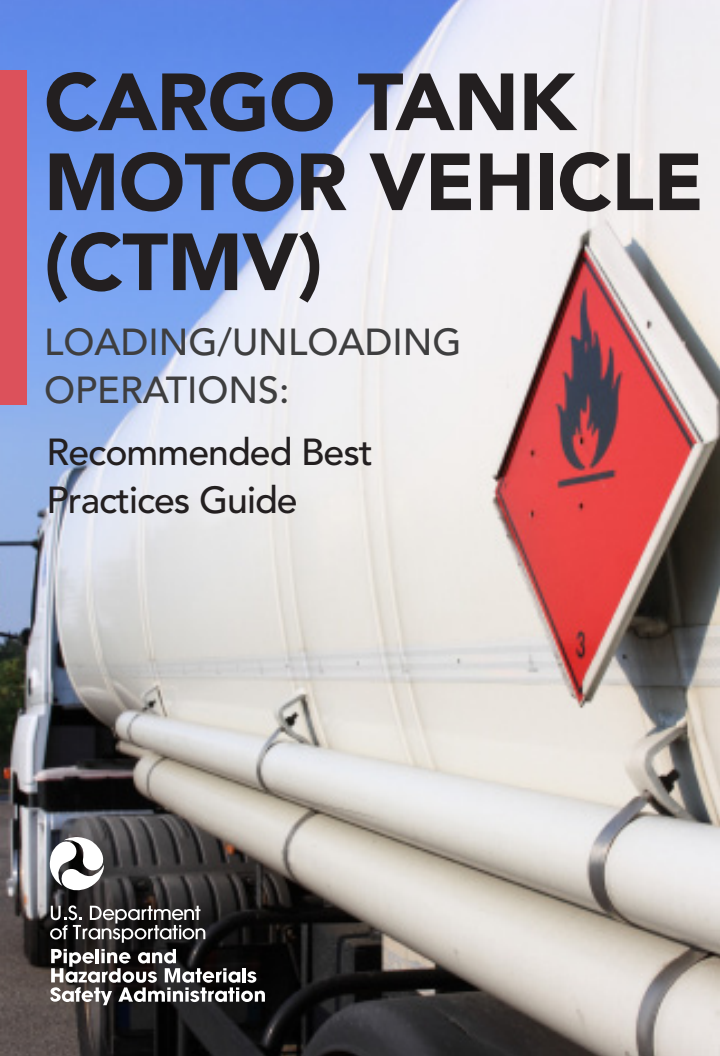
CARGO TANK MOTOR VEHICLE (CTMV)

LOADING/UNLOADING OPERATIONS:

Recommended Best Practices Guide



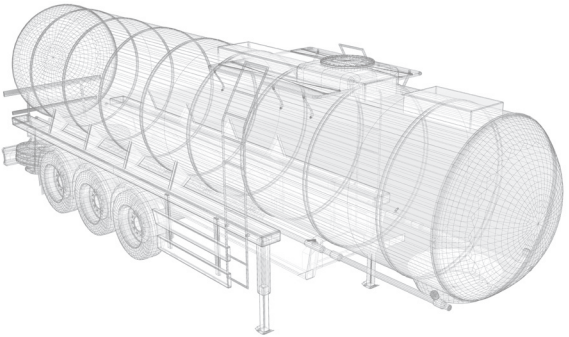
U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration

NOTE

This recommended best practices guide prepared by DOT's Pipeline and Hazardous Materials Safety Administration (PHMSA), with input from the Occupational Safety and Health Administration and the Environmental Protection Agency, is for informational use only and may be used as a supplement to, not to be considered as, applicable regulations. The applicable Hazardous Materials Regulations (HMR), 49 CFR Parts 171-180, are available from the Government Printing Office or may be accessed through our website at http://hazmat.dot.gov. This Guide is a companion document to the *Cargo Tank Motor Vehicle (CTMV) Loading/Unloading Operations Recommended Best Practices Pocket Guide*.

Need help?

Call our Hazardous Materials Information Center at **800-467-4922** between the hours of **9:00 AM and 5:00 PM EST**, Monday through Friday except Federal holidays



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BACKGROUND

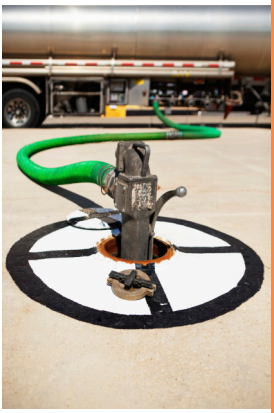
PHMSA's mission is to protect people and the environment from the risks of hazardous materials (hazmat) in transportation. This document is intended to aid hazmat employers (hereinafter referred to as "employer"(s)) and others responsible for cargo tank motor vehicle (CTMV) loading/unloading by offering recommended best practices to further enhance the safety of these operations. A comprehensive summary of the regulations applicable to CTMV loading/unloading operations is provided in Appendix A.

Human error continues to be a major contributing factor for incidents occurring during loading/unloading operations including but not limited to:

- Failing to attend/monitor loading/unloading operations;

- Leaving a valve in the wrong position either prior to, during, or after loading/unloading operations;
- Improperly connecting transfer equipment;
- Overfilling cargo tanks or receiving tanks; and
- Using defective/deteriorated devices and equipment.

