

Cleaning Mobile Tanks in Flammable or Combustible Liquid Service

API PUBLICATION 2013
SIXTH EDITION, JANUARY 1991

American Petroleum Institute
1220 L Street, Northwest
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Safety and Fire Protection Department

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FOREWORD

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Cleaning Mobile Tanks in Flammable or Combustible Liquid Service

SECTION 1—GENERAL

1.1 Scope

This publication provides procedures for safely cleaning mobile tanks used to transport flammable and combustible liquids.

1.2 Definitions

1.2.1 A *mobile tank* is a storage container at atmospheric pressure that is used to transport bulk quantities of petroleum liquids by land or rail. This includes tank trucks, rail tank cars, and skid-mounted tanks, but not tanks for marine transportation.

1.2.2 *Health hazards* are conditions that may create exposure to substances that can cause acute or chronic illness, disease, or death. These substances cause harm as a result of inhalation, ingestion, or skin or eye contact.

1.2.3 *Vapor-freeing* is the process of removing flammable or toxic vapors or gases from a tank to make the tank safe to work in or on. In this document vapor-freeing is equivalent to gas-freeing.

1.2.4 *Hot work* is any procedure that can introduce an ignition source into a potentially flammable atmosphere (for example, welding, brazing, cutting, burning, grinding).

1.2.5 A *flammable liquid* is one that has a flash point below 100°F (37.8°C) and a vapor pressure not exceeding 40 pounds per square inch absolute (2068 millimeters of mercury) at 100°F (37.8°C). Examples are gasoline and most crude oils.

1.2.6 A *combustible liquid* is one that has a flash point at or above 100°F (37.8°C). Examples are diesel and kerosene.

1.3 Referenced Publications

The following standards and publications are cited in this recommended practice:

ACGIH¹

Threshold Limit Values and Biological Exposure Indices, 1989–1990

API

Publ 2015 *Cleaning Petroleum Storage Tanks*

¹American Conference of Governmental Industrial Hygienists, Bldg. D-7, 6500 Glenway Avenue, Cincinnati, Ohio 45211.

Publ 2217 *Guidelines for Work in Confined Spaces in the Petroleum Industry*

OSHA²

29 *Code of Federal Regulations* Subpart Z, "Toxic and Hazardous Substances," and 1910.1000

1.4 Hazards

Personnel who work in or around mobile tanks may be exposed to the following hazards:

- Fires and explosions.
- Toxic substances.
- Physical hazards.
- Oxygen deficiency.

The fourth hazard, oxygen deficiency, may be the most underestimated hazard to personnel entering tanks.

Detailed precautions, which should be considered before personnel are authorized to enter mobile tanks, are contained in API Publication 2217.

1.5 Ventilation

1.5.1 GENERAL

Before personnel are authorized to perform hot work on the tank or to enter the tank, the atmosphere within the tank should be ventilated until all of the conditions described in 1.5.2 through 1.5.4 are met.

1.5.2 FLAMMABLE VAPOR CONTENT

The atmosphere within the tank should contain no more than a trace of flammable vapors or gases. However, work may be performed on a tank containing up to 10 percent of the lower flammable limit (LFL) under the following conditions:

- The source of the vapors or gases is known, and it has been determined that the atmosphere within the tank will never exceed 10 percent of the LFL.
- The flammability of the atmosphere is monitored with a properly calibrated detector. The monitoring may be performed either periodically or continuously.

Respiratory protective equipment may be required if personnel are to enter the tank before it has been gas-freed

²Occupational Safety and Health Administration, U.S. Department of Labor. The *Code of Federal Regulations* is available from the U.S. Government Printing Office, Washington, D.C. 20402.

to 0 percent of the LFL, depending on the concentration and expected duration of exposure to the contaminants within the tank. The type of respiratory equipment required is determined by the characteristics and concentration of the contaminants.

