

# Guidelines for Receiving and Unloading MDI

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## Purpose

The Center for the Polyurethanes Industry (CPI) prepared this guidance document to provide basic principles to users receiving, unloading and handling Methylene Diphenyl Diisocyanate (MDI) and/or various grades<sup>1</sup> in a variety of packagings. This document summarizes some, but not all, U.S. Department of Transportation (DOT) regulatory requirements and industry best practices regarding receiving, unloading and handling of MDI. These guidelines should not be interpreted in a manner that might conflict with existing international, national, state or local laws and regulations. Standards, laws, and requirements can change and have precedence over these guidelines. Consult with appropriate legal counsel to verify applicable standard and requirements.

## Classification of MDI in Transportation

In the U.S. DOT regulates the shipment of hazardous substances that are listed in 49 CFR § 172.101 Appendix A. EPA lists pure MDI as a hazardous substance, and DOT regulates the shipment of pure MDI when contained in single packages equal to or greater than the reportable quantity (RQ) of 5,000 pounds. Mixtures of MDI are regulated if the amount of pure MDI in the mixture equals or exceeds the RQ amount. Polymeric MDI (pMDI) contains about 50% MDI; therefore, a single package of 10,000 pounds is subject to DOT regulation. It is recommended that all federal, state, and local regulations are reviewed prior to the storage and handling of MDI.

When contained in single packages equal to or greater than the RQ the transportation of MDI in the U.S. is regulated by DOT. In addition, export shipments may be regulated by various international organizations that establish specific transport requirements that are observed by all parties. For additional details on how MDI is regulated, contact your supplier.

<sup>1</sup> Pure MDI or 4,4'-Diphenylmethane diisocyanate (MDI, CAS#101-68-8), Polymeric MDI (pMDI, CAS#9016-87-9) and MDI pre polymers, refer to the SDS.

## DOT's Transportation Security Requirements

As of October 1, 2010,<sup>2</sup> MDI is not subject to the U.S. DOT transportation security plan requirements (49 CFR § 172.800(b)).

## Guidance on Safety Information for MDI

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### Personal Protective Equipment (PPE) for Unloading MDI

Overexposure to MDI vapor, liquid or aerosol can be harmful to your health. For additional information on recognizing potential health hazards, see *Guidance for Working with MDI and pMDI: Things You Should Know (AX205)*, available online at [polyurethane.org](http://polyurethane.org).

When handling MDI or engaged in activities where potential exposure to MDI exists, wear appropriate PPE. PPE may include but not limited to:

- Chemical goggles;
- Face shield;
- Chemical gloves, resistant to MDI;<sup>3</sup>
- Long-sleeve coveralls or full body suit, resistant to MDI;<sup>3</sup>
- Fitted boots made of material(s) resistant to MDI,<sup>3</sup> and;
- Head protection, such as a close fitting hood, made of a material resistant to MDI.<sup>3</sup>

The use of suitable respiratory equipment may be considered whenever there is a potential for overexposure to MDI at elevated temperatures (above 130°F) or in the presence of unknown airborne concentrations.

When working with chemicals consider making available a safety shower and eye wash facility, in accordance to the ANSI standard Z358.1.

For additional information on PPE, refer to the manufacturer's Safety Data Sheet (SDS).

### DOT's HazMat Training Requirements

All employees involved in preparing for transport, and in transporting quantities of MDI at or above 5,000 pounds, are required to be HazMat trained, pursuant to 49 CFR §§ 172.700-704. Training of new employees must be completed within 90 days of placement in any job requiring such training, and must be repeated at least every 3 years. DOT requires employers to advise employees of changes in the law that that could affect their job performance. All HazMat employees must be trained in each of the following areas:

<sup>2</sup> Final Rule March 9, 2010 HM-232F.

<sup>3</sup> See CPI Guidelines for Selection of Protective Clothing for MDI Users (AX-178).

- General Awareness/Familiarization
- Function Specific
- Safety
- Security Awareness

According to 49 CFR § 172.704 records must be maintained on all personnel who receive DOT training, both supervisory and non-supervisory personnel. Each employee must have his or her own training log (the formal record) inclusive of the preceding three years. The employer must retain the training log for as long as that employee is employed and for 90 days thereafter.

## Fall Protection

Provide safe access to and from the tops of the bulk intermodal tank containers, cargo tank trailers and rail tank cars. Fall protection for employees working on top for these modes of transport should be considered.

According to OSHA, employees on surfaces shall be protected from holes more than 6 feet above lower levels, by personal fall arrest systems, covers, or guardrail systems (OSHA 29 CFR § 1926.501(b)(4)(ii)). requirements.

## Disposal of Waste MDI

MDI is not a listed hazardous waste under the Resource Conservation and Recovery Act (RCRA).

Neither MDI nor the foam products produced from it possess the characteristics of a hazardous waste. Liquid MDI may be disposed of in a suitable container with an approved environmental contractor in accordance with federal, state, and local regulations.

If you are considering alternative ways of disposal (i.e., reacting with a liquid, decontamination or reacting waste MDI with waste polyol) or you need additional assistance with waste disposal, contact your supplier for more information. ***(CAUTION: The MDI/polyol reaction is exothermic, and may cause spontaneous combustion.)***

## Disposal of Empty Containers

When disposing of empty containers consider contacting the Reusable Industrial Packaging Association (RIPA – [www.reusablepackaging.org](http://www.reusablepackaging.org)) to locate a drum reconditioner near you.

Drums for reconditioning should be empty (as defined by RCRA, 40 CFR § 261.7) before they leave the MDI user's facility. Contact your supplier for further disposal options. ***WARNING: Empty drums may contain liquid or vapor residue, which may be dangerous. Do not burn, cut, torch, weld, braise, solder, or expose containers to heat or flames. Empty drums may not be used for other purposes.***

Tote manufacturers sponsor a tote recycling program. Each tote comes with a return recycling ticket attached to the cage. Return totes in accordance with the manufacturer information on the recycling ticket. **WARNING: Empty totes may contain liquid or vapor residue, which may be dangerous. Empty totes may not be used for other purposes.**

For further information on waste disposal considerations refer to CPI's guidance document, *Guidelines for Responsible Disposal of Wastes and Containers from Polyurethane Processing* (AX151), available on [polyurethane.org](http://polyurethane.org).

## Packaging, Handling and Transport

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### Drums

Checklists may be used when receiving drums of MDI to safeguard the receiver, the carrier and the environment.

#### Driver Check In

The delivering driver checks in with security and the receiving location warehouse/receiving dock. Once driver credentials are verified by the receiver, the delivery is expected and assigned to an unloading position; the bill of lading for the material is verified by the person receiving the delivery. Key paperwork considerations can include, but are not limited to:

- Shipper verification numbers match (purchase order, sales order number, delivery confirmation number);
- Quantity and description of the drums on the bill of lading matches what the receiver is expecting; and,
- Bill of Lading has been properly executed by the shipper (the bill of lading signed by the shipper's agent).

#### Inspection of Trailer

Once the trailer is positioned into the dock, but before the trailer doors are opened, the receiver inspects the exterior for signs of tampering or modification. Such signs are an indication that the shipment may have been tampered with or that the carrier equipment has been modified for illegal purposes.

The final check before opening the trailer doors is to verify that the seals are intact and match the seal numbers that have been printed on the shippers bill of lading. If the seal numbers do not match, notify the shipper immediately. Seal numbers that are missing or that do not match the bill of lading paperwork could be an indication that the shipment has been tampered or compromised. Do not accept or sign for a shipment if the seal numbers fail to match or if there is any evidence of tampering with the shipment.

Once all inspections are complete and all paperwork matches seals, the trailer can be opened and unloaded. Take care when opening the trailer doors because the load may have shifted in transit causing a potentially unsafe condition when the back doors of the trailer are opened.

## Unloading

Methods used to unload the trailer will vary depending on how the drums are loaded. When drums are floor loaded (loose drums loaded directly onto the floor of the trailer), drum handling equipment is a key consideration. A variety of drum handling equipment options are available:

- Manual drum cart
- Drum Hoop Unloading Attachment for a forklift
- Chime Hook Unloading Attachment for a forklift (parrot beak)
- Automated drum handling equipment comes in a variety of configurations, with 1, 2 or 4 drum handling capacity

Drums that are loaded and shipped on pallets are traditionally loaded 4 drums to a pallet. Drums loaded on pallets require a forklift for proper handling.

Once drums are removed from the trailer, they can be placed into warehouse inventory in a variety of configurations. Please consult your MDI supplier for safe stacking configuration and drum stacking height recommendations.

## Heating Drums

Some MDI products in drums may be transported in a frozen or fused state, in which case the MDI needs to be melted before it can be discharged from the drum. For general guidance on heating drums to melt frozen or fused MDI, refer to CPI's *Guidance for Melting 4,4'-Methylene Diphenyl Diisocyanate (MDI) in Drums (AX363)*, available on [polyurethane.org](http://polyurethane.org).

## Mixing

A compatible drum mixing wand can be used to mix MDI. Handle carefully to avoid splashing of MDI during the mixing process. Because of the nature of MDI material and the variation in MDI formulations, consult your MDI supplier for specific advice on mixing drums of MDI.

## Transfer

The first consideration when transferring MDI from a drum is to consult the manufacturer's safety data sheet (SDS). Use required PPE in the transfer process. For further information on PPE refer to CPI's *Guidance for the Selection of Protective Clothing for MDI Users (AX178)*, available on [polyurethane.org](http://polyurethane.org).

A variety of technologies may be employed to transfer MDI. Devices and technology engaged in the transfer of MDI must be constructed of a material that is compatible with MDI. Several devices can be utilized:

- Manual or Electric Drum Pump
- Air-diaphragm pump
- Rotary or Centrifugal Pump
- Drum Pour Spout (gravity transfer method)

Consult your MDI supplier for specific advice on transferring MDI from drums.

### Recycling

When disposing of empty containers consider contacting the Reusable Industrial Packaging Association (RIPA – [www.reusablepackaging.org](http://www.reusablepackaging.org)) to locate a drum reconditioner near you.

