

# Guidelines for Freight Securement: Freight Loading and Securement for Chemical Shipments in the Polyurethane Industry

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## Purpose

This guidance document is intended to provide basic principles and examples of freight loading and securement for intermodal domestic and international shipments. This document references some, but not all, regulatory and/or modal requirements governing these shipments. Please consult with your company's regulatory experts and legal staff to understand your legal obligations.



Center for the  
Polyurethanes Industry

## Introduction

The U.S. Department of Transportation (DOT) in 49 CFR [Parts 171-180](#) and the Federal Motor Carrier Safety Administration (FMCSA) in [Parts 350-399](#) regulates loading, freight securement and offering of chemical shipments such as those used in the polyurethane industry. Modal requirements can be found in Part 174 for rail, Part 176 for water, and Part 177 for highway.



While this guidance document does not address shipments by air, there are additional requirements for international shipments, such as those for air shipments that can be found in 49 CFR Part 175 and in the [International Civil Aviation Organization's \(ICAO\) Technical Instructions](#).

When shipping by water, consider referring to either 49 CFR Part 176 or the [International Maritime Organization's \(IMO\) regulations](#).

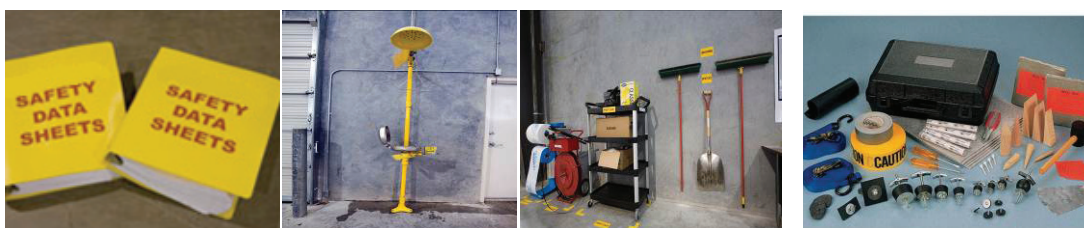


There are additional trade associations that have mandatory requirements for air and water, such as the [Association of American Railroads \(AAR\)](#), [International Air Transport Association \(IATA\)](#) and the [International Maritime Dangerous Goods \(IMDG\) Code](#).

The following information addresses some of a company's considerations under the aforementioned regulations and codes, but remember to contact the agency or trade association for additional information.

## Safety

Prior to beginning the loading process, make all safety equipment needed for loading readily available and staged in close proximity to the loading area.



*This equipment may include: Safety Data Sheet (SDS), formally known as Material Safety Data Sheet (MSDS) for each product handled, safety shower and eye wash stations, emergency spill cleanup equipment as shown above.*



*Personal Protective Equipment (PPE) for use in the event of an unintentional release. The above photo illustrates a full body suit and air purifying mask for respiratory protection.*

## Preload Inspections of Trailers and Containers

A checklist may be used to verify that the trailer or container is suitable for loading and highway transportation. Contents of the checklist may vary depending upon each company's practices, mode of transportation, and their specific needs.

Prior to loading a trailer or container, conduct a walk-around inspection to verify the walls, support rails, and lifting corner posts are in good condition. The following pictures depict some of the areas of interest for the inspection.

Check the door closure devices for proper working order.



*The left photo illustrates a door on a van trailer. The right photo illustrates a door on an export container.*

After a trailer or container has been parked at the loading dock, take measure to prevent accidental movement, for example, use wheel chocks. If the tractor has been disconnected from the trailer or container, then additional supporting mechanisms, such as a jack stand, can be used to support the front of the trailer during the loading/unloading process. Remember to install the jack stand in accordance with the manufacturer's instructions.



*The first photo demonstrates the use of wheel chocks. The other photos demonstrate the use of a jack stand to support the front of the trailer.*

Inspect the inside of the trailer to verify it is free of insects and debris, and to see if the floors, walls, ceilings and doors are in good condition. For security reasons, inspect the trailer to verify there are no false bulkheads that could conceal illegal contraband.



*The above photos illustrate how to inspect a trailer.*

Ensure doors are in good working condition and capable of being closed and secured without affecting the load during transit.



