SAFETY RULES

√ **Remember, methanol is much more flammable than diesel fuel.**

√ **Keep all ignition sources away from methanol fuel.**

- ➤ **Do not strike matches or smoke cigarettes.**
- ➤ **Do not operate welding or cutting tools.**
- ➤ **Do not use tools that generate sparks, like grinding wheels.**
- ➤ **Do not operate electrical equipment which is not approved for use near flammable liquids.**

√ **Spilled methanol will form flammable vapors. Like gasoline vapors, methanol vapors may travel to an ignition source or may accumulate in low spots.**

√ **Methanol spills should be cleaned up using authorized spill control procedures.**

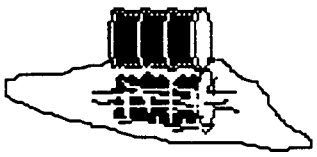
√ **Be aware that the flames from burning methanol may be hard to see.**

√ **The preferred method of extinguishing a methanol fire is with an ABC-rated fire extinguisher.**

Spills

Methanol fuel spills are flammable and dangerous. Clean up spills quickly. Do not allow spilled methanol to remain on the floor. Small spills will evaporate and won't require action.

Where spills can occur



On the street.

Spills could result from a ruptured fuel tank or fuel could leak from a faulty fuel system.

In the fueling or maintenance area.

Methanol fuel could spill in the refueling area if an unattended fuel nozzle falls out or in the maintenance area during repair of the fuel system.

Around storage tanks.

A spill could occur during transfer of fuel into storage tanks.

Spill Procedures

- √ **Remove all immediate sources of ignition (extinguish cigarettes, turn off electrical equipment in use, etc.).**
- √ **Get people away from the spill location.**
- √ **Ensure that the fire department is notified of a large methanol spill (through a supervisor or by other established procedure).**
- √ **If properly equipped, trained, and authorized to do so, apply dry absorbant or use other approved spill control techniques.**

Splashes

Methanol could be accidently splashed on the skin, onto clothing or into the eyes.

On skin - On the skin, methanol will feel cool but will not immediately irritate the skin. Repeated skin contact with small amounts of methanol will result in irritation or rash, dryness, brittleness and cracking. Methanol will be absorbed into the skin by direct contact or through clothing damp with methanol.

Skin Exposure Procedures

√ **If clothing is so wet with methanol that it does not dry within a few minutes – change the damp clothing. Be particularly careful of boots, shoes and gloves that may retain methanol on the inside.**

√ **Wash the exposed skin with large quantities of water.**

√ **Contact a supervisor or medical personnel if the exposure was large or if irritation develops.**

On Eyes - Methanol may be accidently splashed into the eyes during repair work or fueling causing moderate to severe eye irritation.

Eye Exposure Procedures

√ **Flush the eyes thoroughly with water for at least 15 minutes.**

√ **Contact a supervisor and see a doctor for treatment.**

Inhalation

The average person cannot smell methanol until it is at a level where continual exposure is potentially dangerous. Therefore, if fumes are smelled continuously there is reason to move to an area of fresh air. Symptoms can include headaches, nausea or visual problems.

First Aid for Excessive Inhalation

- √ **Move to fresh air and away from vapors.**
- √ **Contact a supervisor or medical personnel.**

Ingestion

Methanol may be accidently swallowed. Since methanol is a poison, serious health effects may occur, including death or blindness. Immediate symptoms of methanol ingestion may include "drunkenness." Within 1 to 2 days, serious symptoms occur including headache, nausea, stomach pain, vision problems, shallow breathing, coma or convulsions. The amount of consumed methanol capable of causing death ranges from 1 to 4 ounces or more.

First Aid for Ingestion

- √ **Contact a supervisor and emergency personnel**
- √ **Have the person lie down and keep warm.**
- √ **Keep the eyes shaded from light.**
- √ **If properly trained and authorized to do so...**
  - √ **Induce vomiting immediately (give 2 glasses of warm water and stick a finger down the person's throat).**
  - √ **If the person is unconscious, do not make them swallow anything.**

➢ With proper medical attention, methanol poisoning CAN be treated successfully. For example, blood testing and analysis allows physicians to determine the extent of methanol poisoning and to prescribe an antidote and course of treatment.