The following incidents illustrate the need for loading/unloading guidance:



- In June 2013, a driver miscommunicated critical information to facility personnel during delivery of corrosive material that was then unloaded into the wrong storage tank containing incompatible materials. Adding to the confusion, this was the driver's first delivery to this location. The comingling of incompatible materials emitted a vapor affecting the breathing of the driver and facility employee resulting in both being transported to a hospital for treatment. Also, approximately 100 gallons of the mixture was released at the time of unloading.

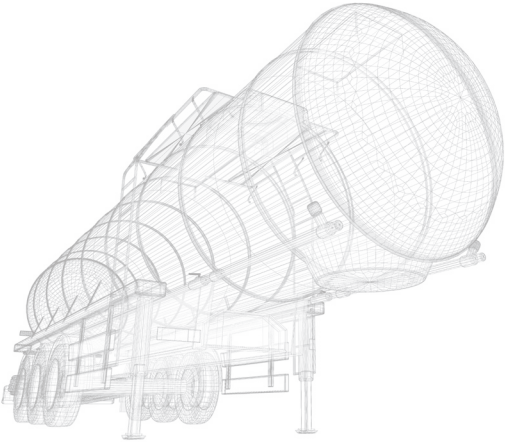
- In November 2011, a carrier loading heating oil into a cargo tank overfilled one of the compartments resulting in the release of approximately 30 gallons of material. The cause was determined to be faulty operation of the high-level sensor.
- In July 2009, the transfer hose on a CTMV ruptured following the transfer of anhydrous ammonia from a cargo tank to a storage tank. The resulting release of anhydrous ammonia caused one fatality, minor respiratory problems for several individuals, and the sheltering in place of nearby residents. An investigation determined the probable cause of the accident was the use of a transfer hose assembly not chemically compatible with anhydrous ammonia.[1]

- In October 2007, a delivery driver used an improperly repaired transfer hose to unload LP gas from his 8,000-gallon cargo tank. The hose detached from its connection to the vehicle's cargo tank allowing gas to

[1] The Federal Motor Carrier Safety Administration has issued guidance regarding this incident, and cargo hose safety at: https://www.fmcsa.dot.gov/safety/carrier-safety/important-notice-regarding-anhydrous-ammonia-and-liquefied-petroleum-gas-hoses.

escape, resulting in an explosion that fatally injured the driver. The accident investigation revealed workers improperly repaired a damaged LP-gas transfer hose by attaching a nozzle using fasteners not designed to withstand pressurized gas.

PHMSA believes focused training and recommended operating procedures can help decrease these types of incidents. Even when human error was not the main reason for an incident or accident occurring, focused training and recommended operating procedures could help avoid them in the future.



RECOMMENDED BEST PRACTICES

A. TRAINING

Training should ensure hazmat employees (hereinafter referred to as “employee”(s)) understand and are qualified to perform duties safely and in compliance with the Hazardous Materials Regulations (HMR). PHMSA recommends that an evaluation of employees’ understanding of safe loading/unloading procedures should be performed on an annual basis, at a minimum. More frequent and routine practice and evaluation of operating procedures should include observation and feedback by a knowledgeable supervisor on the employee’s performance of: covered functions, i.e., those regulated under the HMR; practice sessions; or drills. At a minimum, the training program should include provisions to:

- Identify employees and covered duties, i.e., employees subject to training due to performance of a covered function under the HMR;
- Observe and evaluate covered employees' performance of duties;
- Provide feedback regarding performance of duties;
- Establish a performance improvement plan for employees failing to perform up to standard; and
- Initiate enhanced training if employees are no longer qualified to safely perform covered duties, or if performance of duties contributed to an unintentional release of hazmat.

Further, PHMSA recommends that employers include in the required training record of employees specifics on enhanced training needed, as well as noting when employees safely and successfully perform loading, unloading, or transloading operations. Employers should only use employees who have demonstrated that they can correctly and safely perform these functions.

B. OPERATING PROCEDURES

RISK ASSESSMENT OF OPERATION

PHMSA recommends that persons who load, unload, or provide transfer equipment to load/unload hazmat to/from CTMVs should perform an analysis of operations; otherwise, review past analyses to evaluate hazards with loading/unloading operations,[2] which should include:

- Clearly marking loading/unloading activities for which facility personnel or the operator of a CTMV is responsible.
- Assessing current procedures used to ensure the safety of loading/unloading operations and identifying areas where procedures could be improved. Analysis should be tailored to the complexity of the process and the materials involved in the operation, including—
    - The characteristics and hazards of materials to be loaded/unloaded;
    - Measures necessary to ensure safe handling of the material, such as temperature or pressure controls; and
    - Conditions that could affect the safety of the loading/unloading operation, including access

[2] This would include any device in the loading/unloading system that is designed to transfer product between the internal valve on the cargo tank and the first permanent valve on the supply or receiving equipment (e.g., pumps, piping, hoses, connections, etc.).

control, lighting, ignition sources, and physical obstructions.

- Ensuring these operations analyses are kept with the operating procedures.