*The above photo illustrates an inspection of the trailer doors.*



Conduct an internal inspection to determine that walls, roof and floor are in good condition and suitable for loading. Defects to consider looking for may include but are not limited to:



*Roof (free of holes and cracks)*



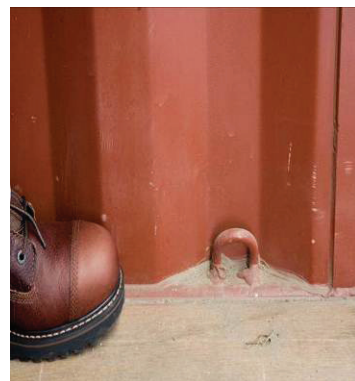
*Floor boards (loose, broken boards)*



*Walls (loose or broken walls or scuff boards)*



*A shovel or the flat side of a squeegee can be used to detect protruding nails or screws in the floor of the trailers. Remove nails, screws, or imbedded sharp objects prior to loading.*



*Inspect tie down loops to see that they do not protrude into the drum storage area. This is a common cause of damage to drums while in transit. If they protrude, readjust so they are positioned within the trailer walls.*

## Planning and Loading

Freight shipped in Less than Truckload (LTL), Truckload (TL) or Intermodal containers requires specific load planning. In all shipping modes, take the following items into consideration:

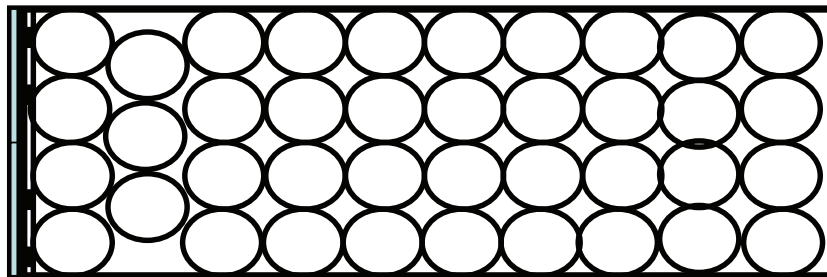
- Mode(s) of transportation
- Customer specific delivery requirements (e.g., palletized versus non-palletized or required temperature controls, etc.)
- Size and type of container
- Weight restrictions for the highway portion of the transport

## Weight Restrictions for the Highway Portion of the Transport

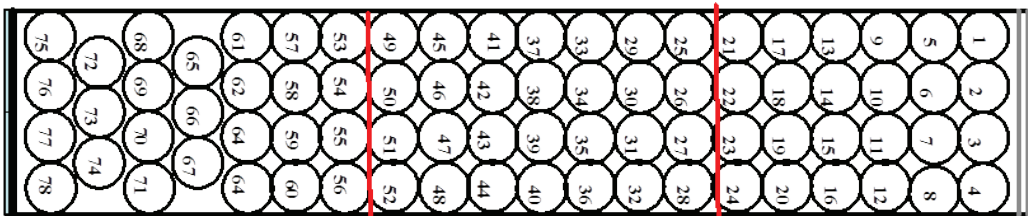
Consider the size of the container to be loaded, e.g. 20-53 foot highway van trailers or 20-40 foot intermodal freight containers.



Establish a loading plan that provides maximum freight protection and proper distribution of weight in the trailer. It is important to consult with the driver during this process to ensure proper weight distribution. Below are examples of trailer and container loading diagrams.

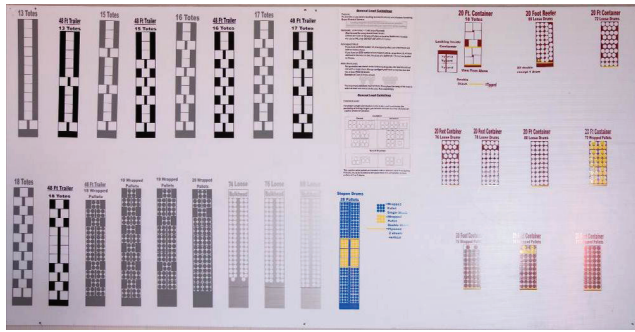


*The above diagram is an example of common loading pattern for 20 ft. export container.*



*The above diagram is an example of common loading pattern for 40 ft. export container.*





*The above diagram is a sample loading guide. A chart near the loading area is a helpful guide to illustrate various loading types.*

When preparing to load a container with other freight already on board, determine if the freight on board is secure and compatible with the freight being prepared for loading (49 CFR 177.834 and 49 CFR 177.848). Proper dunnage materials such as airbags, cardboard, plywood, foam, rubber friction mats or other suitable materials can provide a safe method of securing freight.



*The above photos show the use of dunnage materials to secure freight.*

Once the material has been identified and staged for loading, perform a final inspection to see that it is marked, labeled and in proper condition for transportation (49 CFR Parts 173,174,175,176,177).



*The above photos are of employees performing a final inspection.*



Drums are either loaded directly on the floor of the trailer or placed on pallets and then loaded into a trailer. Maintain loading equipment and inspect prior each use.



