

Best Practices for the Safe Loading and Unloading of Flammable Liquids

Scope

The scope of this best practice consists of guidelines that a facility could use to develop their own detailed and specific procedures, checklists, or work instructions for tank truck and railcar loading and unloading of flammable liquids. The term “flammable” has different definitions under different codes and regulations. For the purpose of this best practice, flammable liquids are defined as liquids with a flash point below 140 °F (60 °C). These are also known as Class I and Class II liquids as defined by NFPA (National Fire Protection Association) and Category 1, 2, and 3 liquids as defined by OSHA. This best practice primarily focuses on the environmental, safety, and health aspects of this activity.

A facility’s detailed work instructions shall be evaluated for safety using a job safety/hazard analysis protocol. Applicable U.S. regulations include 29 CFR 1910.106, 29 CFR 1926.152 and possibly 29 CFR 1910.119 (Process Safety Management) if the flash point is below 100 °F (37.8 °C) and depending on other criteria and exceptions specified in the regulation. In addition, the consensus standard NFPA 30 applies. When in transportation, the Department of Transportation (DOT) Hazardous Materials Transportation Act regulation applies at Title 49 of the Code of Federal Regulations (CFR). Also note that hazardous waste regulations at 40 CFR 239-282 may apply for flammable/ignitable liquids that are declared a waste. Finally, check the local fire codes, building codes, and with the local Fire Marshal. The reader shall be familiar with all applicable codes and regulations.

Key Points

- Loading/unloading procedures shall be documented and evaluated using a Job Hazard/Safety Analysis. A checklist used with each loading/unloading activity is best practice.
- Proper grounding must be used to dissipate static electricity and prevent spark potential.
- The loading/unloading area for flammable liquids shall have equipment that is properly electrically classified.
- The loading/unloading area for flammable liquids shall have spill protection.

Hazards Associated with Flammable Liquids

The safety data sheet shall be reviewed prior to handling each specific flammable liquid.

General hazards include the following:

- The most obvious harm is the danger of a fire or explosion.
- Flammable liquids may also cause health problems depending on the specific material and route of exposure (breathing the vapor/mist, eye or skin contact, or swallowing), including corrosivity to eyes, skin, lungs, mucus membranes.



- Many flammable liquids undergo dangerous chemical reactions if they contact incompatible chemicals such as oxidizing materials, or if they are stored improperly.
- Some flammable liquids have vapors that are heavier than air and can accumulate in low lying areas.

Department of Transportation (DOT) Classification

Flammable liquids are Hazard Class 3. The Packing Group will be I, II, or III depending on the flash point and boiling point, with PG I would be the most flammable.

Hazardous Area Classification and Control of Vapors

As a result of the flammability hazard, loading and unloading areas must be designed to the appropriate hazardous area classification for the presence, or potential presence of flammable vapors. This hazardous area classification establishes requirements to prevent sparks that would initiate a fire or explosion in the presence of flammable vapors. Electrical equipment in the affected area should either be Class I Division 1 or Class I Division 2. Class I indicates that the flammability hazard is due to vapors and not dust. Division 1 indicates that flammable vapors are likely present during normal operation. Division 2 indicates that flammable vapors may be present during upset conditions or mechanical failures. In addition, ventilation equipment must be non-sparking in the designated classified areas.

Equipment used in the handling of flammable liquids must be properly grounded. This includes tanks, piping, motors, and all other process equipment, including equipment used intermittently, such as loading and unloading equipment piping, booms, as well as tank trucks, rail cars, drums, totes, etc. that are being filled or unloaded.

Grounding

When loading dry bulk or liquid products, moving material creates friction and an electrostatic charge builds on the vehicle's surface. This buildup increases the risk of a static spark and a potential ignition source. If properly grounded, the electrostatic charge has a path to the earth, keeping charge from building up. For that voltage to be discharged, the vehicle must be connected to the ground through a copper or steel wire that's attached to an electrode in the ground. For top loading, the fill pipe must also be bonded (connected by a wire) to the tank. Ground wires that are too long can have enough resistance to prevent static electricity from totally dissipating will seek a shorter path by jumping gaps in equipment, creating a spark or ignition source for flammable gases. Both the NFPA and API (American Petroleum Institute) recommend that the resistance of these ground wires measure no more than 10 ohms end to end.