1.5.3 OXYGEN CONTENT

The maximum oxygen content of the atmosphere within the tank should not exceed 21 percent. The minimum oxygen content for entry into tanks without respiratory protection equipment is 19.5 percent. However, whenever the oxygen concentration is below 20.9 percent, suitable and approved respiratory protective equipment may be required.

Atmospheres containing less than 19.5 percent oxygen require the use of approved and suitable respiratory protection equipment.

Additional discussion on this topic may be found in API Publication 2217.

1.5.4 HEALTH HAZARDS

Health hazards are of special concern for personnel who enter tanks but are also of concern for personnel outside the tank near openings such as hatches and manways. Typical toxic substances to which personnel cleaning a mobile tank may be exposed include lead compounds from leaded gasoline, benzene from gasoline, and hydrogen sulfide from sour crudes and sludges.

INFORMATION CONCERNING SAFETY AND HEALTH RISKS AND PROPER PRECAUTIONS WITH RESPECT TO PARTICULAR MATERIALS AND CONDITIONS SHOULD BE OBTAINED FROM THE EMPLOYER, MANUFACTURER, OR THE MATERIAL SAFETY DATA SHEET.

A health and safety plan should be developed that includes an evaluation of potential industrial hygiene concerns and that specifies the need and types of protective measures necessary to prevent worker exposure to levels above the permissible exposure limits (PELs) defined by government regulatory agencies and advisory organizations such as the American Conference of Governmental Industrial Hygienists.³

Personnel should not enter the tank without a suitable and approved respirator, unless contaminants within the tank are below the PELs discussed above. API Publication 2217 contains additional guidelines and information about safe entry into confined spaces typically found in the petroleum industry.

³For PELs, consult the most recent edition of *Occupational Safety and Health Standards, 29 Code of Federal Regulations* Subpart Z, "Toxic and Hazardous Substances," Section 1910.1000 and following. Also consult the most recent edition of the ACGIH handbook *Threshold Limit Values and Biological Exposure Indices*. For complete reference information, see 1.3.

SECTION 2—DRAINING THE MOBILE TANK

2.1 Location

Before gases or vapors are removed from a tank, the tank should be moved to a well-ventilated area away from ignition sources such as vehicles and heaters.

Draining the tank while it is within an enclosed structure should be avoided, if possible, and may not be permitted by some regulatory agencies. If a tank containing flammable liquids must be drained while it is within an enclosed structure, adequate ventilation must be provided and care taken to ensure that a flammable atmosphere does not develop within the structure.

The mobile tank should also be located in a safe area where flammable or toxic gases or vapors released elsewhere in the facility cannot enter the work area in which the tank is located.

2.2 Draining the Tank

Before the tank is entered or hot work is undertaken, all tank compartments and connecting piping systems should be thoroughly drained or pumped into approved metallic containers or tanks, or into an oil/water separator with

enough capacity to handle the anticipated volume of released liquids.

Electrostatic charges generated by draining the tank should be controlled by bonding the tank to the metal container. Nonconductive (for example plastic) containers should not be used because they can accumulate large static charges. Where product is drained into a separator, care should be taken to minimize splashing.

Product drained from the tank should be reclaimed or properly disposed of in accordance with regulatory requirements and company practices. Care should also be exercised to ensure that all ignition sources have been removed from the immediate area and from the nearby areas downwind of the mobile tank.

2.3 Internal Emergency Valves, Vents, Lines, and Meters

Depending on the work to be done, the type of tank, and the products contained, it may be necessary to ensure that all ancillary equipment and lines have been properly drained. Where necessary, each pipe should be discon-

nected from the compartments and from any associated equipment. Equipment such as meters, air eliminators, and manifold valves should be disconnected or removed. To ensure complete drainage, it may also be necessary to remove the internal valves or sump covers.

Any remaining product should be removed, and all connections should be wiped or otherwise allowed to dry. Cloths or mops used for this purpose should be washed, dried, and stored, or disposed of in accordance with regulatory requirements and company practices.