IMPLEMENTING OPERATING PROCEDURES

We also recommend that persons having performed an analysis should develop, maintain, and adhere to the operating procedure for the specific loading/unloading operation based on the results of the analysis; or, update/revise current procedures based on such results. At a minimum, operating procedure(s) should include the following elements:

- **Pre-loading/-unloading.** Procedures to ensure the reliability of the cargo tank and associated transfer equipment, ensure the CTMV is secured against movement, prepare the cargo tank and transfer equipment for the loading/unloading operation, and verify the receiving container into which the material is to be transferred, including measures to—
    - Identify the piping path, equipment lineups, and operational sequencing and procedures for connecting piping, hoses, or other transfer connections[3];

[3] Adaptors are not, by definition, part of a delivery host assembly under the HMR, but carriers may have a variety of adaptors at their disposal to connect to various customer systems. Measures should be taken to ensure awareness of which adaptors are suitable/appropriate for each distinct loading or unloading operation.

- Verify that the material is being transferred into the appropriate receiving container, and that the container, and its contents, are compatible with

Ideas for ensuring proper connections and use of transfer equipment include color-coding components and/or receiving containers or introducing specially designed connections/couplings that only link with other components intended for use in the transfer of a specific material.

  the lading and has sufficient capacity to hold the quantity of material being transferred;

- Check components of the transfer system, including equipment such as delivery hose assemblies, piping, and connections, to ensure they are of sound quality without obvious defects (visually and audibly), and that connections are secure.

Operators do not need to use instruments or take extraordinary actions to verify material or receiving containers, or check components not readily visible. Pumps, piping, hoses, and connections supplied by a facility or the motor carrier and used to load/unload from a CTMV should be compatible and maintained (if not already done so by requirement) similar to the maintenance program established for operators of CTMVs in liquefied compressed gas service (see

§ 180.416 of the HMR). The driver of the CTMV can rely on information provided by the facility operator to confirm that transfer equipment meets requirements. Persons should not load/unload a CTMV using components of a transfer system that could result in unsafe conditions.

- **Loading/unloading.** Persons responsible for the loading/unloading of a CTMV should consider implementing procedures for monitoring the transfer operation, including measures to—
    - Initiate and control the lading flow;
    - Monitor, where necessary, the temperature of the material being transferred and the pressures of the cargo tank into which the material is being transferred;
    - Ascertain, for materials that are heated prior to being loaded/unloaded, the heat input to be applied and the rate at which heat will be applied, and monitor the pressure inside the cargo tank being heated to ensure the heating process does not result in over-pressurization or an uncontrolled exothermic reaction;
    - Monitor filling limits and ensure the quantity of hazmat to be transferred is the appropriate size for the cargo tank (containment vessel);
    - Terminate lading flow; and
    - Ensure the cargo tank is attended by a qualified person at all times when being loaded/

unloaded. The qualified person attending the cargo tank should have an unobstructed view of the cargo tank and delivery hose.

- **Emergency management**. Persons responsible for loading/unloading of a CTMV should consider procedures for handling emergencies, including —
  - Instrumentation to monitor for leaks/releases;
  - Equipment to isolate leaks/releases and take appropriate emergency shutdown measures;
  - Training for use of emergency response equipment;
  - Emergency shutdown systems and assignment of shutdown responsibility to qualified operators ensuring the shutdown is executed safe/timely;
  - Emergency communication/spill reporting; and
  - Safe startup following emergency shutdown.
- **Post-loading/-unloading.** Persons responsible for the loading/unloading of a CTMV should consider procedures for securing transfer equipment, transport vehicle or packaging, and containment vessel into which material is transferred, including—
  - Evacuating transfer system and depressurizing the containment vessel;
  - Disconnecting transfer equipment safely; and
  - Securing fittings, valves, and closures.

- **Design, maintenance, and testing of transfer equipment.** Transfer equipment, used to load/unload cargo tanks, should be compatible with the lading. Transfer equipment/systems, including pumps, piping, hoses, and connections, should be maintained/tested on a routine basis at time intervals considering how often they are used, the hazmat they are used to transfer, and components' useful life. We recommend persons who conduct operations should develop/implement periodic maintenance schedules to prevent equipment deterioration and conduct periodic operational tests to ensure that equipment functions properly. Equipment and system repairs should be completed promptly and prior to subsequent loading/unloading operations.
- **Facility oversight of carrier personnel.** Facility operators performing risk assessments should ensure carriers who load/unload CTMVs at facilities—
    - Are supervised by personnel trained on the facility's loading/unloading procedures;
    - Are provided with written instructions on how to conduct transfer operations in accordance with procedures; or
    - Have sufficient information to conduct transfer operations in accordance with procedures.

Recordkeeping. Carrier operating procedures should remain in the transport vehicle. Facility operating procedures should always be available to carriers at loading/unloading facilities.

REAL-WORLD APPLICATIONS

The HMR are more likely to impact carrier personnel (e.g., drivers) than facility personnel, as drivers are more likely to perform hazmat transportation functions. Drivers are categorized as private or for-hire, the latter representing the larger population, which is the bigger challenge for implementing best practices. It is difficult to balance the need to tailor loading/unloading procedures to each facility's unique operation with the need for consistency for those for-hire carriers servicing numerous facilities. Where a person has ownership of the loading facility, transport vehicle, and unloading facility, a risk assessment, development of operating procedures, and training on those procedures is less complex because it can be handled "in house." In reality, the loading, transportation, and unloading of hazmat is likely to involve multiple persons; therefore, we discuss further the recommended best

practices presented above with a focus on carrier-performed loading/unloading operations to clarify where facility personnel should play a primary role.