Drums for reconditioning should be empty (as defined by RCRA, 40 CFR § 261.7) before they leave the MDI user's facility.<sup>4</sup> Contact your supplier for further disposal options. **WARNING: Empty drums may contain liquid or vapor residue, which may be dangerous. Do not burn, cut, torch, weld braise, solder, or expose containers to heat or flames. Empty drums may not be used for other purposes.**

For further information on waste disposal considerations refer to CPI's guidance document, *Guidelines for Responsible Disposal of Wastes and Containers from Polyurethane Processing* (AX151), available on [polyurethane.org](http://polyurethane.org).

### Totes

Checklists may be used when receiving totes of MDI to safeguard the receiver, the carrier and the environment.

### Driver Check In

The delivering driver checks in with security and the receiving location warehouse/receiving dock. Once driver credentials are verified by the receiver, the delivery expected and assigned to an unloading position; the bill of lading for the material is verified by the person receiving the delivery. Key paperwork considerations can include, but are not limited to:

- Shipper verification numbers match (purchase order, sales order number, delivery confirmation number);
- Quantity and description of the totes on the bill of lading matches what the receiver is expecting; and,
- Bill of lading has been properly executed by the shipper (the bill of lading signed by the shipper's agent).

<sup>4</sup> According to 40 CFR § 261.7, an empty container is one that is "drip dry"—i.e., one that has been emptied of all materials which can be removed using the practices commonly employed to remove materials from that type of container; e.g., pouring, pumping, or aspirating. (Note that the "one inch" residue rule for determining whether a drum is empty applies only to non-flowable products, such as very viscous resins.)

## Inspection of Trailer

Once the trailer is positioned into the dock, but before the trailer doors are opened, receiver inspects the exterior for signs of tampering or modification. Such signs are an indication that the shipment may have been tampered with or that the carrier equipment has been modified for illegal purposes.

The final check before opening the trailer doors is to verify that the seals are intact and match the seal numbers that have been printed on the shipper's bill of lading. If the seal numbers do not match, notify the shipper immediately. Seal numbers that are missing or that do not match the bill of lading paperwork could be an indication that the shipment has been tampered or compromised. Do not accept or sign for a shipment when the seal numbers fail to match or if there is any evidence of tampering with the shipment.

Once all inspections are complete and all paperwork matches seals, the trailer can be opened and unloaded. Take care when opening the trailer doors because the load may have shifted in transit causing a potentially unsafe condition when the back doors of the trailer are opened.

## Unloading

Methods used to unload the trailer will vary depending on how the totes are loaded. Totes are traditionally floor loaded and can be unloaded safely with a forklift.

Carefully position forklift blades under the tote. Forklift blades may extend beyond the target tote and could cause puncture damage to the tote immediately in front of the target tote.

To further aid in removing the totes from the trailer, it is helpful to have a forklift equipped with fully adjustable blades; left-right articulation, forward-aft articulation and also the capability to adjust blade width. Adjustable blades allow the receiver flexibility to properly position blades under the lading from a variety of positions inside the trailer and improve handling safety.

Once totes are removed from the trailer, they can be placed into warehouse inventory in a variety of configurations. Consult your MDI supplier for safe stacking configuration and tote stacking height recommendations.

## Mixing

A compatible tote mixing wand can be used to mix MDI. Traditionally the mixing wand is inserted into the center opening on the top of the tote. Avoid splashing of MDI during the mixing process. Because of the nature of MDI material and the variation in MDI formulations, consult your MDI supplier for specific advice on mixing totes of MDI.

## Transfer

The first consideration when transferring MDI from a tote is to consult the manufacturer's safety data sheet (SDS). Use required PPE in the transfer process. For further information on PPE refer to CPI's *Guidance for the Selection of Protective Clothing for MDI Users* (AX178), available on polyurethane.org.

A variety of technologies may be employed to transfer MDI. Devices and technology engaged in the transfer of MDI must be constructed of a material that is compatible with MDI. Several devices can be utilized:

- Manual or Electric Pump
- Air-diaphragm Pump
- Rotary or Centrifugal Pump
- Tote Pour Spout (gravity transfer method)

Please consult your MDI supplier for specific advice on transferring MDI from totes.

### Recycling

Some MDI suppliers offer a tote recycling program that is sponsored by the tote manufacturer. To determine if your MDI supplier participates in this program look for a toll free phone number for the recycler on the label plate of the tote. If you have any further questions about the recycling program, please contact your MDI supplier directly.

When disposing of empty containers consider contacting the Reusable Industrial Packaging Association (RIPA – [www.reusablepackaging.org](http://www.reusablepackaging.org)) to locate a tote reconditioner near you.

Totes for reconditioning should be empty (as defined by RCRA, 40 CFR § 261.7) before they leave the MDI user's facility.<sup>5</sup> Contact your supplier for further disposal options. **WARNING: Empty totes may contain liquid or vapor residue, which may be dangerous. Empty totes may not be used for other purposes.**

For further information on waste disposal considerations refer to CPI's guidance document, *Guidelines for Responsible Disposal of Wastes and Containers from Polyurethane Processing* (AX151), available on [polyurethane.org](http://polyurethane.org).

### Bulk Intermodal Tank Containers

MDI products are often transported on marine vessels in "bulk intermodal tank containers," which are also commonly called "tank containers", "iso tanks," "isotainers," and "deck tanks." For the purpose of this guidance document we will refer to this transport as tank containers. These tank containers resemble over-the-road bulk tank trailers, but are mounted in a rectangular metal frame for stacking on marine vessels. The containers are unloaded from a marine vessel and placed on a chassis so they may be transported over the road to their final destination.

<sup>5</sup> According to 40 CFR § 261.7, an empty container is one that is "drip dry" i.e., one that has been emptied of all materials which can be removed using the practices commonly employed to remove materials from that type of container, e.g., pouring, pumping, or aspirating. Note that the "one inch" residue rule for determining whether a drum is empty applies only to non-flowable products, such as very viscous resins.

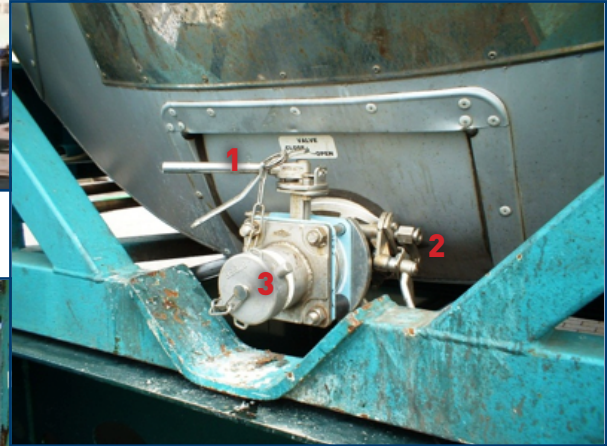




The image to the left illustrates a typical Tank Container.



The photo above illustrates location of the pull cable for remote emergency shutoff device on a typical Tank Container.



The above photo illustrates bottom unloading valves on a typical Tank Container: 1) External Valve; 2) Internal Valve; 3) Closure Cap for Unloading Connection.

## Receiving

Facilities receiving tank containers of MDI may consider having procedures and a checklist developed for receiving and unloading. Prior to unloading, consider the following steps, which may include, but are not limited to:

- Verify consignee, product trade name, and tank container number is consistent on all shipping paperwork.
- Verify tank container number matches container number listed on the shipping paper work.
- Verify the hazard class and identification number on the placards affixed to the container match the shipping paperwork and are correct for the product being received.
- Verify the security seal on the tank container unloading piping is intact.
- Verify the proper unloading line and storage tank.
- Verify there is adequate room in the storage tank for the entire contents of the tank container.

## Receiver and Driver Responsibilities

DOT requirements for unloading hazardous materials are outlined in 49 CFR § 177.834. Transport Canada's Dangerous Goods regulations permit DOT's regulations to apply for shipments from the U.S. into Canada (Transport Canada, SOR/2012-245 Amendment 11). Personnel involved in unloading hazardous materials must be trained and certified in accordance with 49 CFR §§ 172.700 – 704 or Part 6 of Transport Canada's Clear Language Dangerous Goods regulations as applicable. In addition to these requirements consider the following:

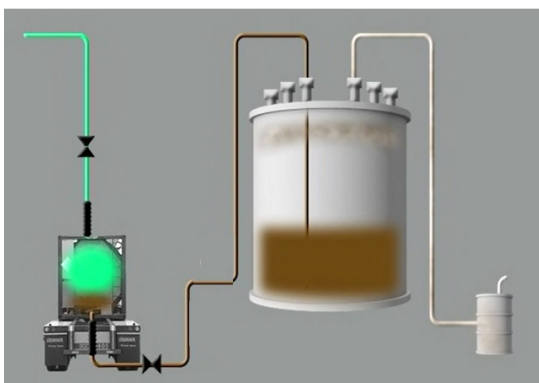
- Spot the tank container on an impervious surface where spills can be contained and prevented from entering sewers or waterways.
- Shutdown the tractor's engine unless it will be used to drive a compressor to generate dry air.
- Set the tractor's parking brake, chock the wheels on the chassis and connect the grounding cable.
- Restrict access to the unloading area.
- Receiver checks the driver's paperwork thoroughly to verify that the proper material is being received.
- Receiver verifies that there is adequate capacity in the receiving tank for the contents of the tank container.
- Receiver records the receiving tank inventory reading before and after unloading.
- Receiver verifies that the unloading connection is made to the proper receiving tank container.
- Driver will require the receiver to sign the carrier's paperwork to verify that the previous three items are complete and accurate.
- Receiver consults the SDS regarding wearing PPE during hook-up and disconnect activities.
- Receiver will confirm that anyone involved in unloading the tank container is wearing all PPE, required for the discharge operation.
- Typically, the driver will make and break all connections to the tank container and operate the container valves.
- Receiver checks that discharge and vapor return hoses are clean and fit for use.
- Receiver will make and break all connections to the receiver's piping, and operate all valves in the unloading piping and at the receiving tank.
- Federal law requires the driver to attend the tank container throughout the course of unloading. Refer to 49 CFR § 177.834(o) for attendance requirements.