*The photo on the right illustrates drums placed on a pallet prior to moving by a forklift. The photo on the left illustrates the use of a 4 drum picking device, which uses “parrot beak” grabbers to lift the drums by their top chimes. These devices are commonly designed for lifting either 2 or 4 drums.*

Total gross weight capacity of the export containers are stenciled on the exterior of the container doors. For trailers or containers, calculate the weight of pallets, bracing, dunnage and miscellaneous items to secure the freight to avoid exceeding the maximum allowable weight for transport. Refer to US Department of Transportation Federal Highway Administration (23 USC 127 and 658) for such information.

The image shows a close-up of an orange metal container door. At the top, the code '42G1' is stenciled. Below it, there are two columns of stenciled text. The left column lists categories: 'MAX.GROSS', 'TARE', 'MAX.PAYLOAD', and 'CUBE'. The right column lists the corresponding values in both kilograms (kg) and pounds (lbs) for weight, and in cubic meters (m³) and cubic feet (cuft) for volume.

|                    |  |
|--------------------|--|
| <b>42G1</b>        |  |
| <b>MAX.GROSS</b>   | <b>32.500 kg</b><br><b>71.650 lbs</b>          |
| <b>TARE</b>        | <b>3.980 kg</b><br><b>8.770 lbs</b>            |
| <b>MAX.PAYLOAD</b> | <b>28.520 kg</b><br><b>62.880 lbs</b>          |
| <b>CUBE</b>        | <b>67.7 m<sup>3</sup></b><br><b>2.390 cuft</b> |

*The above photo is of a typical export container door.*

When loading trailers in excess of 40 foot in length, it may be necessary to install a bulkhead to distribute weight within the trailer. One method used is collapsible “A” Frames, which help distribute the weight properly.



*The above photos demonstrate how to install and use “A frames”.*

Another method for constructing a bulk head for weight distribution is the use of pallets and plywood.



*The above photos demonstrate the use of pallets and plywood.*

Prior to transporting drums on pallets, shipper considerations include:

- Gross weight of drums being palletized.
- Selection of pallet to support the drums under conditions normal transportation.
- Method of securing drums to the pallet to prevent movement under normal transportation conditions.
- Method of adequately securing the palletized load to prevent movement of the shipment under conditions normal to transportation.
- Modal regulations for freight securement such as; 49 CFR 173.24(b); 174.55; 176.76; 177.834(a) and 393.100.



*Although the drums in the photo above are properly secured to the pallet, they are substantially overhanging the pallet which could result in damage to the drums during transportation.*



*The above photo shows drums properly palletized and secured.*



When placing the drums in the containers, rest drums on the flat surface and not on top of the adjacent drums. Overlapping chimes can lead to damage and/or leaks in transit.



*The above photo is an example of overlapping chimes, which could lead to damage and/or leaks in transit.*

## Restraint Systems

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This section provides information on several restraint systems used to prevent damage during transport. The type of restraint system used depends on a number of factors, including the following: the material being transported, packaging type, the mode(s) of transport selected and any applicable national, international or modal-specific laws and regulations. (49 CFR 393.100-136)

There are many types of restraint systems commercially available. This section provides examples of several commonly used restraint systems, including but not limited to: adhesive-backed laminated fabric (such as TyGard™), nylon strapping, wood blocking and bracing, telescoping metal bar system, and palletizing drums. Prior to using any freight securement system, check with the manufacturer for proper use. The trademark products referenced in this section are commonly used for freight securement and their mention here as an example is not an official endorsement of these products.

### Adhesive-Backed Laminated Fabric

TyGard™ is an example of an adhesive backed laminated fabric system that can be used to immobilize domestic and international freight.

#### Van Trailer (Domestic Highway)



*Prior to the application, check the trailer walls to see if clean and free of debris so that system can adhere to walls as set forth in the manufacturer's instructions.*





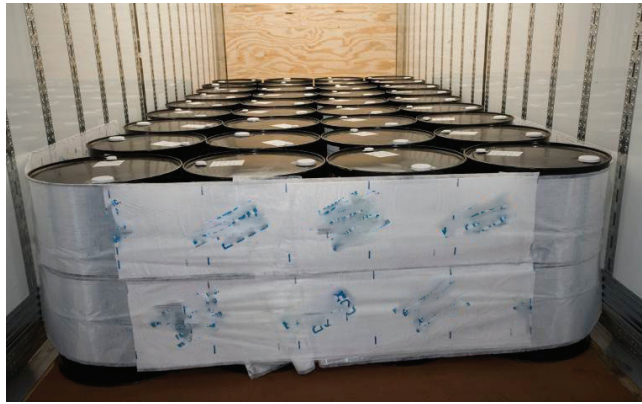
*After the freight is loaded inside the trailer, the two end pieces of the adhesive-backed laminated fabric are joined together and tightened with the appropriate tool. Take care to not over tighten.*