A. TRAINING AND EVALUATION

Training and testing for-hire carrier personnel on each facility's loading/unloading requirements could present an immense task depending on the number of facilities serviced, variety of hazmat serviced, and size of the company. PHMSA suggests that employers refine training programs to include some form of annual training, the scope of which could be limited to universal functions. All employees performing these functions may not need annual retraining, thus, training regimens could be tailored to new employees or those having been involved in incidents. This annual training would be for a set period of time and could be adjusted to the HMR baseline of three years for refresher training. Other options include limiting annual training to employees performing operations involving higher risk hazmat (e.g., flammable gas) or those performing operations at a facility with higher risks (e.g., locations near populated or environmentally sensitive areas).

B. RISK ASSESSMENT

PHMSA's recommendation that risk assessments be performed by persons who load/unload, or provide transfer equipment to load/unload, hazmat to or from

a CTMV does not apply to *drivers* of CTMVs; rather, it applies to *employees*—carrier and facility operators—involved in these operations. Additionally, carriers performing risk assessments should focus on the integrity of their equipment, and facilities should focus on equipment they own or have oversight of as well as the loading/unloading operations at these facilities.

C. EMERGENCY RESPONSE

Responsibility for this part of the loading/unloading operations lies primarily with facility operators, as carriers should not be engaged in the full scope of emergency response. Carriers should, however, be involved in emergency response dealing with preventing the further spread of an incident resulting in the release of hazmat, i.e., emergency shut-down procedures. This is especially true for operations conducted at unmanned facilities or at retail facilities (e.g., gas stations).

D. OPERATING PROCEDURES

Common causes of CTMV loading/unloading incidents are discussed below with recommended best practices regarding roles and means to prevent similar incidents.

- **Transfer Equipment Connections.** Persons involved in loading/unloading operations have a shared responsibility to verify that transfer equipment is properly connected between CTMV equipment

and facility equipment. Verify proper connection is made at time of connections, as well as prior to hazmat transfer, by using a connection sequencing checklist. If multiple persons are involved, facility representatives and carrier personnel should certify (e.g., via signature) that connection integrity was verified prior to transfer, and components of the transfer equipment are appropriate for the hazmat being transferred.

- **Failure to Attend.** The HMR places the responsibility of attendance of CTMV loading/unloading primarily on the carrier during the operation; however, facilities also should provide trained persons to attend the operations. Facility personnel are most familiar with the hazmat being handled, facility structure/layout, and emergency response procedures, although they need not attend in the same manner as carrier personnel. Facility personnel could provide on-site supervision via remote video with full coverage and visual of the location. Adding a secondary layer of attendance could prevent/minimize overfills of CTMVs or receiving containers (e.g., storage tanks). Note this level of on-site supervision is not expected for residential customers arranging for delivery of hazmat (e.g., propane) for personal use.
- **Compatible Materials and Packaging.** The HMR provide requirements to ensure compatibility of hazmat with CTMVs or residue materials contained therein. PHMSA recommends applying these practices to hazmat that is unloaded into receiving

containers/storage tanks. Facility personnel should play a lead role with ensuring hazmat is being transferred to/from the right facility container as part of the pre-loading/-unloading procedures and, once verified, should authorize the transfer. Additional steps to ensure compatibility include certifying that a CTMV has been in dedicated service for a compatible hazmat, maintaining proof of tank wash prior to loading, and using visual aids on receiving containers at a facility to communicate the appropriate container (e.g., the chemical name, a GHS[4] label, etc.).

- **Overfills.** With regard to unloading (not to include transloading) from a CTMV, both the carrier and facility have responsibility in preventing overfills of a receiving container; however, facility operators have primary responsibility for ensuring that containers have enough *space* to handle the volume of product being unloaded. As part of standard procedures, carriers should include steps to verify with facility personnel that receiving containers provide adequate space, or use facility-provided checklists that verify required space is available.
- **Unmanned Facility.** Unmanned facilities are those not likely to have personnel available to assist with loading/unloading operations at the time a carrier delivers hazmat (e.g., night deliveries). These facilities are typically locked and access is given only to drivers that have completed some form of training

[4] Globally Harmonized System of Classification and Labelling of Chemicals.

requirements. PHMSA recommends additional training in facility operations when there are few personnel and many facilities to service. Rather than a training program for each employee at each facility, carrier personnel can be trained on unique aspects or higher risks of a facility's operations. The extent of the training could be expanded based on the circumstance of the carrier personnel (e.g., personnel are provided for exclusive service). Facilities could post a checklist that carrier personnel (i.e., drivers) can reference prior to, during, and following a loading or unloading operation.

APPENDICES

APPENDIX A –

DOT Regulations as of January 1, 2015[5]

1. DEFINITIONS

The following definitions of HMR terms used throughout Appendix A are provided for ease of understanding by the reader.

Carrier means: A person who transports passengers or property in commerce by rail car, aircraft, motor vehicle, or vessel.

Hazmat employee means: A person who is:

[5] Regulations are subject to revision. Always review the GPO e-cfr for the most current regulations.

(1) Employed on a full-time, part time, or temporary basis by a hazmat employer and who in the course of such full time, part time or temporary employment directly affects hazardous materials transportation safety;

(2) Self-employed (including an owner-operator of a motor vehicle, vessel, or aircraft) transporting hazardous materials in commerce who in the course of such self-employment directly affects hazardous materials transportation safety;

(3) A railroad signalman; or

(4) A railroad maintenance-of-way employee.