## Unloading Methods

DOT requires that a tank container on a transport vehicle with the motive power unit attached be attended by a qualified person at all times during unloading. The qualified person must be alert, remain within 25-feet and have an unobstructed view of the unloading operation (49 CFR § 177.834(o)). MDI is unloaded from tank containers in a similar fashion to cargo tank trailers, and the most commonly utilized methods are:

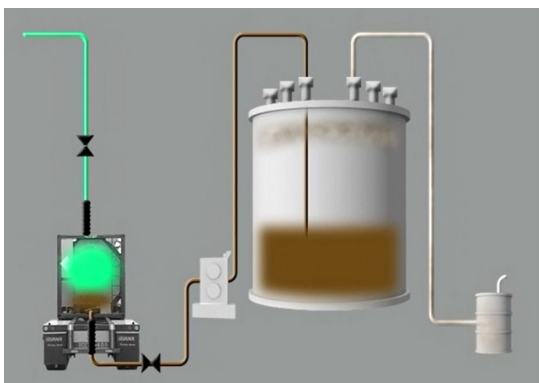
- Pressure Transfer, or
- Pump Transfer with Pressure Assist

Regardless of the method employed, prevent a vacuum from developing in the tank container, prevent over-pressurization of the tank container or the receiving tank, and prevent discharge of MDI vapors from the receiving tank to the atmosphere.



**Figure 1: Tank Container Pressure Transfer**

This method uses dry air or nitrogen (dew point  $-40^{\circ}\text{F}$ ) to pressure transfer material from the tank container to the receiving tank. Maintain the unloading pressure below the set point of the pressure relief device on the tank container. Vapor discharge from the receiving tank may need to be treated during normal unloading operations.



**Figure 2: Tank Container Pump Transfer with Pressure Assist**

This method utilizes the receiver's pump to transfer material from the tank container to the receiving tank. A small amount of nitrogen or dry air pressure is added to the tank container to replace the liquid volume being pumped out. Vapor discharge from the receiving tank may need to be treated during normal unloading operations.

The driver has a responsibility to protect the tank container and the hazardous material being delivered. The receiver has a responsibility to ensure the product is safely discharged into the proper storage tank. Cooperation between the driver and the receiver is necessary to ensure the transfer is conducted safely. **An example of a checklist for unloading bulk intermodal tank containers is available as Appendix A of this document.**

## Return Shipment

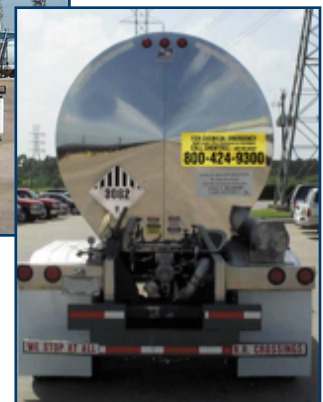
Once the tank container has been completely unloaded, the driver will close all valves on the tank container, and store and secure all hoses and fittings. The driver follows the shipper instructions for returning the tank container to the port or cleaning facility. Return empty tank containers with a positive pad of nitrogen or dry air (5-psig minimum).

## Cargo Tank Trailers

MDI products are typically shipped in single barrel DOT Specification 407 or MC 307 cargo tank trailers constructed of stainless steel. These trailers are insulated and most have the equipment necessary for heating after loading or during transit.

These trailers are equipped for bottom unloading, typically at the rear of the trailer. Additional equipment will usually include a top manway, a pressure gauge, a temperature gauge, a desiccant dryer, a nitrogen/air inlet connection, a vapor exchange connection, pressure and vacuum relief devices, a hydraulically operated internal valve, a manually operated external valve, a remote emergency shutoff device and a 2-inch Kamlok®<sup>6</sup> style quick coupler on the end of the unloading piping. Many shippers affix a product identification tag to the trailer's unloading connection and apply a tamper evident seal to this connection.

The product unloading connection and transfer hoses used for MDI products are typically 2-inch diameter to differentiate them from the 3-inch diameter hoses and fittings generally used for polyol products. Consider using 2-inch diameter hoses and fittings for vapor exchange if that method of unloading is employed.



*The photos above illustrate a typical DOT specification 407 Cargo Tank Trailer.*

<sup>6</sup> Kamlok® is a registered trade name. Kamlok® is commonly used within industry, to describe a cam and groove engineering system.



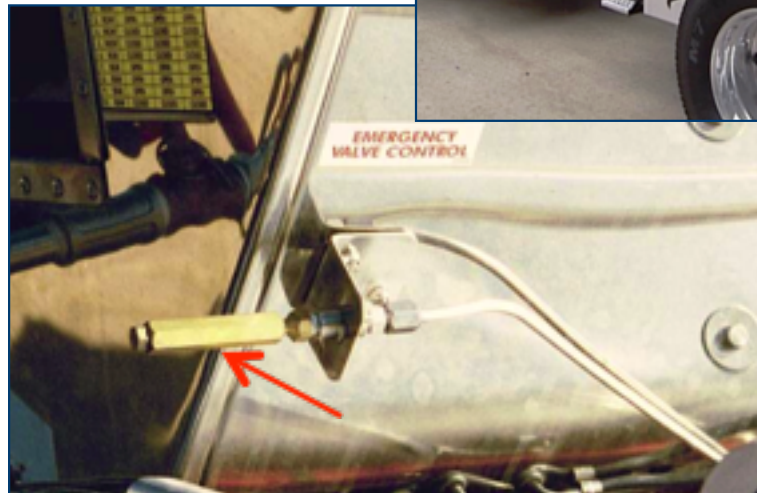


The above photo points to the desiccant dryer located on a Cargo Tank Trailer.

The photo on the right illustrates the rear unloading area of a Cargo Tank Trailer: 1) Temperature Gauge; 2) Hydraulic Jack to Operate Internal Valve; 3) External Valve; 4) 2-inch Unloading Connection.



The photo to the left points out the top fittings of a Cargo Tank Trailer: 1) Pressure Gauge; 2) Vacuum Relief Device; 3) Pressure Relief Device; 4) Manway; 5) Vapor Exchange Valves/Fittings; 6) Airline in from Desiccant Dryer.



*The above photos point out the remote emergency shutoff for a Cargo Tank Trailer.*

### Receiving

Facilities receiving cargo tank trailer deliveries of MDI may consider having procedures and checklists developed for receiving and unloading to avoid transfer errors. Prior to unloading consider the following steps, which may include but are not limited to the following:

- Verify consignee, product trade name and trailer numbers are consistent on all shipping paperwork.
- Verify number of trailer to be unloaded matches trailer number listed on shipping paperwork.
- Verify hazard class and identification numbers on the placards affixed to the trailer match shipping paperwork and are correct for product being received.
- Verify security seal on the trailer unloading piping is intact.
- Verify product trade name on the tag affixed to trailer unloading piping is correct for material being received.
- Verify proper unloading line and storage tank.
- Verify adequate room in storage tank for entire contents of the trailer.

## Receiver and Driver Responsibilities

DOT requirements for unloading trailers of hazardous materials are outlined in 49 CFR § 177.834. Transport Canada's Dangerous Goods regulations permit DOT's regulations to apply for shipments from the U.S. into Canada (Transport Canada, SOR/2012-245 Amendment 11). Personnel involved in unloading trailers containing hazardous materials must be trained and certified in accordance with 49 CFR § 172.700 – 704 or Part 6 of Transport Canada's Clear Language Dangerous Goods regulations as applicable. In addition to these requirements consider the following:

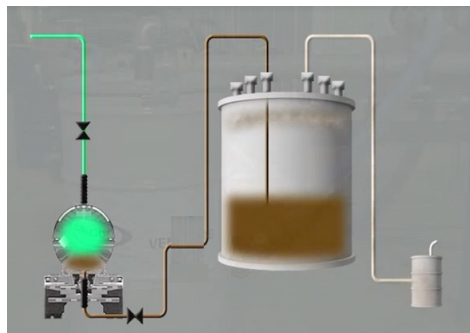
- Spot the trailer on an impervious surface where spills can be contained and prevented from entering sewers or waterways.
- Shutdown the tractor's engine (unless it will be used to drive a compressor to generate dry air).
- Set the tractor's parking brake, chock the wheels on the trailer and connect the grounding cable.
- Restrict access to the unloading area.
- Receiver checks the driver's paperwork thoroughly to verify that the proper material is being received.
- Receiver verifies that there is adequate capacity in the receiving tank for the contents of the trailer.
- Receiver records the receiving tank inventory reading before and after unloading.
- Receiver verifies that the unloading connection is made to the proper receiving tank.
- Driver has the receiver sign the carrier's paperwork to verify that the previous three items are complete and accurate.
- Receiver consults the SDS regarding wearing PPE during hook-up and disconnect activities.
- Typically, the driver will make and break all connections to the trailer and operate the trailer valves.
- Receiver checks that discharge and vapor return hoses are clean and fit for use.
- Receiver makes and breaks all connections to the receiver's piping and operate valves in the unloading piping and at the receiving tank.
- Federal law requires the driver to attend the trailer throughout the course of unloading. Refer to 49 CFR § 177.834(i) for cargo tank trailer attendance requirements.

## Unloading Methods

DOT requires the driver to be alert, within 25 feet and have an unobstructed view of the unloading operation to ensure the cargo tank is attended by a qualified person at all times during unloading (49 CFR § 177.834(i)). The following methods are commonly used to unload MDI products from cargo tank trailers:

- Pressure Transfer,
- Pump Transfer with Pressure Assist, or
- Pump Transfer with Vapor Exchange

Regardless of the method employed, prevent a vacuum from developing in the cargo tank, prevent over-pressurization of the trailer or the receiving tank, and prevent discharge of MDI vapors from the receiving tank to the atmosphere.



**Figure 3: Cargo Tank Trailer Pressure Transfer**

This method uses dry air or nitrogen to pressure transfer material from the trailer to the receiving tank. Trailers are equipped with a pressure relief valve that will start to discharge above 25-psig so the unloading cannot exceed this level. Vapor discharge from the receiving tank may need to be treated during normal unloading operations.



**Figure 4: Cargo Tank Trailer Pump Transfer with Pressure Assist**

This method utilizes the receiver's pump to transfer material from the trailer to the receiving tank. A small amount of nitrogen or dry air pressure is added to the trailer to replace the liquid volume being pumped out. Vapor discharge from the receiving tank may need to be treated during normal unloading operations.