2.4 Strainers and Filters

Some tanks are equipped with a strainer or filter in the discharge line. In this case the cover plate, drain plug, and

strainer basket or filter element should be removed from the line and should not be replaced until all repair work has been completed.

2.5 Bottom-Loading Connections

If tanks are equipped with bottom-loading adapters, it may be necessary to remove these adapters to ensure complete drainage of the adapter line and manifold. The adapter components should not be replaced until all work has been completed.

Before the tank is entered or hot work is undertaken, it should be verified that no flammable or toxic liquids or vapors remain in the valves or piping.

SECTION 3—GAS-FREEING THE TANK

3.1 General

This section provides procedures that can be used to remove vapors or gases from the tank. Gas-freeing may be accomplished by any of the following procedures:

- Filling the tank with water.
- Injecting steam into the tank.
- Ventilating the tank.

3.2 Filling the Tank With Water

After the tank has been completely drained and before it is filled with water, it should be determined that it is on a level surface that will adequately support the weight of the water-filled tank. If the tank is disconnected from the truck or tractor and allowed to rest on its landing gear or stiff-leg supports, it should be determined that the landing gear can support the total load of the water-filled tank. Additional supports or blocking may be required.

The tank should then be completely filled with water and permitted to overflow until all traces of product are removed. Hot water and detergent may be required to remove the residue from some heavy oils.

If hot work is to be performed on the exterior of the tank or on the dispensing system components, the water may be permitted to remain in the compartments during the hot work.

3.3 Limitations of Filling the Tank With Water

Filling the tank with water is acceptable only if the water remaining in the compartments or between the bulkheads after draining does not interfere with the intended hot work. Filling with water may not be practical where temperatures drop below freezing.

Water that has drained or overflowed from the tank should be disposed of in accordance with federal, state, and local regulatory requirements and company practices.

3.4 Steam Injection

Steam injection is effective for removing petroleum products, including those with a high viscosity or pour point.

Before and during steam injection, the steam hose nozzle should be bonded to the tank shell, and the tank should be grounded to prevent the buildup of static electricity.

Low-pressure steam should be slowly injected into the tank compartments and allowed to vent until the temperature of the tank reaches a minimum of 170°F (77°C). At this temperature the steam will have displaced the oxygen in the tank so that no ignitable mixture can be formed within the tank.

After steam injection is completed, the tank should be flushed out with water, which should be disposed of in accordance with federal, state, and local regulatory requirements and company practices.

3.5 Limitations of Steam Injection

The principal difficulties associated with steam injection include the following:

- The need to obtain sufficient quantities of steam.
- The time required to accomplish gas-freeing.
- The precautions that must be taken to prevent freezing during cold weather.
- The need to ensure adequate venting to prevent tank collapse as the steam cools and creates a vacuum.
- The precautions that must be taken to prevent overpressuring the tank.

f. The precautions that must be taken to prevent hazardous accumulations of static electricity.

The heat of the steam may also have the following effects:

- a. It may damage the painted surface on the outside of the tank.
- b. It may damage composition valve seats, gaskets, and diaphragms.
- c. It may actuate or damage the heat-sensitive elements of internal emergency valves, fusible plugs, and tank-overfill sensors.
- d. It may damage the air lines used to control internal emergency valves.

3.6 Tank Ventilation

3.6.1 GENERAL

Powered or natural ventilation may also be used to remove flammable and toxic vapors and gases from the mobile tank.

The effectiveness of the ventilation should be determined by frequent testing of the atmosphere within the tank for vapors or gases and for oxygen. Care should be taken to prevent the personnel performing these tests from being exposed to fire or health hazards.

3.6.2 AIR MOVER DISCHARGING INTO DOME OPENINGS

A steam- or air-operated venturi-type air inductor or air mover may be mounted on the tank to discharge air into the tank compartment fill openings on top of the tank.

Air movers, including fan blowers, powered by safe means including explosionproof electrical motors approved for use in Class I, Division 1, locations are also acceptable.