This term includes an individual, employed on a full time, part time, or temporary basis by a hazmat employer, or who is self-employed, who during the course of employment:

- **Loads, unloads, or handles hazardous materials (emphasis added);**
- Designs, manufactures, fabricates, inspects, marks, maintains, reconditions, repairs, or tests a package, container or packaging component that is represented, marked, certified, or sold as qualified for use in transporting hazardous material in commerce;
- Prepares hazardous materials for transportation;
- Is responsible for safety of transporting hazardous materials; or

- Operates a vehicle used to transport hazardous materials.

Hazmat employer means:

(1) A person who employs or uses at least one hazmat employee on a full-time, part time, or temporary basis;

(2) A person who is self-employed (including an owner-operator of a motor vehicle, vessel, or aircraft) transporting materials in commerce; or

(3) A department, agency, or instrumentality of the United States Government, or an authority of a State, political subdivision of a State, or an Indian tribe; and who:

- Transports hazardous materials in commerce;
- Causes hazardous materials to be transported in commerce; or
- Designs, manufactures, fabricates, inspects, marks, maintains, reconditions, repairs or tests a package, container, or packaging component that is represented, marked, certified, or sold by that person as qualified for use in transporting hazardous materials in commerce.

Maximum allowable working pressure or **MAWP** means: The maximum pressure allowed at the top of the tank in its normal operating position. The MAWP must be calculated as required in ASME Code (Section VIII). In use, the MAWP must be

greater than or equal to the maximum lading pressure conditions prescribed in § 173.33 of the HMR.

Outage (ullage) means: The amount by which a packaging falls short of being liquid full, usually expressed in percent by volume.

Person means: An individual, corporation, company, association, firm, partnership, society, joint stock company; or a government, Indian Tribe, or authority of a government or Tribe, that offers a hazardous material for transportation in commerce, transports a hazardous material to support a commercial enterprise, or designs, manufactures, fabricates, inspects, marks, maintains, reconditions, repairs, or tests a package, container, or packaging component that is represented, marked, certified, or sold as qualified for use in transporting hazardous material in commerce. This term does not include the United States Postal Service or, for purposes of 49 U.S.C. 5123 and 5124, a Department, agency, or instrumentality of the government.

2. TRAINING

The HMR require a training program that ensures a hazmat employee: (1) has familiarity with the general requirements of the HMR; (2) is able to recognize and identify hazmat; (3) has knowledge of specific requirements of the HMR applicable to functions performed by the employee; and (4) has knowledge

of emergency response information, self-protection measures and accident prevention methods and procedures. Also, there are additional training requirements specific to motor vehicle transportation of hazmat. Employees must be trained prior to performing a hazmat function and must be retrained every three (3) years. Regulated persons may exceed these minimum training standards. This section describes the current training standards required under the HMR and recommended best practices PHMSA encourages regulated persons to consider when developing training materials and programs.[6]

CURRENT REQUIREMENTS: (§ 172.704; § 177.800; § 177.816)

It is the responsibility of the hazmat employer to ensure that each hazmat employee is trained in accordance with the requirements of the HMR. A hazmat employee who performs any function subject to the requirements of the HMR cannot perform that function unless instructed in those function-specific requirements of HMR. Training may be provided by the hazmat employer or other public or private sources.

A new hazmat employee, or a hazmat employee who changes job functions, must be trained prior

[6] PHMSA supports training and development through the Outreach and Training Division. Information is available at: http://www.phmsa.dot.gov/hazmat/outreach-training. Appendix C also lists useful training documents.

to performance of any regulated functions. A new hazmat employee may perform a HMR regulated function prior to the completion of training provided:

- The employee performs those functions under the direct supervision of a properly trained and knowledgeable hazmat employee; and
- The training is completed within 90 days after employment or a change in job function.

Hazmat employee training must cover the following elements:

- General awareness and familiarization of the HMR;
- Function-specific;
- Safety; and
- Security awareness (See § 172.704 for details.)

Carrier responsibility:
A carrier may not transport a hazmat by motor vehicle unless all employees involved in that transportation are trained as required by the HMR.

Driver training:
No carrier may transport, or cause to be transported, a hazmat unless each hazmat employee who will operate a motor vehicle has been trained in the applicable requirements of the Federal Motor Carrier Safety Regulations (49 CFR Parts 390-397) and the procedures

necessary for the safe operation of that motor vehicle[7]. Driver training must include the following subjects:

- Pre-trip safety inspection;
- Use of vehicle controls and equipment, including operation of emergency equipment;
- Operation of the vehicle including procedures for maneuvering tunnels, bridges, and railroad crossings;
- Requirements pertaining to attendance of vehicles, parking, smoking, routing, and incident reporting; and
- Loading/unloading of materials.

There are specialized training requirements associated with cargo tanks. Each driver of a CTMV must have the appropriate State-issued commercial driver's license (CDL) required by 49 CFR Part 383. Specialized training must include the following:

- Operation of emergency control features of the cargo tank;
- Special vehicle handling characteristics, including: high center of gravity, fluid-load subject to surge, effects of fluid-load surge on braking, characteristic differences in stability among baffled, unbaffled, and multi-compartmented tanks; and effects of partial loads on vehicle stability;
- Loading/unloading procedures;

[7] FMCSA provides resources for drivers. Information is available at http://www.fmcsa.dot.gov/resources-for-drivers.