**Figure 5: Cargo Tank Trailer Pump Transfer with Vapor Exchange**

This method utilizes the receiver's pump to transfer material from the trailer to the receiving tank. The vapor space of the receiving tank and trailer are equalized so pad pressure remains constant in both the receiving tank and trailer throughout the transfer.

The driver has a responsibility to protect the trailer and the hazardous material being delivered. The receiver has a responsibility to ensure the product is safely discharged into the proper storage tank. Cooperation between the driver and the receiver is necessary to ensure the transfer is conducted safely. **An example of a checklist for unloading cargo tank trailers is available as Appendix B of this document.**



## Return Shipment

Once the trailer has been completely unloaded, the driver will close all trailer valves, store all hoses/fittings and secure all fittings on the cargo tank. Return empty trailers with a positive pad of nitrogen or dry air (5-psig minimum). The shipper provides instructions to the driver as to whether in transit heat is required on the empty trailer for the return trip.

## Rail Tank Cars

Rail tank cars used for transportation of MDI must meet design and construction requirements for the transportation of hazardous materials. These requirements are found in 49 CFR Part 179. The various subparts of Part 179 describe the requirements for construction material, welding, wall thickness, gaskets, valves, valve protection, and venting devices. Consult 49 CFR Part 179 for further information.

## Receiving

Verify the physical railcar number (i.e., ABCX1234) matches that of the car requested. Cars can have similar numbers and could contain totally separate commodities. Many cars are shipped with security seals and commodity tags affixed to assist in identifying the product as well as ensuring the car was not tampered with during transit. Verify the seal number and commodity tag against the shipping paperwork provided by the supplier.

*This photo illustrates a typical Rail Tank Car in MDI service.*



## Receiver Responsibilities





DOT requires a rail tank car be protected against movement or coupling prior to unsecuring any closure on the car. This regulation states that the hazmat employee responsible for unloading a tank car must do the following: secure access to the track to prevent entry by other rail equipment, place caution signs on the track to warn persons approaching the cars, verify the handbrake is set on the car, and block at least one wheel of the tank car against movement in both directions (49 CFR § 173.31(g)). Other considerations include the following guidelines:

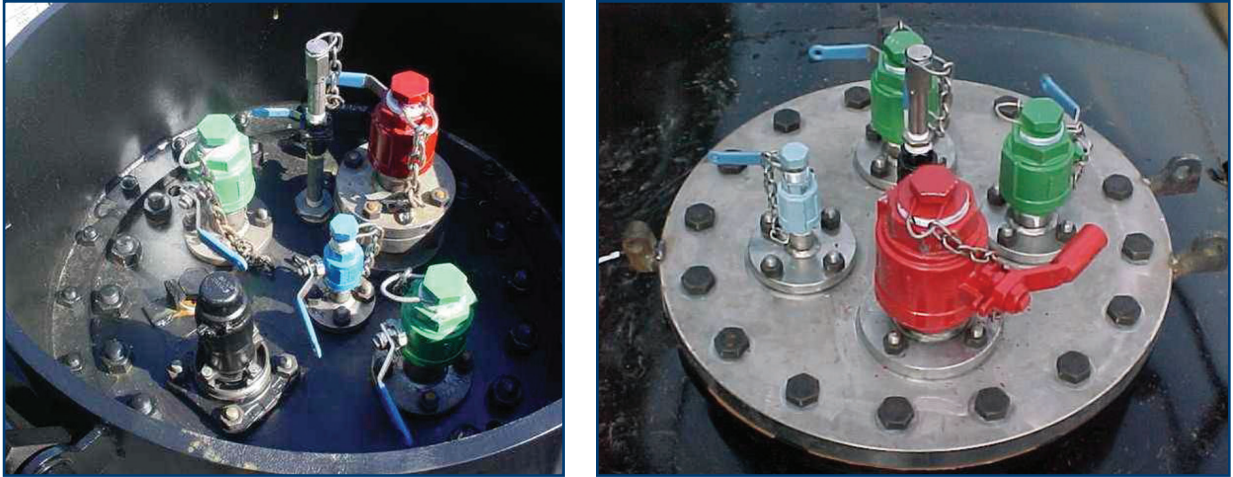
- Verify the location and operation of the nearest safety shower and eyewash.
- Thoroughly check the rail tank car and shipping paperwork, product tag and placards to verify that the proper material is being received.
- If heating is required, follow your company's procedure for heating rail tank cars.
- Verify that there is adequate capacity in the receiving tank for the contents of the rail tank car.
- Record the tank inventory reading before and after unloading.
- Verify that transfer hoses are constructed of suitable materials and should be included in an inspection and testing program in accordance with the hose manufacturer's recommendations. In addition, inspect hoses prior to each use.
- Consult the SDS regarding wearing PPE for hook-up and disconnect activities.
- Verify that the rail tank car is connected to the proper receiving tank.
- Attend the rail tank car throughout the transfer.

## Fitting Identification

Rail tank car appliances are identified to assist in avoiding mistakes when connecting transfer lines. In some cases, the shipper might identify the appliances by using a color code system with a reference chart. In other cases, appliances might be identified with a small tag affixed to the appliance identifying its use.

*The photo to the right illustrates a possible color-code scheme for unloading fittings used by some MDI suppliers.*

	Product Valve
	Vapor Valve
	Air/Nitrogen Valve
	Thermowell



*The above photos illustrate top unloading fittings on a typical Rail Tank Car in MDI service.*

### Inspection

Visually check that safety appliances (ladders, hand-rails and grab irons) and placard holders are in place and in good condition. Visually check that securement devices (valves, gaskets, man way cover assemblies, and chains on plugs and caps) are in place and in good condition. Report any defects to the shipper.

### Heating

Low pressure steam or a heated glycol recirculation system is generally sufficient to raise the temperature of various products without adversely affecting product quality. Higher pressure steam can result in localized heating and affect product quality. For guidance on heating rail tank cars contact your product supplier.



*This photo illustrates the heater coil inlet and outlet on the bottom of a Rail Tank Car.*

### **Regulatory Pre-Unloading**

After a tank car has been positioned for loading or unloading and before any fixture has been unsecured, the tank car must be protected against movement and or coupling (49 CFR § 173.31(g)). A derail or lined and locked switches provide adequate protection against other rail equipment entering the track and affecting loading or unloading operations.

Caution signs must be affixed to the track or tank car to warn persons entering from the open end of the track and the signs must be in place until all fixtures have been secured and the tank car is ready for transportation. Design specifications for and use of the signs can be found in citation 49 CFR § 173.31(g)(2).

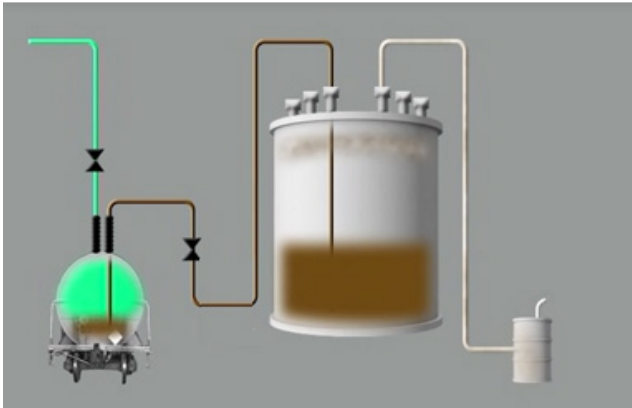
In addition to the requirements above, the tank car hand brake must be set and at least one wheel of the tank car must be blocked to prevent movement in both directions. (49 CFR § 173.31(g)(3))

### **Unloading Methods**

DOT requirements for unloading rail tank cars of hazardous materials are outlined in Title 49 of the Code of Federal Regulations. Transport Canada's Clear Language regulations are found in Part 5.14(b) through reference to CGSB-43.147.97. Personnel involved in unloading rail tank cars containing hazardous materials must be trained and certified in accordance with 49 CFR § 172.700 – 704 or Part 6 of Transport Canada's Clear Language Dangerous Goods regulations as applicable. The following methods are commonly used to unload MDI products from rail tank cars:

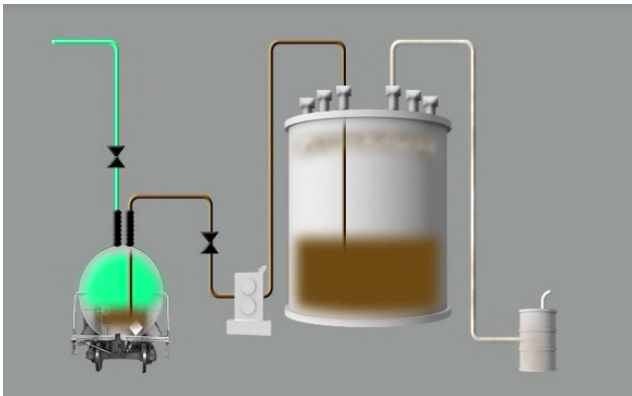
- Pressure Transfer,
- Pump Transfer with Pressure Assist, or
- Pump Transfer with Vapor Exchange

Regardless of the method employed, prevent a vacuum from developing in the rail tank car, prevent over-pressurization of the rail tank car or the receiving tank, and prevent discharge of MDI vapors from the receiving tank to the atmosphere.



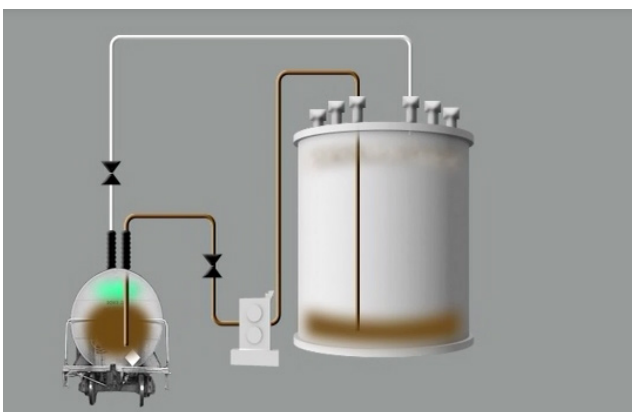
**Figure 6: Rail Tank Car Pressure Transfer**

This method uses dry air or nitrogen to pressure transfer material from the rail tank car to the receiving tank. Rail tank cars are equipped with a pressure relief valve that will start to discharge typically above 75 to 165-psig so the pressure used to unload cannot exceed this level. The shipper typically recommends the unloading pressure be between 15 to 25-psig. Vapor discharge from the receiving tank may need to be treated during normal unloading operations.