Loading procedure during transfers involves the driver connecting the truck or railcar to the earth (grounding) before any other operations. Best practice is for the truck or railcar grounding system to have interlocks that prevent the transfer of the flammable liquid if the ground connection has not been made. Typically, the loading rack has a grounding system that connects to the truck or railcar. Note that although the tracks that railcars run on have their



own grounding system; however, many railcars have wheel bearings that are not conductive, which makes the rest of the carriage assembly isolated electrically.

Facility Siting, Piping, and Shutoff Valves

Locate flammable liquid loading and unloading areas 15-25 feet away from important buildings and structures, based on the flash point per NFPA 30. Consider these distances as minimums. Best practice is to have dedicated piping for this service and to have automatic shutoff valves with clearly marked emergency manual shutoff valves located a safe distance away.

General Precautions

The following general guidelines apply to both loading and unloading of flammable liquids, both by tank truck and railcar. Most of the following applies to loading and unloading any type of liquid.

- All loading/unloading inspections shall be properly documented through a checklist. Best practice is to use a checklist for each loading and unloading event.
- In addition, a Job/Safety Hazard Analysis shall be performed on the procedure and associated checklist.
- Use independent verification to ensure the valves are aligned to/from the proper tank(s) for loading and unloading.
- The loading/unloading area should have adequate lighting and be free of obstacles or unnecessary equipment.
- Verify that safety equipment such as safety showers, eyewash stations, fire extinguishers, and perhaps sprinkler systems are present and operational before conducting loading/unloading activities.
- Ensure that proper tools are used for loading and unloading operations. They must be clean and in good condition at all times.
- Be aware of "line of fire" hazards when connecting and disconnecting hoses.
- Be aware of ergonomic hazards, particularly when in awkward positions and when handling heavy hoses.
- To avoid spills and housekeeping issues, ensure loading/unloading hoses are pumped or drained clear of any residual material after use during the loading or unloading process.
- Best practice is to conduct flammable liquid loading and unloading with spill protection equipment (containment areas, spill pans) in place.
- Be aware of tripping hazards caused by slippery material on the ground, on hoses, and other objects.

Tank Truck Unloading

- Verify all applicable paperwork before unloading tank truck.
- Don PPE per the safety data sheet and facility policy.
- Spot truck and ensure engine is turned off.
- Chock wheels in both directions.



- Attach grounding clamp(s) per manufacturer's recommendations. Confirm the grounding condition, typically through illuminated indicator.
- Bleed off pressure in the tank truck, then close the vent.
- Connect unloading hose. Use self-locking hose fittings or secure the ears on hose fitting using a pin, wire, or high visibility Velcro straps.
- If unloading by pump, open dome lid while using adequate fall protection, such as a personnel access ramp or using a harness and lanyard attached to an approved anchor point.
- If unloading by pump, a positive displacement pump is recommended for pumping soap. See the section below, Positive Displacement Pump Safety.
- If unloading using air pressure, ensure air pressure is regulated to prevent over pressurization of the tank truck.
- Align valves and pump/pressure off black liquor. Align valves and pump/pressure off soap. Measure quantities of black liquor and soap unloaded. Use independent verification, as appropriate, for proper valve alignment to prevent misdirection.
- Visually inspect container to make sure it is completely empty.
- Close dome lid accessed by personnel access ramp or by using adequate fall protection and secure all bolts.
- Close outlet valve(s).
- Replace outlet cap.
- Install valve seals/car seals.
- Wash up area, hose, and fittings with water.
- Remove wheel chocks.

Railcar Unloading

- Check all applicable paperwork before unloading the railcar.
- Don PPE per the safety data sheet and facility policy.
- Verify any vessel inspection stencils prior to loading. Verify no inspection dates on the vessel have not expired.
- Put a caution sign, commonly known as a blue flag, into place. If the car can be approached from either direction be sure to put up a sign at both ends.
- Prevent entry into the track by locking the switch and/or locking derailer.
- Check the hand brakes to make certain they have been applied. Do not assume that someone else has set them.
- Chock wheels in both directions.
- Attach grounding clamp(s) per manufacturer's recommendations. Confirm the grounding condition, typically through illuminated indicator.
- Bleed off pressure, then close the vent.
- Verify that the bottom valve is closed and remove boot/belly cap. Be aware of product. Carefully remove the belly cap, ensuring that no/minimal liquid (black liquor or soap) flows out as the cap is loosened. There have been cases where the bottom valve was defective and appeared to be in the closed position but allowed significant quantities of

fluid to escape when the belly cap was removed. Use an Aluminum pipe wrench which is more lightweight.