Changes in the Job

The use of methanol fuel will likely create a few changes in the job routine for many employees, including those employees who repair buses. Knowledge of fire safety and human toxicity rules is essential. In summary, they are:

FIRE SAFETY RULES


No Smoking


No Open Flame

- √ Remember, methanol is much more flammable than diesel fuel.
- √ Keep all ignition sources away from methanol fuel.
  - ➤ Do not strike matches or smoke cigarettes.
  - ➤ Do not operate welding or cutting tools.
  - ➤ Do not use tools that generate sparks, like grinding wheels.
  - ➤ Do not operate electrical equipment which is not approved for use near flammable liquids.
- √ Be aware that the flames from burning methanol may be hard to see.
- √ Methanol spills should be cleaned up using authorized spill control procedures.
- √ The preferred method of extinguishing a methanol fire is with an ABC-rated fire extinguisher.
- √ Like gasoline vapors, methanol vapors are heavier than air and may accumulate in low spots.

HUMAN TOXICITY RULES

- ✘ Don't even think of drinking methanol. It is poisonous and cannot be made nonpoisonous. Even a mouthful can cause blindness or death.

- ✘ If methanol is spilled on the body, wash it off immediately. Be careful that articles of clothing, such as shirts, pants or shoes, do not retain spilled methanol because it can be absorbed through the skin.
- ✘ Do not breathe methanol vapors for a long time. If you can smell methanol, the concentration is probably too high and continual exposure is potentially dangerous.
- ✘ It can take several days for methanol to be eliminated from the body. If you are exposed to an unusual amount of methanol, be extra careful to avoid additional exposure for the next 2-3 days.
- ✘ Methanol exposure can be treated successfully if appropriate medical action is taken.

The following are points of information for maintenance personnel **who would work on a methanol coach fuel system:**


No Smoking

Absolutely **NO SMOKING.** Remember, methanol is potentially explosive in a closed tank. Welding, grinding, or working with an open flame near a methanol coach is to be avoided. Know the location of approved fire extinguishers.


No Open Flame

- Impervious gloves SHOULD BE WORN when working with liquid methanol in order to avoid skin contact. Goggles are recommended to protect from splashes that could get in the eyes. Both are available in the shop.

- **Work only over vented pits** (methanol vapors are denser than air and will tend to accumulate in low spots). Do not break open a fuel system if the coach is over an unvented pit. Use an exhaust fan around the engine when breaking open a fuel system.

- If changing fuel filters or working on the fuel system, **shut off the fuel at the line valve** and **drain methanol only into approved containers.**

- Use only replacement parts that are approved for methanol. (For example, fuel lines must be made of stainless steel. Methanol will corrode aluminum).

- Fill new filters before installing only from an approved safety can containing uncontaminated methanol.

- Absorb any residual fuel with rags before restarting the coach (or allow small amounts to evaporate where proper ventilation will allow).

- Do not siphon or blow on a methanol fuel line.

- Avoid the use of ether or other starting aids.

- Dispose of rags in a designated closed container.

The use of methanol fuel will likely create a few changes in the job routine for many employees, including those who drive the buses. Knowledge of fire safety and human toxicity rules is essential. In summary, they are:

FIRE SAFETY RULES


No Smoking


No Open Flame

- √ Remember, methanol is much more flammable than diesel fuel.
- √ Keep all ignition sources away from methanol fuel.
  - ➤ Do not strike matches or smoke cigarettes.
  - ➤ Do not operate welding or cutting tools.
  - ➤ Do not use tools that generate sparks, like grinding wheels.
  - ➤ Do not operate electrical equipment which is not approved for use near flammable liquids.
- √ Be aware that the flames from burning methanol may be hard to see.
- √ Methanol spills should be cleaned up using authorized spill control procedures.
- √ The preferred method of extinguishing a methanol fire is with an ABC-rated fire extinguisher.
- √ Like gasoline vapors, methanol vapors are heavier than air and may accumulate in low spots.

HUMAN TOXICITY RULES

- ✘ Don't even think of drinking methanol. It is poisonous and cannot be made nonpoisonous. Even a mouthful can cause blindness or death.
- ✘ If methanol is spilled on the body, wash it off immediately. Be careful that articles of clothing, such as shirts, pants or shoes, do not retain spilled methanol because it can be absorbed through the skin.
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- ✘ Methanol exposure can be treated successfully if appropriate medical action is taken.

☞ **Questions from passengers**

Many passengers will be curious about methanol fuel. As a driver, you will likely be asked many questions about the bus and the fuel. Remember that you are one of the first transit properties in the nation to demonstrate methanol fuel use in mass transportation. You are participating in an exciting new technology. Air quality is important to everyone.