**Figure 7: Rail Tank Car Pump Transfer with Pressure Assist**

This method utilizes the receiver's pump to transfer material from the rail tank car to the receiving tank. A small amount of nitrogen or dry air pressure is added to the rail tank car to replace the liquid volume being pumped out. Vapor discharge from the receiving tank may need to be treated during normal unloading operations.



**Figure 8: Rail Tank Car Pump Transfer with Vapor Exchange**

This method utilizes the receiver's pump to transfer material from the rail tank car to the receiving tank. The vapor space of the receiving tank and rail tank car are equalized so pad pressure remains constant in both the receiving tank and rail tank car throughout the transfer.



It is recommended that the receiver assigned to unload the rail tank car follow the regulations and facility procedures to ensure the transfer is conducted safely. **An example of a checklist for unloading rail tank cars is available as Appendix C of this document.**

### **Preparation for Return**

After removing hoses and fittings from the rail tank car, make final check of rail tank car valves, gauging devices, internal rod valve packing gland, and caps to prevent leakage in transit. For example, tighten gauging device and thermowell covers against O-ring seals. Wrap all plugs and fittings that were removed with sealing tape (PTFE sealant tape) and tightened with a bar, wrench, or other suitable tool. Close and secure the top hatch cover and verify the car is properly placarded. Ensure the car is returned with a positive pad of nitrogen or dry air (5-psi minimum). All of these items apply to empty and loaded cars. (49 CFR § 173.31)



*The above photo illustrates proper use of tool to secure the plug.*

### **Federal Railroad Administration (FRA) Inspections**

The FRA conducts routine rail tank car inspections to ensure safety compliance and inspectors can issue citations for compliance violations. Some examples of violations include: missing placards, valve plugs that are not wrench tight, and loose dome bolts. If for some reason a device cannot be secured as designed, contact the product supplier to address the issue.

### **Removing External Residue**

As stated in, 49 CFR § 173.24(b)(4), "there will be no hazardous material residue adhering to the outside of the package during transport." Accordingly, a placarded car with external residue cannot be released by the shipper without first removing the residue. In some cases, an environmental service company might be contracted to safely remove the external residue.

## HazMat Shipper Registration

Offerors and transporters of certain quantities and types of hazardous materials, including hazardous wastes, are required to register with DOT Pipeline and Hazardous Materials Safety Administration. The quantities and types of hazardous materials that require registration as well as the fee schedule can be found in 49 CFR § 107.601–620.

MDI is only regulated as Class 9 miscellaneous hazardous material for transportation purposes when in a quantity in one package exceeds the product RQ of 5,000 pounds. Based on the classification of MDI in transportation, shippers of tank cars containing residue of MDI have two options in which to return the tank car and each affects whether or not the shipper must be registered with the DOT:

1. For shippers returning empty tank cars containing a residue of MDI in a quantity below the RQ, the shipper may remove the placards and provide transportation information to the railroad indicating that material is not a hazardous material in transport. The shipper would NOT be required to register with the DOT unless the shipper is already handling other materials that require such a registration.
2. For shippers returning empty tank cars containing a residue of MDI, if the placards remain on the tank car, then the shipment is considered to be a regulated hazardous material, must be declared to the railroad as a hazardous material, and thus the shipper must be registered with the DOT.

## Legal Notice

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This guidance document was prepared by the American Chemistry Council's Center for the Polyurethanes Industry. It is intended to provide general information on receiving and unloading MDI. It is not intended to serve as a substitute for in-depth training or specific handling requirements, nor is it designed or intended to define or create legal rights or obligations. It is not intended to be a "how-to" manual, nor is it a prescriptive guide. All persons involved in receiving and unloading MDI have an independent obligation to ascertain that their actions are in compliance with current federal, state and local laws and regulations and should consult with legal counsel concerning such matters. The guidance is necessarily general in nature and individual companies may vary their approach with respect to particular practices based on specific factual circumstance, the practicality and effectiveness of particular actions and economic and technological feasibility. Neither the American Chemistry Council, nor the individual member companies of the Center for the Polyurethanes Industry of the American Chemistry Council, nor any of their respective directors, officers, employees, subcontractors, consultants, or other assigns, makes any warranty or representation, either express or implied, with respect to the accuracy or completeness of the information contained in this guidance document; nor do the American Chemistry Council or any member companies assume any liability or responsibility for any use or misuse, or the results of such use or misuse, of any information, procedure, conclusion, opinion, product, or process disclosed in this guidance document. Any mention of specific products, services, courses or programs in this document is for illustration purposes only and is not intended as a recommendation or endorsement of such products by ACC or the Center for the Polyurethanes Industry of the ACC. Items in this document may be trademarked, which may or may not be noted in this document. NO WARRANTIES ARE GIVEN; ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY EXCLUDED.

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## Appendix A: Example of Checklists for Unloading Bulk Intermodal Tank Containers

This Appendix contains example checklists for deliveries of MDI in bottom discharge tank containers, which we will refer to this Appendix as tank containers, and the different methods for unloading. Due to variations in the configuration of facilities, the specific activities involved and/or the sequence in which they are conducted may differ from what is described in this Appendix.

The purpose of these example checklists is to demonstrate the complexity of the unloading operation and to describe the division of responsibility between the receiver and the driver conducting the transfer. These example checklists may be used as a guide for developing your own site specific checklist.

The U.S. Department of Transportation (DOT) requires that a tank container on a transport vehicle with the motive power unit attached be attended by a qualified person at all times during unloading. The qualified person must be alert, remain within 25-feet and have an unobstructed view of the unloading operation (49 CFR § 177.834(o)).

The driver has a responsibility to protect the tank container and the hazardous material being delivered. The receiver has a responsibility to ensure the product is safely discharged into the proper storage tank. Cooperation between the driver and the receiver is necessary to conduct the transfer.

### Example Checklist for Tank Container Unloading

DOT requirements for unloading tank container quantities of hazardous materials are outlined in 49 CFR § 177.834. Transport Canada's Dangerous Goods regulations permit DOT's regulations to apply for shipments from the U.S. into Canada (Transport Canada, SOR/2012-245 Amendment 11). Personnel involved in unloading tanks containing hazardous materials must be trained and certified in accordance with 49 CFR § 172.700-704 or Part 6 of Transport Canada's Clear Language Dangerous Goods regulations as applicable. In addition to the regulations, the following are some general steps to consider:

	Receiver	Driver
Verify your facility expects to receive a delivery.	<input type="checkbox"/>	
Spot container/chassis on impervious surface where spills can be contained and prevented from entering sewers or waterways.	<input type="checkbox"/>	<input type="checkbox"/>
Shutdown tractor's engine unless it will be used for air compressor.		<input type="checkbox"/>
Set tractor's parking brake.		<input type="checkbox"/>
Chock wheels on containers chassis and connect grounding cable.	<input type="checkbox"/>	
Provide suitable catch containers to place under ends of hose.	<input type="checkbox"/>	
Restrict access to unloading area.	<input type="checkbox"/>	
Check driver's paperwork to verify proper material being received.	<input type="checkbox"/>	
Verify adequate capacity in receiving tank for amount in container.	<input type="checkbox"/>	
Record receiving tank inventory reading before and after unloading.	<input type="checkbox"/>	



Verify temperature and pad pressure on container.	<input type="checkbox"/>	<input type="checkbox"/>
Verify connection made to proper receiving tank.	<input type="checkbox"/>	
Show driver location of safety shower/eyewash and explain emergency procedures.	<input type="checkbox"/>	
Show receiver location/operation of container's remote emergency shutoff.		<input type="checkbox"/>
Sign carrier's paperwork to verify proper material is being received, unloading hose is connected to proper receiving tank and tank has room to hold contents of tank container.	<input type="checkbox"/>	
Make/break connections to tank container and operate container valves.		<input type="checkbox"/>
Make/break connections to receiving tank piping and operate valves in unloading piping and at receiving tank.	<input type="checkbox"/>	
Wear proper personal protective equipment (PPE) during hookup, sampling, start of flow and disconnect activities.	<input type="checkbox"/>	<input type="checkbox"/>
Federal law requires the tank container be attended by a qualified person during unloading. Refer to 49 CFR § 177.834(o) for tank container attendance requirements.		<input type="checkbox"/>

### Example Checklist for Pressure Transfer

This method uses dry air or nitrogen (N<sub>2</sub>) to pressure transfer material from the tank container to the storage tank. Maintain unloading pressure below the set point of the pressure relief device on the portable tank container. Vapor discharge from the receiving tank may need to be treated during normal unloading operations. Following are steps for consideration in the pressure transfer process:

	Receiver	Driver
Satisfy steps in "Example Checklist for Tank Container Unloading."	<input type="checkbox"/>	<input type="checkbox"/>
Inspect unloading hose, gaskets and fittings.	<input type="checkbox"/>	<input type="checkbox"/>
Connect 2-inch product hose to container unload piping. Secure quick coupler connection.		<input type="checkbox"/>
Connect opposite end of hose to 2-inch diameter Kamlok® style quick coupler on receiving tank piping. Secure quick coupler connection.	<input type="checkbox"/>	
Connect regulated supply of dry air or N <sub>2</sub> to container air inlet valve. Secure air hose connection.		<input type="checkbox"/>
Sign driver's paperwork indicating a good hookup has been made.	<input type="checkbox"/>	
Open receiving tank vent valve to suitable vapor treatment system.	<input type="checkbox"/>	
Open valves in unload piping.	<input type="checkbox"/>	
Open container internal valve and check for leaks.		<input type="checkbox"/>
Slowly open container external valve and check for leaks.		<input type="checkbox"/>
Open valves in dry air or N <sub>2</sub> supply.	<input type="checkbox"/>	
Open air inlet valve on container. Build dry air or N <sub>2</sub> to required pressure.		<input type="checkbox"/>
Monitor container and unload hose throughout transfer.		<input type="checkbox"/>