- The properties and hazards of the material transported; and
- Retest and inspection requirements for cargo tanks.

Compliance with the current requirements for a CDL with a tank vehicle or hazmat endorsement may be used to satisfy these driver training requirements.

3. OPERATING PROCEDURES

The HMR provide for requirements associated with loading/unloading operating procedures throughout the regulations. This includes operating procedures contained in: (1) the general requirements for packages and packagings; (2) additional general requirements for bulk packagings; (3) requirements for hazmat in cargo tanks; (4) requirements for compressed gases in cargo tanks; and (5) the general requirements for loading/unloading. Below we provide a summary of regulations applicable to loading/unloading operations, however, this summary discussion is not all encompassing and we remind readers to become familiar with the HMR to educate themselves on all the requirements that would apply to their specific loading/unloading operations.

CURRENT REQUIREMENTS: (§ 173.24; § 173.24B; § 173.30; § 173.33; § 173.315; PART 177, SUBPART B)

GENERAL SAFETY:

Smoking on or about a CTMV is forbidden while loading or unloading any Class 3 flammable liquid, Class 4 flammable solid, Class 5 oxidizer, or Division 2.1 flammable gas.

Extreme care must be taken to keep fire away and to prevent persons in the vicinity from smoking, lighting matches, or carrying any flame or lighted cigar, pipe, or cigarette when loading or unloading of any Class 3 flammable liquid, Class 4 flammable solid, Class 5 oxidizer, or Division 2.1 flammable gas.

No hazmat may be loaded into or unloaded from a CTMV unless the handbrake is securely set and all other reasonable precautions are taken to prevent motion of the vehicle during such loading or unloading operations.

PRE-LOADING/UNLOADING:

Each person offering a hazmat that requires the use of a specification CTMV must confirm that the CTMV conforms to the specification required for the hazmat and that the MAWP of the cargo tank is greater than or equal to the largest pressure as follows:

- For compressed gases and some refrigerated liquids that are not cryogenic liquids, the pressure required in § 173.315.
- For cryogenic liquids, the pressure required in § 173.318.

- For liquid hazmat loaded in DOT specification cargo tanks equipped with a 1 psig normal vent, the sum of the tank static head plus 1 psig. In addition, for hazmat loaded in these cargo tanks, the vapor pressure of the hazmat at 115°F must not be >1 psig, except for gasoline transported in accordance with Special Provision B33 in § 172.102(c)(3).
- For liquid hazmat not covered above, the sum of the vapor pressure of the lading at 115°F, plus the tank static head exerted by the hazmat, plus any pressure exerted by the gas padding, including air in the outage space or dome.
- The maximum pressure in the tank during loading or unloading.

Before unloading from a CTMV containing a liquefied compressed gas, the qualified person performing the function must check those components of the discharge system, including delivery hose assemblies and piping, that are readily observed during the normal course of unloading to assure they are of sound quality, without obvious defects detectable through visual observation and audio awareness, and that connections are secure. This check must be made after the pressure in the discharge system has reached at least equilibrium with the pressure in the cargo tank. Operators need not use instruments or take extraordinary actions to check components not readily visible. No operator may unload liquefied compressed gases from a CTMV with a delivery hose assembly found to have any condition identified

in § 180.416(g)(1) or with piping systems found to have any condition identified in § 180.416(g)(2) of the HMR.

LOADING:

This section provides a summary of loading requirements categorized by subtopics based on frequent types of incidents.

PACKAGING AND COMPATIBILITY

No person may fill and offer for transportation a specification CTMV for which the required periodic retest or inspection is past due until the retest or inspection has been successfully completed. A cargo tank filled prior to the retest or inspection due date may be transported.

Two or more materials may not be loaded in a CTMV the mixing of which would cause an unsafe condition such as an explosion, fire, an excess increase in pressure or heat, or the release of toxic vapors.

A hazmat may not be loaded into a cargo tank if during the course of transportation contact by any part of the tank with the hazmat would result in a dangerous reaction (e.g., release of toxic vapors).

A hazmat may not be loaded into a cargo tank that will adversely affect the tank's integrity or:

- May combine with residue or contaminants in the tank to produce an explosion, fire, excess increase in pressure (or heat), or release of toxic vapors.

- May severely corrode or react with the tank material at any concentration or temperature during transportation.
- Is prohibited by the HMR.

OVERFILLING / OVER-PRESSURIZATION

A liquid or liquefied gas hazmat must be loaded so that the outage is at least five percent and at least one percent of the cargo tank capacity (or any compartment) for material poisonous by inhalation and for all other materials, respectively. The reference temperatures are 115°F for non-insulated tanks and 105°F for insulated tanks.

Air pressure in excess of ambient atmospheric pressure may not be used to load a hazmat which may create an air-enriched mixture within the flammability range of the material in the vapor space of the tank.

The loading rate used must be less than or equal to the rate indicated on the cargo tank specification plate. If no loading rate is marked on the specification plate[8], the loading rate and pressure used must be limited such that the pressure in the tank may not exceed 130 percent of the maximum allowable working pressure.

A hazmat that is classed as Division 6.1, Packing Group I or II (poisonous liquid) must be loaded in a CTMV having a maximum allowable working pressure of ≥25 psig.

[8] Exceptions for cryogenic liquids are provided in § 173.318(b)(6).