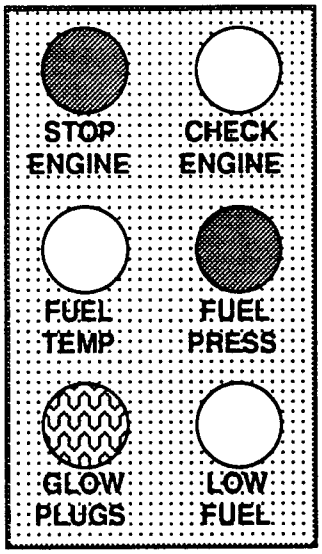
☞ **What coach do you have?** Although the outside of the bus may be visibly marked as methanol powered, the inside of the bus and the driver's compartment may look practically the same as any other similar coach. The most obvious difference is the presence of additional indicator lights near the steering column. Those lights and their meaning are shown below.

☞ **Indicator lights** The additional indicator lights are typically for the purposes shown below.

If this RED light comes on, SHUT DOWN the engine and notify the Dispatcher.

The fuel temperature is nearing 140 F. Report at end of shift.

This is a timed light. After turning on the Master Switch, WAIT UNTIL THIS LIGHT GOES OUT before engaging the starter.



Indicates an abnormality in the engine compartment. Report at end of shift.

The fuel pressure is low. After turning on the Master Switch, do not engage the starter until this light goes out.

Little fuel remains in the tanks.

☞ **Starting the coach**

1. It is not necessary to press on the accelerator pedal at any time during starting.
2. TURN the MASTER SWITCH to run. The glow plug indicator light on the dash will illuminate.
3. After approximately 60 seconds, the glow plug light will go OFF. PRESS the starter button. If the engine fails to engage after a few seconds, release the starter switch and wait 15 seconds before pressing it again.
4. If after the second attempt, the engine fails to engage, contact the Dispatcher.

Note: During the first 2 or 3 minutes after startup, the engine may run roughly. Do not move the coach until the engine has warmed up and smooths out.

☞ **Restarting** Same as above.

☞ **Stopping the coach** No difference.

☞ **Sudden rough running engine, loss of power, or backfire** If any of these things occur after warmup, move immediately to a safe location and shut down the coach. Call the Dispatcher. (The engine could be pumping raw fuel into the exhaust, creating a potential for fire).

☞ **Too hot an engine** Follow normal procedures (Shut down over 220 degrees and call the Dispatcher).

☞ **If you are involved in an accident** Shut off the engine.

If an accident involves damage to the fuel system and a major fuel spill or leak, evacuate the coach and move passengers to a safe location (upwind if possible). Notify the Dispatcher of the extent of the spill or leak. Follow all appropriate accident procedures.

☞ **If you are involved in an accident that causes a fuel spill**

In the event of any fuel spill or leak, DO NOT USE FLARES. When police or fire personnel arrive on the scene, make sure that they are aware that a methanol coach is involved.

No Smoking

Be prepared to PREVENT passengers or bystanders from SMOKING. Remember, methanol looks like water and onlookers may think there is no danger from smoking.

☞ **Driving over obstacles** Methanol coaches have larger fuel tanks. Be especially careful about road obstacles, and do not drive over any obstacle that has the potential to damage the underside of the coach.

☞ **Other Notes:**

The use of methanol fuel will likely create a few changes in the job routine for many employees, including those employees who fuel buses. Knowledge of fire safety and human toxicity rules is essential. In summary, they are:

FIRE SAFETY RULES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No Open Flame

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- ✘ Methanol exposure can be treated successfully if appropriate medical action is taken.

Other points of information for fuelers include:

- Be knowledgeable of health and toxicity rules.

-  Absolutely NO SMOKING around the fueling area.

No Smoking

- Impervious gloves SHOULD BE WORN while fueling the methanol buses in order to avoid skin contact. Goggles are recommended toprotect the eyes from splashes that could occur. Both are available in the shop.

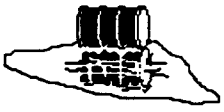
- It is necessary to BE MORE AWARE of the fueling process - that the nozzle is correctly placed and secured and that no fuel leaks.

- It is a good idea to make an **extra** effort not to splash methanol on skin or clothing and to avoid any continual breathing of fumes. Places of skin contact should be washed off with soap and water.

- It is important to be aware of the location off all shut off valves. Those include:

  * the feed shut off valve at the dispenser
  * breaker switch in the shop

- Spill Procedures:



  √ Remove all immediate sources of ignition (turn off electrical equipment in use, do not come into the area with a cigarette, etc.)

  √ Get people away from the spill location.

  √ Ensure the fire department is notified of a large methanol spill (through the supervisor).

  √ If properly equipped, trained, and authorized to do so, clean up the spill.