Monitor transfer piping and receiving tank throughout transfer.	<input type="checkbox"/>	
Keep all valves open until container is empty.	<input type="checkbox"/>	<input type="checkbox"/>
Close container valves and air inlet valve on tank container.		<input type="checkbox"/>
Shut off dry air or N2 supply.	<input type="checkbox"/>	
Let container “drain” for a couple of minutes.	<input type="checkbox"/>	<input type="checkbox"/>
Again, carefully open container valves to allow pressure remaining in container to transfer residual material to receiving tank.		<input type="checkbox"/>
When unload hose and piping have been blown clear, close tank container internal valve.		<input type="checkbox"/>
Close valves in receiving tank product and vent piping.	<input type="checkbox"/>	
Carefully relief pressure from unload hose into catch container.		<input type="checkbox"/>
Close container external valve.		<input type="checkbox"/>
Disconnect hose from container and replace quick coupler plugs/caps on container and hose.		<input type="checkbox"/>
Disconnect hose from receiving tank piping and replace quick coupler caps/plugs on hose and piping.	<input type="checkbox"/>	
Carefully relieve pressure from air hose and disconnect from container.		<input type="checkbox"/>
Return empty tank container with positive pad of dry air or N2.		<input type="checkbox"/>
Sign driver’s paperwork, remove wheel chocks and barricades.	<input type="checkbox"/>	
Provide driver with instructions for departing your facility.	<input type="checkbox"/>	

### Example Checklist for Pump Transfer with Pressure Assist

This method utilizes the receiver’s pump to transfer material from the tank container to the receiving tank. A small amount of dry air or nitrogen (N2) pressure is added to the tank container to replace the liquid volume being pumped out. Vapor discharge from the receiving tank may require treatment during normal unloading operations. Following are steps for consideration in the pump transfer with pressure assist process:

	Receiver	Driver
Satisfy steps in “Example Checklist for Tank Container Unloading.”	<input type="checkbox"/>	<input type="checkbox"/>
Inspect unloading hose, gaskets and fittings.	<input type="checkbox"/>	<input type="checkbox"/>
Connect 2-inch product hose to container unload piping. Secure quick coupler connection.		<input type="checkbox"/>
Connect opposite end of hose to the 2-inch diameter Kamlok® style quick coupler on suction side of unloading pump. Secure quick coupler connection.	<input type="checkbox"/>	
Connect regulated supply of dry air or N2 to container air inlet valve. Secure air hose connection.		<input type="checkbox"/>
Sign driver’s paperwork indicating a good hookup has been made.	<input type="checkbox"/>	
Open receiving tank vent valve to suitable vapor treatment system.	<input type="checkbox"/>	

Open valves in pump suction and discharge piping.	<input type="checkbox"/>	
Open container internal valve and check for leaks.		<input type="checkbox"/>
Slowly open container external valve and check for leaks.		<input type="checkbox"/>
Open valves in dry air or N2 supply.	<input type="checkbox"/>	
Open air inlet valve on container. Build dry air or N2 to required pressure.		<input type="checkbox"/>
Start unload pump.	<input type="checkbox"/>	
Monitor container and unload hose throughout transfer.		<input type="checkbox"/>
Monitor pump, transfer piping and receiving tank throughout transfer.	<input type="checkbox"/>	
During transfer, make periodic checks to ensure positive pressure is maintained in container.		<input type="checkbox"/>
When container starts to flow empty, the hose will become lighter and may "jump." The pump discharge pressure gauge will show a decrease in pressure.	<input type="checkbox"/>	<input type="checkbox"/>
Shut off pump and close valves in receiving piping.	<input type="checkbox"/>	
Close air inlet valve on container.		<input type="checkbox"/>
Close valves in dry air or N2 piping.	<input type="checkbox"/>	
Let container "drain" for a couple of minutes.	<input type="checkbox"/>	<input type="checkbox"/>
Again open receiving piping valves and start pump.	<input type="checkbox"/>	
Walk hose to pump to ensure all material is removed from hose.	<input type="checkbox"/>	<input type="checkbox"/>
When container is completely empty shut off pump and close receiving piping valves.	<input type="checkbox"/>	
Close container internal valve.		<input type="checkbox"/>
Close storage tank vent valve.	<input type="checkbox"/>	
Carefully relieve pressure from unload hose into catch container.		<input type="checkbox"/>
Close container external valve.		<input type="checkbox"/>
Disconnect unload hose from container and replace quick coupler plugs/caps on container and hose.		<input type="checkbox"/>
Disconnect hose from receiving tank piping and replace quick coupler caps/plugs on hose and piping.	<input type="checkbox"/>	
Carefully relieve pressure from air hose and disconnect from container.		<input type="checkbox"/>
Return empty tank container with positive pad of dry air or N2.		<input type="checkbox"/>
Sign driver's paperwork, remove wheel chocks and barricades.	<input type="checkbox"/>	
Provide driver with instructions for departing your facility.	<input type="checkbox"/>	

## Appendix B: Example Checklists for Unloading Cargo Tank Trailers

This Appendix contains example checklists for cargo tank trailer deliveries of MDI and the different methods for unloading. Due to variations in the configuration of facilities, the specific activities involved and/or the sequence in which they are conducted may differ from what is described in this Appendix.

The purpose of these example checklists is to demonstrate the complexity of the unloading operation to describe the division of responsibility between the receiver and the driver conducting the transfer. These example checklists may be used as a guide for developing your own site specific checklist.

The U.S. Department of Transportation (DOT) requires the driver to be alert, remain within 25 feet and have an unobstructed view of the unloading operation to ensure the cargo tank is attended by a qualified person at all times during unloading (49 CFR § 177.834(i)).

The driver has a responsibility to protect the trailer and the hazardous material being delivered. The receiver has a responsibility to ensure the product is safely discharged into the proper storage tank. Cooperation between the driver and the receiver is necessary to ensure the transfer is conducted safely.

### Example Checklist for Cargo Tank Trailer Unloading

DOT requirements for unloading cargo tank trailer of hazardous materials are outlined in 49 CFR § 177.834. Transport Canada's Dangerous Goods regulations permit DOT's regulations to apply for shipments from the U.S. into Canada (Transport Canada, SOR/2012-245 Amendment 11). Personnel involved in unloading trailers containing hazardous materials must be trained and certified in accordance with 49 CFR § 172.700 – 704 or Part 6 of Transport Canada's Clear Language Dangerous Goods regulations as applicable. In addition to the regulations, the following are some general steps to consider:

	Receiver	Driver
Verify your facility expects to receive a delivery.	<input type="checkbox"/>	
Spot trailer on impervious surface where spills can be contained and prevented from entering sewers or waterways.	<input type="checkbox"/>	<input type="checkbox"/>
Shutdown tractor's engine unless it will be used for air compressor.		<input type="checkbox"/>
Set tractor's parking brake.		<input type="checkbox"/>
Chock wheels on trailer and connect grounding cable.	<input type="checkbox"/>	
Provide suitable catch containers to place under ends of hose.	<input type="checkbox"/>	
Restrict access to unloading area.	<input type="checkbox"/>	
Check driver's paperwork to verify proper material being received.	<input type="checkbox"/>	
Verify adequate capacity in receiving tank for amount in trailer.	<input type="checkbox"/>	
Record receiving tank inventory reading before and after unloading.	<input type="checkbox"/>	
Verify connection is made to proper receiving tank.	<input type="checkbox"/>	

Verify temperature and pad pressure on trailer.	<input type="checkbox"/>	<input type="checkbox"/>
Show driver location of safety shower/eyewash and explain emergency procedures.	<input type="checkbox"/>	
Show receiver location/operation of trailer's remote emergency shutoff.		<input type="checkbox"/>
Sign carrier's paperwork to verify proper material is being received, unloading hose is connected to proper receiving tank and tank has room to hold contents of trailer.	<input type="checkbox"/>	
Make/break connections to trailer and operate trailer valves.		<input type="checkbox"/>
Make/break connections to receiving tank piping and operate valves in unloading piping and at receiving tank.	<input type="checkbox"/>	
Wear proper personal protective equipment (PPE) during hookup, sampling, start of flow and disconnect activities.	<input type="checkbox"/>	<input type="checkbox"/>
Federal law requires the motor carrier to ensure the cargo tank is attended during unloading. Refer to 49 CFR § 177.834(i) for cargo tank trailer attendance requirements.		<input type="checkbox"/>

### Example Checklist for Pressure Transfer

This method uses dry air or nitrogen (N<sub>2</sub>) to pressure transfer material from the trailer to the storage tank. Trailers are equipped with a pressure relief valve that will start to discharge above 25-psig so unloading pressure cannot exceed this level. Vapor discharge from the receiving tank may need to be treated during normal unloading operations. Following are steps for consideration in the pressure transfer process:

	Receiver	Driver
Satisfy steps in "Example Checklist for Cargo Tank Trailer Unloading."	<input type="checkbox"/>	<input type="checkbox"/>
Inspect unloading hose, gaskets and fittings.	<input type="checkbox"/>	<input type="checkbox"/>
Connect 2-inch product hose to trailer unload piping. Secure quick coupler connection.		<input type="checkbox"/>
Connect opposite end of hose to 2-inch Kamlok® style quick coupler on receiving tank piping. Secure quick coupler connection.	<input type="checkbox"/>	
Connect a regulated supply of dry air or N <sub>2</sub> to trailer's air inlet valve. Secure air hose connection.		<input type="checkbox"/>
Sign driver's paperwork indicating a good hookup has been made.	<input type="checkbox"/>	
Open receiving tank vent valve to suitable vapor treatment system.	<input type="checkbox"/>	
Open all valves in unload piping.	<input type="checkbox"/>	
Open trailer internal valve and check for leaks.		<input type="checkbox"/>
Slowly open trailer external valve and check for leaks.		<input type="checkbox"/>
Open valve in dry air or N <sub>2</sub> supply.	<input type="checkbox"/>	
Open air inlet valves on trailer. Build dry air or N <sub>2</sub> to required pressure.		<input type="checkbox"/>
Monitor trailer and unload hose throughout transfer.		<input type="checkbox"/>
Monitor transfer piping and receiving tank throughout transfer.	<input type="checkbox"/>	
Keep all valves open until trailer is empty.	<input type="checkbox"/>	<input type="checkbox"/>