ATTENDANCE

A cargo tank must be attended by a qualified[9] person at all times when it is being loaded. The person who is responsible for loading the cargo tank also is responsible for ensuring that it is attended. A qualified person "attends" the loading of a cargo tank if, throughout the process, the person is alert and is within 25 feet of the cargo tank.

HAZMAT SPECIFIC REQUIREMENTS

Engine stop (Division 2.1 material)

Unless the engine is used for the operation of the transfer pump of the vehicle, no material may be loaded into any CTMV with the engine running. Unless the delivery hose is equipped with a shut-off valve at its discharge end, the engine of the motor vehicle must be stopped at the finish of such loading operation while the connections are disconnected.

Engine stop (Class 3 material)

Unless the engine of a CTMV is to be used for the operation of a pump, no material may be loaded while the engine is running. The diesel engine of a CTMV may be left running during loading if the ambient atmospheric temperature is at or below 10 °F (−12 °C).

[9] A person is "qualified" if the person is aware of the nature of the hazmat that is to be loaded or unloaded, has been instructed on emergency procedures, and is authorized to move the cargo tank and has the means to do so.

Bonding for Class 3 material – Open filling hole: When a cargo tank is loaded through an open filling hole, one end of a bond wire must be connected to the stationary system piping or integrally connected steel framing, and the other end to the shell of the cargo tank to provide a continuous electrical connection. (If bonding is to the framing, it is essential that piping and framing be electrically interconnected.) This connection must be made before any filling hole is opened, and must remain in place until after the last filling hole has been closed. Additional bond wires are not needed around all-metal flexible or swivel joints, but are required for nonmetallic flexible connections in the stationary system piping.

Vapor tight – not open filling hole. When a cargo tank is loaded through a vapor-tight top or bottom connection, so that there is no release of vapor at a point where a spark could occur, bonding or grounding is not required. Contact of the closed connection must be made before flow starts and must not be broken until after the flow is completed.

A CTMV in chlorine service may not be moved, coupled or uncoupled, when any loading connections are attached to the vehicle, nor may it be left without the power unit attached unless the vehicle is chocked or equivalent means are provided to prevent motion.

Full equilibration of a cargo tank transporting a Division 2.1 (flammable gas) material that is a cryogenic liquid

may only be done at a facility that loads or unloads a Division 2.1 (flammable gas) material that is a cryogenic liquid and must be performed and verified as follows:

- The temperature and pressure of the liquid must be reduced by a manually controlled release of vapor; and
- The pressure in the cargo tank must be measured at least ten minutes after the manual release is terminated.

UNLOADING:

This section provides a summary of unloading requirements categorized by subtopics based on frequent types of incidents.

OVERFILLING / OVER-PRESSURIZATION

Air pressure in excess of ambient atmospheric pressure may not be used to unload a hazmat that may create an air-enriched mixture within the flammability range of the lading in the vapor space of the tank.

The unloading rate used must be less than or equal to the rate indicated on the cargo tank specification plate. If no unloading rate is marked on the specification plate, the unloading rate and pressure used must be limited such that the pressure in the tank may not exceed 130 percent of the MAWP.

ATTENDANCE

A motor carrier must ensure that the cargo tank is attended by a qualified person[10] at all times during unloading[11]. Except for unloading operations covering combustible liquids (see § 177.837(d)), and liquefied petroleum gas and anhydrous ammonia in metered and non-metered delivery service (see § 177.840(p) and (q)), a qualified person "attends" the loading or unloading of a cargo tank if, throughout the process, the person is alert and is within 25 feet of the cargo tank. The qualified person must have an unobstructed view of the cargo tank and delivery hose to the maximum extent practicable during the unloading operation.

HAZMAT SPECIFIC REQUIREMENTS

Engine stop (Division 2.1 material)

Unless the engine is used for the operation of the transfer pump of the vehicle, no material may be unloaded from any CTMV with the engine running. Unless the delivery hose is equipped with a shut-off valve at its discharge end, the engine of the motor

[10] A person is "qualified" if the person is aware of the nature of the hazmat that is to be loaded or unloaded, has been instructed on emergency procedures, and is authorized to move the cargo tank and has the means to do so.

[11] The carrier's obligation to ensure attendance during unloading ceases when: transportation is completed; the cargo tank is on the customer's property; and the motive power has been removed from the cargo tank and the property.

vehicle must be stopped at the finish of such unloading operation while the connections are disconnected.

Engine stop (Class 3 material)

Unless the engine of a CTMV is to be used for the operation of a pump, no material may be unloaded while the engine is running. The diesel engine of a CTMV may be left running during unloading if the ambient atmospheric temperature is at or below 10 °F (−12 °C).

Bonding for Class 3 material – Open filling hole: When a cargo tank is unloaded by a suction-piping system through an open filling hole of the cargo tank, electrical continuity must be maintained from cargo tank to receiving tank.

Vapor tight – not open filling hole. When a cargo tank is unloaded through a vapor-tight (not open hole) top or bottom connection, so that there is no release of vapor at a point where a spark could occur, bonding or grounding is not required. Contact of the closed connection must be made before flow starts and must not be broken until after the flow is completed. Bonding or grounding is not required when a cargo tank is unloaded through a non-vapor-tight connection into a stationary tank provided the metallic filling connection is maintained in contact with the filling hole.