- Connect unloading hose. Use self-locking hose fittings or secure the ears on hose fitting using pins, wire or high visibility Velcro straps. Note that this step must be done with care, due to ergonomic hazards working underneath a railcar.
- If unloading by pump, open dome lid, using adequate fall protection, such as a personnel access ramp or using a harness and lanyard attached to an approved anchor point.
- If unloading by pump, a positive displacement pump is recommended for pumping soap. See the section below, Positive Displacement Pump Safety.
- If unloading using air pressure, ensure air pressure is regulated to prevent over pressurization of the railcar.
- Align valves and pump/pressure off black liquor. Measure quantity of black liquor unloaded. Use independent verification, as appropriate, for proper valve alignment to prevent misdirection.
- Heat contents with direct steam injection or indirect heating coils to facilitate pumping off the soap. Alternatively, soap can be sluiced out with water or black liquor. Monitor the temperature of the contents if heating with steam to prevent overheating / boilover.
- Align valves and pump/pressure off soap. Use independent verification as appropriate to prevent misdirection. Measure quantity of soap unloaded.
- Visually inspect container to make sure it is completely empty
- Close dome lid accessed by personnel access ramp or using adequate fall protection and secure all bolts.
- Close all valves, disconnect unloading hose, and re-install boot/belly cap.
- Install valve seals/car seals.
- Wash up area, hoses, and fittings with water.
- Remove wheel chocks, blue flag, and derailer.

Tank Truck Loading

- Don PPE per the safety data sheet and facility policy.
- Verify that the tank truck is empty.
- Verify any vessel inspection stencils prior to loading. Verify no inspection dates on the vessel have not expired.
- Spot truck and ensure engine is turned off.
- Chock wheels in both directions.
- Attach grounding clamp(s) per manufacturer's recommendations. Confirm the grounding condition, typically through illuminated indicator.
- If possible, bottom fill the material. If top loading, use a fill extension downspout (a.k.a. dip tube or fill pipe) that is within 6 inches of the bottom of the tank so that the material being loaded doesn't free fall to accumulate static charge and possibly cause a spark.



- Load material, ensuring adequate ventilation for displaced vapors, or possibly venting the vapors to a vapor balancing or recovery system.
- During the loading/unloading process, the tank truck must be attended by trained personnel or monitored by an approved monitoring system, e.g. video monitoring, level switch, etc.
- Close dome lid accessed by personnel access ramp and secure all bolts using star pattern.
- Install valve seals / car seals.
- Prepare shipping papers. Apply placards.
- Wash up area, hose, and fittings with water.
- Remove wheel chocks.

Railcar Loading

- Don PPE per the safety data sheet and facility policy.
- Verify that the railcar is empty.
- Verify that the testing/inspection markings are up-to-date.
- Put a caution sign, commonly known as a blue flag, into place. If the car can be approached from either direction be sure to put up a sign at both ends.
- Prevent entry into the track by locking the switch and/or locking derailer.
- Check the hand brakes to make certain they have been applied. Do not assume that someone else has set them.
- Chock wheels in both directions.
- Attach grounding clamp(s) per manufacturer's recommendations. Confirm the grounding condition, typically through illuminated indicator.
- If possible, bottom fill the material. If top loading, use a fill extension downspout (a.k.a. dip tube or fill pipe) that is within 6 inches of the bottom of the tank so that the material being loaded doesn't free fall to accumulate static charge and possibly cause a spark.
- Load material, ensuring adequate ventilation for displaced vapors, or possibly venting the vapors to a vapor balancing or recovery system.
- During the loading/unloading process, the railcar must be attended by trained personnel or monitored by an approved monitoring system, e.g. video monitoring, level switch, etc.
- Close all valves and caps. Prepare shipping papers. Apply placards.
- Close dome lid and secure all bolts using star pattern.
- Install valve seals / car seals.
- Wash up area, hose, and fittings with water.
- Remove wheel chocks, blue flag, and derailer.

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