Close trailer valves and shut off air inlet valves on trailer.		<input type="checkbox"/>
Shut off dry air or N2 supply.	<input type="checkbox"/>	
Let trailer “drain” for a couple of minutes.	<input type="checkbox"/>	<input type="checkbox"/>
Again carefully open trailer valves to allow pressure remaining in trailer to transfer residual material to receiving tank.		<input type="checkbox"/>
When the unload hose and piping have been blown clear, close trailer internal valve.		<input type="checkbox"/>
Close valves in receiving tank product and vent piping.	<input type="checkbox"/>	
Carefully relieve pressure from unload hose into catch container.		<input type="checkbox"/>
Close trailer external valve.		<input type="checkbox"/>
Disconnect hose from trailer and replace quick coupler plugs/caps on trailer and hose.		<input type="checkbox"/>
Disconnect hose from receiving tank piping and replace quick coupler caps/plugs on hose and piping.	<input type="checkbox"/>	
Carefully relieve pressure from air hose and disconnect from trailer.		<input type="checkbox"/>
Return empty trailer with positive pad of dry air or N2.		<input type="checkbox"/>
Sign driver’s paperwork, remove wheel chocks and barricades.	<input type="checkbox"/>	
Provide driver with instructions for departing your facility.	<input type="checkbox"/>	

### Example Checklist for Pump Transfer with Pressure Assist

This method utilizes the receiver’s pump to transfer material from the trailer to the receiving tank. A small amount of dry air or nitrogen (N2) pressure is added to the trailer to replace the liquid volume being pumped out. Vapor discharge from the receiving tank may need to be treated during normal unloading operations. Following are steps for consideration in the pump transfer with pressure assist process:

	Receiver	Driver
Satisfy steps in “Example Checklist for Cargo Tank Trailer Unloading.”	<input type="checkbox"/>	<input type="checkbox"/>
Inspect unloading hose, gaskets and fittings.	<input type="checkbox"/>	<input type="checkbox"/>
Connect 2-inch product hose to trailer unload piping. Secure quick coupler connection.		<input type="checkbox"/>
Connect opposite end of hose to the 2-inch diameter Kamlok® style quick coupler on suction side of unloading pump. Secure quick coupler connection.	<input type="checkbox"/>	
Connect regulated supply of dry air or N2 to trailer air inlet valve. Secure air hose connection.		<input type="checkbox"/>
Sign driver’s paperwork indicating a good hookup has been made.	<input type="checkbox"/>	
Open receiving tank vent valve to suitable vapor treatment system.	<input type="checkbox"/>	
Open valves in pump suction and discharge piping.	<input type="checkbox"/>	
Open trailer internal valve and check for leaks.		<input type="checkbox"/>
Slowly open trailer external valve and check for leaks.		<input type="checkbox"/>

Open valves in dry air or N2 supply.	<input type="checkbox"/>	
Open air inlet valves on trailer. Build dry air or N2 to required pressure.		<input type="checkbox"/>
Start unload pump.	<input type="checkbox"/>	
Monitor trailer and unload hose throughout transfer.		<input type="checkbox"/>
Monitor pump, transfer piping and receiving tank throughout transfer.	<input type="checkbox"/>	
During transfer, make periodic checks to ensure positive pressure is maintained in trailer.		<input type="checkbox"/>
When trailer starts to flow empty, the hose will become lighter and may "jump". The pump discharge pressure gauge will show a decrease in pressure.	<input type="checkbox"/>	<input type="checkbox"/>
Shut off pump and close valves in receiving piping.	<input type="checkbox"/>	
Close air inlet valves on trailer.		<input type="checkbox"/>
Close valves in dry air or N2 supply.	<input type="checkbox"/>	
Let trailer "drain" for a couple of minutes.	<input type="checkbox"/>	<input type="checkbox"/>
Again open receiving piping valves and start pump.	<input type="checkbox"/>	
Walk hose to pump to ensure all material is removed from hose.	<input type="checkbox"/>	<input type="checkbox"/>
When trailer is completely empty shut off pump and close receiving piping valves.	<input type="checkbox"/>	
Close trailer internal valve.		<input type="checkbox"/>
Close storage tank vent valve.	<input type="checkbox"/>	
Carefully relieve pressure from unload hose into catch container.		<input type="checkbox"/>
Close trailer external valve.		<input type="checkbox"/>
Disconnect unload hose from trailer and replace quick coupler plugs/caps on trailer and hose.		<input type="checkbox"/>
Disconnect hose from receiving tank piping and replace quick coupler caps/plugs on hose and receiving piping.	<input type="checkbox"/>	
Carefully relieve pressure from air hose and disconnect from trailer.		<input type="checkbox"/>
Return empty trailer with positive pad of dry air or N2.		<input type="checkbox"/>
Sign driver's paperwork, remove wheel chocks and barricades.	<input type="checkbox"/>	
Provide driver with instructions for departing your facility.	<input type="checkbox"/>	

## Example Checklist for Pump Transfer with Vapor Exchange

This method utilizes the receiver’s pump to transfer material from the trailer to the receiving tank. The vapor space of the receiving tank and trailer are equalized so pad pressure remains constant in both the tank and trailer throughout the transfer. Following are steps for consideration in the pump transfer with vapor exchange process:

	Receiver	Driver
Satisfy steps in “Example Checklist for Cargo Tank Trailer Unloading.”	<input type="checkbox"/>	<input type="checkbox"/>
Inspect unloading hose, gaskets and fittings.	<input type="checkbox"/>	<input type="checkbox"/>
Connect 2-inch product hose to trailer unload piping. Secure quick coupler connection.		<input type="checkbox"/>
Connect opposite end hose to the 2-inch diameter Kamlok® style quick coupler on suction side of unloading pump. Secure quick coupler connection.	<input type="checkbox"/>	
Connect 2-inch vapor exchange hose to vapor fitting on top of trailer. Secure vapor hose connection.		<input type="checkbox"/>
Connect opposite end of vapor hose to receiving tank vapor piping.	<input type="checkbox"/>	
Sign driver’s paperwork indicating a good hookup has been made.	<input type="checkbox"/>	
Open receiving tank vapor exchange valve.	<input type="checkbox"/>	
Open vapor exchange valve on trailer.		<input type="checkbox"/>
Open all valves in pump suction and discharge piping.	<input type="checkbox"/>	
Open trailer internal valve and check for leaks.		<input type="checkbox"/>
Slowly open trailer external valve and check for leaks.		<input type="checkbox"/>
Start unload pump.	<input type="checkbox"/>	
Monitor trailer and unload hose throughout transfer.		<input type="checkbox"/>
Monitor pump, transfer piping and receiving tank throughout transfer.	<input type="checkbox"/>	
During transfer, make periodic checks to ensure positive pressure is maintained in trailer.		<input type="checkbox"/>
When trailer starts to flow empty, the hose will become lighter and may “jump.” The pump discharge pressure gauge will show a decrease in pressure.	<input type="checkbox"/>	<input type="checkbox"/>
Shut off pump and close valves in receiving piping.	<input type="checkbox"/>	
Let the trailer “drain” for a couple of minutes.	<input type="checkbox"/>	<input type="checkbox"/>
Again open receiving piping valves and start pump.	<input type="checkbox"/>	
Walk hose to pump to ensure all material is removed from hose.	<input type="checkbox"/>	<input type="checkbox"/>
When trailer is completely empty shut off pump and close receiving piping valves.	<input type="checkbox"/>	
Close trailer internal valve.		<input type="checkbox"/>
Close storage tank vapor exchange valve.	<input type="checkbox"/>	
Close vapor exchange valve on trailer.		<input type="checkbox"/>
Carefully relieve pressure from unload hose into catch container.		<input type="checkbox"/>
Close trailer external valve.		<input type="checkbox"/>



Disconnect hose from trailer and replace quick coupler plugs/caps on trailer and hose.		<input type="checkbox"/>
Disconnect hose from receiving tank piping and replace quick coupler caps/plugs on hose and receiving piping.	<input type="checkbox"/>	
Carefully relieve pressure from vapor hose and disconnect from trailer.		<input type="checkbox"/>
Disconnect vapor hose from receiving tank vapor piping.	<input type="checkbox"/>	
Return empty trailer with positive pad of dry air or N2.		<input type="checkbox"/>
Sign driver's paperwork, remove wheel chocks and barricades.	<input type="checkbox"/>	
Provide driver with instructions for departing your facility.	<input type="checkbox"/>	

## Appendix C: Example Checklists for Unloading Rail Tank Cars

This Appendix contains example checklists for rail tank car deliveries of MDI and the different methods for unloading. Due to variations in the configuration of facilities, the specific activities involved and/or the sequence in which they are conducted may differ from what is described in this Appendix.

The purpose of these example checklists is to demonstrate the complexity of the unloading operation and the need for a checklist to ensure the hazmat employee assigned to unload the tank car understands what is required to ensure the transfer is conducted safely. These example checklists may be used as a guide for developing your own site specific checklist.

The U.S. Department of Transportation (DOT) requires a rail tank car be protected against movement or coupling prior to unsecuring any closure on the car. This regulation states that the hazmat employee responsible for unloading a tank car must secure access to the track to prevent entry by other rail equipment, must place caution signs on the track to warn persons approaching the cars, must verify the handbrake is set on the car and must block at least one wheel of the tank car against movement in both directions (49CFR § 173.31(g)).