A CTMV used for transportation of chlorine may not be moved, coupled or uncoupled, when any

unloading connections are attached to the vehicle, nor may it be left without the power unit attached unless the vehicle is chocked or equivalent means are provided to prevent motion.

Unloading of chlorine from a CTMV must be performed in compliance with Section 3 of the Chlorine Institute Pamphlet 57, "Emergency Shut-off Systems for Bulk Transfer of Chlorine." [Note the OSHA requirements also apply for this operation.]

PERSONAL PROTECTION EQUIPMENT:

CTMVs in chlorine service must be equipped:

- With an approved respirator by the National Institute for Occupational Safety and Health (NIOSH), U.S. Department of Health and Human Services, see NIOSH Certified Equipment List at www.cdc.gov/niosh/npptl/topics/respirators/CEL/; and
- With an emergency kit for controlling leaks in fittings on the dome cover plate. (The Chlorine Institute can be used as a resource for obtaining such a kit.)

A carrier of carbon monoxide, cryogenic liquid must provide each driver with a self-contained breathing apparatus (SCBA) that is approved by NIOSH, see NIOSH Certified Equipment List at www.cdc.gov/niosh/npptl/topics/respirators/CEL/.

APPENDIX B – Other Federal Oversight

Several Federal agencies share responsibility for the safety of loading, unloading or transloading operations involving hazmat and associated with CTMVs—DOT (PHMSA), the Occupational Safety and Health Administration (OSHA), and the Environmental Protection Agency (EPA). Below is a brief summary of OSHA and EPA programs relating to loading/unloading operations.

OSHA REQUIREMENTS

OSHA's Process Safety Management (PSM) standard (see 29 CFR 1910.119) contains requirements for processes that use, store, manufacture, handle, or transport threshold quantities of highly hazardous chemicals (HHC)[12] on-site as well as processes containing 10,000 pounds or more of flammable liquids or gases with certain exemptions. Bulk[13] loading/unloading operations involving PSM-covered chemicals or other processes with PSM-covered chemicals are subject to the requirements of the PSM standard. The PSM standard requires employers to compile process safety information (PSI) to identify and understand the hazards of a process. PSI is then used to perform a process hazard analysis to identify, evaluate, and control the hazards of the process. The results of the analysis are then used as the basis for development and implementation of written operating procedures providing instructions for safe operations of

a process, such as loading/unloading operations to or from bulk containers (see 29 CFR 1910.119(f)). After the procedures are developed, each employee, including a contract employee, who is involved in loading/unloading operations must be trained in the required processes and procedures, in accordance with 29 CFR 1910.119(g). Detailed information about the OSHA PSM standard and additional guidance is available at the following website: www.osha.gov/SLTC/processsafetymanagement/.

OSHA's Hazardous Waste Operations and Emergency Response standard (HAZWOPER) (29 CFR 1910.120) contains requirements for the cleanup of hazardous waste and the responding to releases of hazardous substances without regard to the location of the hazard. Where applicable, 29 CFR 1910.120(q) requires an emergency response plan that would include elements on emergency recognition and prevention, emergency alerting and response procedures, and personal protective equipment. In addition, those that respond to a hazardous substance release must be trained in accordance with 29 CFR 1910.120(q)(6). Detailed information about the OSHA HAZWOPER standard and additional guidance is available at the following website: www.osha.gov/SLTC/hazardouswaste/index.html.

[12] 29 CFR 1910.119(b), defines a *highly hazardous chemical* as a substance possessing toxic, reactive, flammable, or explosive properties and specified by paragraph (a)(1) of § 1910.119.

[13] The use of this term with respect to the PSM standard is not the same as defined in the PHMSA HMR.

EPA REQUIREMENTS

EPA regulations establish a general duty for facility owners or operators of facilities that produce, handle, process, distribute, or store certain chemicals to identify hazards associated with the accidental release of extremely hazardous substances, design and maintain a safe facility as needed to prevent such release, and minimize the consequences of release. In addition, stationary sources with more than a threshold quantity of a regulated substance in a process are subject to EPA's accident prevention regulations, including the requirement to develop a Risk Management Plan (RMP) and submit the RMP to the EPA (see 40 CFR Part 68). EPA's RMP requirements contain accident prevention measures that are virtually identical to those within the OSHA PSM standard. Detailed information about the EPA RMP standard and additional guidance is available at the following website: www2.epa.gov/rmp.

APPENDIX C – Additional Resources

The following documents provide additional educational resources and recommended practices that can enhance the safety of loading/unloading operations.

- **"Liquefied Compressed Gases Compliance Assistance Guide"** – This brochure describes the testing, recordkeeping, and unloading requirements for operators of CTMVs when transporting liquefied compressed gases.
- **"Important Notice Regarding Anhydrous Ammonia and Liquefied Petroleum Gas Hoses"** – This notice provides information on incidents occurring during the transfer of these materials to or from a CTMV, and provides recommended procedures to prevent future incidents.
- **"What You Should Know: A Guide to Developing a Hazardous Materials Training Program"** – This guidance explains the training requirements in the Hazardous Materials Regulations, identifies those employees who must be trained, and provides a tool to help employers determine what type of training and training environment may be best for their employees.

Need help?

Call our Hazardous Materials Information Center at 800-467-4922 between the hours of 9:00 AM to 5:00 PM EST, Monday through Friday except Federal holidays

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