The discharge outlets should be open when air is introduced to the tank. Some of the vapor within the tank will leave the tank through the discharge outlets, and the remainder will leave through the opening around the air mover.

The air mover should be bonded to the tank shell, and the tank shell should be grounded. If a duct is used, all metallic parts and accessories should be bonded to the tank and the air mover.

3.6.3 AIR MOVER DISCHARGING INTO THE BOTTOM CONNECTION

Air movers may be installed on the bottom connection of the tank, and the vapors vented through the top openings.

To facilitate thorough ventilation of the tank, an air deflector can be installed within the tank through the dome cover opening. To maximize ventilation, the deflector should extend below the top of the tank into the vapor space. The deflector should be made from an electrically conductive material and should be bonded to the tank shell.

Fan blowers powered by safe means may also be connected to the tank through air ducts. The air mover should be bonded to the tank shell, and the tank shell should be grounded. All metallic parts and accessories should be bonded to the tank and the air mover.

3.6.4 AIR MOVER DISCHARGING OUT OF THE DOME OPENINGS OR BOTTOM CONNECTIONS

Suitable fan blowers, may be mounted on the tank to withdraw gases and vapors from the mobile tank and replace them with clean air. The blowers may be connected to the tank through suitable air ducts.

Care should be taken to allow sufficient airflow into the tank to prevent a vacuum from forming and causing tank damage. The density of the flammable or toxic gases or vapors within the tank should be considered when determining the proper location for air inflow to the tank.

Other precautions that should be considered when using this gas-freeing procedure are similar to those discussed in 3.6.2 and 3.6.3.

3.6.5 NATURAL VENTILATION

Another acceptable procedure is to open all tank compartment hatches and bottom openings and allow natural ventilation to dissipate the gases and vapors present.

3.6.6 VENTILATION LIMITATIONS

Recovery and treatment of gases or vapors released during ventilation may be required, depending on regulatory requirements and company practices.

If the gases or vapors are released to the open air, precautions should also be taken to eliminate ignition sources near the point of release. Personnel entering an area where toxic vapors or gases may be present may be required to wear appropriate respiratory equipment, depending on the concentration of the toxic substance and the duration of exposure.

Natural ventilation may require a much longer time than would forced ventilation. This may result in the presence of a flammable atmosphere within the tank for an extended period of time.

SECTION 4—GAS-FREEING TANKS THAT HAVE CONTAINED VISCOUS MATERIALS

Some companies have cleaned tanks that have contained viscous materials by filling the tank about one-fourth to one-half full with a suitable solvent and driving the truck around for a short time to agitate the contents. A suitable solvent would have a flash point at least 20°F (11°C) above the highest ambient temperature expected. Solvents used include diesel and kerosene, as well as hot water and detergent. Special precautions may be necessary when water containing detergents is drained into an oil/water separator.

Other companies have cleaned tanks that once held viscous materials by filling the tank with water and then heating the water by means of steam introduced into the tank heater coils.

If steam injection is used, the injection rate should be controlled to prevent the temperature of any of the products within the tank from coming within 20°F (11°C) of its flashpoint. Care should also be taken to ensure that the domes are open far enough to prevent tank collapse when the tank cools.

When injection is complete, the dome cover and the bottom outlet valve should be opened, and the liquid disposed of in accordance with regulatory requirements and company practices.

If vapor remains after the procedures above have been used, the tank should be gas-freed using the ventilation, steam-injection, or water-filling procedures described in Section 3.

SECTION 5—SPECIAL CASES

5.1 Double Bulkheads

Some mobile tanks have double bulkheads, the space between which may trap liquid or vapor. The space between the bulkheads should be inspected and tested for flammable or toxic liquids or vapors. If liquid is found between the bulkheads, the bulkheads should be drained and ventilated, or flushed with water, and tested again before hot work is begun.