### Example Checklist for Rail Tank Car Unloading

DOT requirements for unloading rail tank cars of hazardous materials are outlined in Title 49 of the Code of Federal Regulations. Transport Canada's Clear Language regulations are found in Part 5.14(b) through reference to CGSB-43.147. Personnel involved in unloading rail tank cars containing hazardous materials must be trained and certified in accordance with 49 CFR § 172.700 – 704 or Part 6 of Transport Canada's Clear Language Dangerous Goods regulations as applicable. In addition to the regulations, the following are some general steps to consider:

	Receiver
Verify location and operation of nearest safety shower and eyewash.	<input type="checkbox"/>
Check rail tank car number (i.e., ABCX1234), shipping paperwork, product tag and placards to verify proper material is being received.	<input type="checkbox"/>
If heating is required, follow your company's procedure for heating rail tank cars.	<input type="checkbox"/>
Verify connection to proper receiving tank.	<input type="checkbox"/>
Verify adequate capacity in receiving tank for contents of rail tank car.	<input type="checkbox"/>
Record receiving tank inventory reading before and after unloading.	<input type="checkbox"/>
Set hand brake and chock wheels on car to be unloaded.	<input type="checkbox"/>
Apply required caution sign on lead end of track.	<input type="checkbox"/>
Secure access to track to prevent entry by other rail equipment, including motorized service vehicles. Derails, lined and blocked switches, portable bumper blocks or other equipment that provides an equivalent level of security may be used to satisfy this requirement.	<input type="checkbox"/>
Transfer hoses constructed of suitable materials may be included in an inspection and testing program in accordance with the hose manufacturer's recommendations. In addition, visually inspect hoses prior to each use.	<input type="checkbox"/>

Wear proper personal protective equipment (PPE) is for hook-up, any sampling, start of flow and disconnect activities.	<input type="checkbox"/>
Verify rail tank car is connected to proper receiving tank.	<input type="checkbox"/>
Verify rail tank car is attended by a qualified person throughout the transfer.	<input type="checkbox"/>

### Example Checklist for Pressure Transfer

This method uses dry air or nitrogen (N2) to pressure transfer material from the rail tank car to the storage tank. Generally this unloading method is accomplished with 15-35-psig. Vapor discharge from the receiving tank may need to be treated during normal unloading operations. Following are general steps for consideration in the pressure transfer process:

	Receiver
Satisfy steps in "Example Checklist for Rail Tank Car Unloading."	<input type="checkbox"/>
Inspect unload hose, gaskets and fittings.	<input type="checkbox"/>
Connect 2-inch product hose from rail tank car unloading valve to the receiving tank unloading piping. Secure quick coupler connections.	<input type="checkbox"/>
Connect regulated supply of dry air or N2 to rail tank car air inlet valve. Secure air hose connections.	<input type="checkbox"/>
Open receiving tank vent valve to suitable vapor treatment system.	<input type="checkbox"/>
Open valves in unload piping.	<input type="checkbox"/>
Slowly open rail tank car unloading valve and check for leaks.	<input type="checkbox"/>
Open valves in dry air or N2 supply and air inlet valve on rail tank car. Build dry air or N2 to required pressure.	<input type="checkbox"/>
Monitor car, unload hose, fittings and piping throughout transfer.	<input type="checkbox"/>
When rail tank car is empty, shut off dry air or N2 supply to car and close the car's unloading valve.	<input type="checkbox"/>
Let the car "drain" for a couple of minutes.	<input type="checkbox"/>
Again slowly open unloading valve to ensure all material is unloaded from car.	
When the unload hose and piping have been blown clear, close the rail tank car unloading valve and valves in receiving tank product and vent piping.	<input type="checkbox"/>
Carefully relieve pressure from unload hose into catch container. Disconnect hose and replace plugs/caps on hose and piping.	<input type="checkbox"/>
Carefully relieve pressure from air hose and disconnect from car.	<input type="checkbox"/>
Return empty car with positive pad of dry air or N2.	<input type="checkbox"/>
Ensure empty car is properly prepared for return shipment. This includes: closing all valves on car, removing all unloading connections, installing proper closure plugs/caps and making them wrench tight, closing valve cover hatch and inserting securement pin (49 CFR §173.31(d)).	<input type="checkbox"/>
Secure top hatch cover with tamper evident security seal.	<input type="checkbox"/>
Verify car is properly placarded.	<input type="checkbox"/>

Verify car is free of product residue on outside (49 CFR § 173.24(b)(4)).	<input type="checkbox"/>
Remove wheel chocks and rail warning sign.	<input type="checkbox"/>
Return unloading track to a position that can be accessed by railroad by removing derails, lined and blocked switches, portable bumper blocks or other equipment that was installed to prevent access to the unloading track.	<input type="checkbox"/>
Offer empty car for return shipment.	<input type="checkbox"/>

### Example Checklist for Pump Transfer with Pressure Assist

This method utilizes the receiver’s pump to transfer material from the rail tank car to the receiving tank. A small amount of dry air or nitrogen (N2) pressure is added to the rail tank car to maintain product supply to the pump and to replace the liquid volume being pumped out. Vapor discharge from the receiving tank may need to be treated during normal unloading operations. Following are general steps for consideration in the pump transfer with pressure assist process:

	Receiver
Satisfy steps in “Example Checklist for Rail Tank Car Unloading.”	<input type="checkbox"/>
Connect 2-inch product hose from rail tank car unloading valve to suction side of unloading pump. Secure quick coupler connections.	<input type="checkbox"/>
Connect regulated supply of dry air or N2 to rail tank car air inlet valve. Secure air hose connection.	<input type="checkbox"/>
Open receiving tank vent valve to suitable vapor treatment system.	<input type="checkbox"/>
Open valves in pump suction and discharge piping.	<input type="checkbox"/>
Slowly open rail tank car unloading valve and check for leaks.	<input type="checkbox"/>
Open valves in dry air or N2 supply and air inlet valve on rail tank car. Build dry air or N2 to required pressure.	<input type="checkbox"/>
Start pump and continue pumping until rail tank car is empty.	<input type="checkbox"/>
Monitor car, unload hose, fittings and piping throughout transfer.	<input type="checkbox"/>
During transfer, make periodic checks to ensure positive pressure is maintained in the rail tank car.	<input type="checkbox"/>
When the rail tank car starts to flow empty, the hose will become lighter and may “jump”. The pump discharge pressure gauge will show a decrease in pressure.	<input type="checkbox"/>
Shut off pump and close valves in receiving piping.	<input type="checkbox"/>
Let car “drain” for a couple of minutes.	<input type="checkbox"/>
Again open valves in receiving piping and start pump.	<input type="checkbox"/>
Walk hose toward the pump to ensure all material is removed from hose.	<input type="checkbox"/>
When the rail tank car is completely empty, shut off pump, close rail tank car unloading valve and close valves in receiving tank’s product and vent piping.	<input type="checkbox"/>
Close dry air/N2 supply valve and rail tank car air inlet valve.	<input type="checkbox"/>
Carefully relieve pressure from the unload hose into catch container and disconnect it from car. Replace quick coupler plugs/caps on hose and piping.	<input type="checkbox"/>

Carefully relieve pressure from air hose and disconnect from the car.	<input type="checkbox"/>
Return empty car with positive pad of dry air or N2.	<input type="checkbox"/>
Ensure empty car is properly prepared for return shipment. This includes: closing all valves on car, removing all unloading connections, installing proper closure plugs/caps and making them wrench tight, closing valve cover hatch and inserting securement pin (49 CFR § 173.31(d)).	<input type="checkbox"/>
Secure top hatch cover with tamper evident security seal.	<input type="checkbox"/>
Verify car is properly placarded.	<input type="checkbox"/>
Verify car is free of product residue on the outside (49 CFR § 173.24(b)(4)).	<input type="checkbox"/>
Remove wheel chocks and rail warning sign.	<input type="checkbox"/>
Return unloading track to a position that can be accessed by railroad.	<input type="checkbox"/>
Offer empty car for return shipment.	<input type="checkbox"/>

### Example Checklist for Pump Transfer with Vapor Exchange

This method utilizes the receiver’s pump to transfer material from the rail tank car to the receiving tank. The vapor space of the receiving tank and rail tank car are equalized so pad pressure remains constant in both the tank and car throughout the transfer. Following are general steps for consideration in the pump transfer with vapor exchange process:

	Receiver
Satisfy steps in “Example Checklist for Rail Tank Car Unloading.”	<input type="checkbox"/>
Connect 2-inch product hose from rail tank car unloading valve to suction side of unloading pump. Secure quick coupler connections.	<input type="checkbox"/>
Connect 2-inch vapor hose from rail tank car vent valve to receiving tank vapor return piping. Secure quick coupler connections.	<input type="checkbox"/>
Open valves in pump suction and discharge piping and slowly open rail tank car unloading valve. Check for leaks.	<input type="checkbox"/>
Allow pad pressure in rail tank car to prime pump, then open valves in vapor exchange system and vent valve on rail tank car.	<input type="checkbox"/>
Start pump and continue pumping until rail tank car is empty.	<input type="checkbox"/>
Monitor car, unload hose, fittings and piping throughout transfer.	<input type="checkbox"/>
During transfer, make periodic checks to ensure positive pressure is maintained in the rail tank car.	<input type="checkbox"/>
When rail tank car is empty, the hose will become lighter and may “jump.” The pump discharge pressure gauge will show a decrease in pressure.	<input type="checkbox"/>
Shut off pump and close the rail tank car unloading valve.	<input type="checkbox"/>
Let car “drain” for a couple of minutes.	<input type="checkbox"/>
Again slowly open unloading valve and restart pump.	<input type="checkbox"/>
Walk hose toward pump to ensure all material is removed from hose.	<input type="checkbox"/>

When the car is empty turn off pump, close rail tank car unloading valve and all valves in unload piping.	<input type="checkbox"/>
Close rail tank car vent valve and valves in vapor exchange system.	<input type="checkbox"/>
Carefully relieve pressure from unload hose into catch container.	<input type="checkbox"/>
Carefully relieve pressure in vapor hose.	<input type="checkbox"/>
Disconnect both hoses and replace plugs/caps on hoses and piping.	<input type="checkbox"/>
Return empty car with positive pad of dry air or N2.	<input type="checkbox"/>
Ensure empty car is properly prepared for return shipment. This includes: closing all valves on car, removing all unloading connections, installing proper closure plugs/caps and making them wrench tight, closing valve cover hatch and inserting securement pin (49 CFR § 173.31(d)).	<input type="checkbox"/>
Secure top hatch cover with tamper evident security seal.	<input type="checkbox"/>
Verify car is properly placarded.	<input type="checkbox"/>
Verify car is free of product residue on outside (49 CFR § 173.24(b)(4)).	<input type="checkbox"/>
Remove wheel chocks and rail warning sign.	<input type="checkbox"/>
Return unloading track to a position that can be accessed by railroad.	<input type="checkbox"/>
Offer empty car for return shipment.	<input type="checkbox"/>



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