5.2 Box-Type Bolsters

If the axle and the fifth wheel on a semitrailer unit are attached directly to the tank, any pipe plugs in the bolster structure should be removed. Such sections should be tested for the presence of flammable or toxic vapors or liquids. If they are present, the sections should be ventilated by directing low-pressure compressed air through one of the plug holes. Care should be taken not to overpressure the bolster box.

5.3 Insulated Tanks

Some mobile tanks have an insulating jacket outside the shell that may trap liquid. The insulation should be inspected and tested for flammable or toxic liquids or vapors before the work is begun (see API Publication 2015).

If the insulation has been contaminated with flammable or toxic liquids, it should be removed before hot work is begun.

5.4 Vehicle Fuel Supply Tank

Before hot work on the vehicle's fuel tank is begun, the tank should be drained, ventilated, and gas-freed using the procedures discussed in Section 3.

Other components of the fuel system that are potential sources of fuel leakage, such as the fuel lines, filters, and fuel pumps, should also be drained and gas-freed.

The vapor space in the fuel tank should not be assumed to be too rich or too lean to burn. The precautions listed above should be performed regardless of the type of fuel in the tank.

5.5 Other Enclosed Spaces

A check should be made to ensure that no other spaces exist in which liquid can be trapped. Some tanks have inverted V- or U-shaped semiclosed structural members or channels along the top of the tank in which product can be trapped during loading.

These members, along with any drain tubes, closed-ring stiffeners, and vapor-recovery piping, should be checked for trapped liquid or vapor.

SECTION 6—TANK INSPECTION

After draining and gas-freeing, the tank atmosphere should be tested with suitable combustible- and toxic-gas detectors to ensure that the conditions listed in 1.5 have

been met. The interior of the tank should be inspected with a mirror, an approved flashlight, or an extension light to determine whether all product has been removed.

SECTION 7—TANK REPAIR

7.1 Hot Work on Tank Compartments

Tank repairs that are considered hot work (that is, work that introduces an ignition source into the work area) should not be performed until all tank compartments have been drained and gas-freed. The adequacy of the gas-freeing should be checked using approved and calibrated portable combustible-gas detectors.

Hot-work permits should be used to ensure and document that all testing and equipment checkout have been performed. Hot-work permits have proved effective in reducing instances of fires.

Leaks in tank shells are sometimes repaired with an overlay patch. Before any hot work is begun around a patch, the area should be checked to ensure that no flammable material is trapped between the patch and the shell.

It should be ensured that the area surrounding the tank is suitable for hot work.

7.2 Hot Work on Nontank Areas

Welding or cutting on any part of the vehicle that does not involve heating of the tank shell, compartments, or piping may be performed without draining and emptying the tank, provided the work area is continuously tested to ensure that the surrounding atmosphere is not within the flammable range.

Actions must be taken to prevent product vapor from escaping from the tank compartments. Such actions include checking that the compartment covers are kept closed and that all connections that might release product into the work area are plugged or vented to a safe area.

An approved and calibrated portable combustible-gas detector should be used to check that the atmosphere in the work area is not within the flammable range.

7.3 Repairs Not Requiring Hot Work

Judgment should be exercised in deciding whether to perform repairs that do not involve hot work without first emptying and gas-freeing a tank. If the repairs are to be performed indoors or if personnel are to enter the tank, the tank should be drained and gas-freed using the procedures discussed above.

7.4 Tank Entry

Before a tank is entered, the guidelines discussed in API Publication 2217 should be followed, along with company policies.

7.5 Extended Storage

If a tank that has contained flammable or toxic materials is to remain inside a building for an extended period, all tank compartments should be drained and gas-freed.

SECTION 8—PERSONAL PROTECTION

Before work is begun, the health hazards presented by the materials within the tank should be reviewed to determine the appropriate personal protective equipment. This information may be found on the Material Safety Data Sheets.

If any product or toxic material comes in contact with the skin, the skin should be washed immediately with soap

and water. Any clothing contaminated by product should be removed and replaced with clean clothing. The contaminated clothing should be cleaned or disposed of in accordance with all federal, state, and local regulatory requirements and company practices.

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