*Once tightened, an adhesive-backed laminated patch (such as TY-Patch 2000™) is placed over adjoined ends to secure in place.*



*As illustrated in the photo above, corrugated paper or plywood sheets can be placed on the floor of the trailer prior to loading to prevent lateral or circular movement of the drum, which may reduce the risk of damage to the drums during transit.*



*Photo shows a trailer with installed adhesive-backed laminated fabric restraint system.*

### Intermodal Freight Container

If any portion of the shipment involves rail transportation of regulated materials, then review the AAR Intermodal Loading Guide for Closed Trailers and Containers, which requires the shipment to be secured at the mid and final loading positions. The AAR Manual has been adopted by the DOT and incorporated by reference. The AAR Manual freight securement document covers DOT non-regulated as well as DOT regulated materials. It also states that single securement in the back of the trailer after loading is acceptable for non-regulated materials.



*In accordance to the manufacturer's application instructions, check the container walls to see if clean and free of debris so that system can adhere to walls.*



*The photo above illustrates drums double stacked in a 20 ft. container with mid-point securement completed. The photo illustrates final securement completed.*



*In the photo above, plywood sheets are placed on the floor of the container prior to loading, which can reduce the risk of damage to the drums during loading and transit.*



*Photo shows a container with installed adhesive-backed laminated fabric restraint system.*

## Nylon Strapping

The tensile strength of nylon strapping varies based on thickness and width. Consult the manufacturer to determine which strapping is the appropriate tensile strength for this application.



## Van Trailer (Domestic Highway)

Nylon strapping can be used to unitize a group of drums or secure drums to a pallet in a van trailer.



*Photo shows drums secured using nylon strapping.*

## Intermodal Freight Container

Nylon strapping can be readily attached to the container's sidewalls or floors and assist in unitizing the load and preventing movement within the container. Consult AAR ([www.aar.org](http://www.aar.org)) requirements to determine if this restraint system is approved for the package and/or product being shipped.



*A strapping system is demonstrated above.*



Some key points in installation include, but are not limited to the following: ensuring the “D rings” are not broken; location of buckles are not in physical contact with the loaded drum; the vertical straps are secured at the appropriate tension, the horizontal straps are maintained at the appropriate height to facilitate proper securement of the freight. Consult the manufacturer for complete installation guidelines.



*The photo above shows a container with installed nylon strapping restraint system.*

## Wood Blocking and Bracing

The type and size of wood used for blocking and bracing varies based upon the weight and size of freight being restrained. Wood blocking may be used on the floor of a van trailer for blocking and bracing. For international shipments, the wood may be required by International Plant Protection Convention (IPPC) to be heat treated and marked in conformance.



*Above is wood that has been heat traced and marked in conformance.*

## Van Trailer (Domestic Highway)



*The photo above illustrates the use of wood for blocking a unitized set of drums loaded on the floor of a van trailer. Steel banding was used to unitize the drums.*



*The photos above illustrates an adhesive backed bracing system used in conjunction with wood to secure freight. With all adhesive backed systems, consult the manufacturer's instructions for guidance, including how best to clean the walls.*

## Intermodal Freight Container

Container doors are not permitted by AAR Intermodal Circulation Guide 43-D paragraph 5, as a means of freight securement. A commonly used method for freight securement involves the use of wood as indicated in the picture below. Due to mode and carrier specific requirements, consider contacting each carrier involved in the transport regarding their specific requirements.



*When using this method of wood blocking and bracing, leave sufficient space for inspectors to see a product label.*

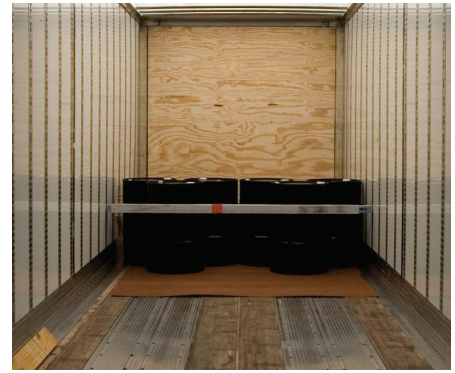
## Telescoping Load Bars

Telescoping load bars with locking devices are commonly used as restraint systems in domestic highway transportation. These devices are constructed of metal tubular or square bars that are telescoped into place to obtain sufficient tension.



*The above photo illustrates the placement of a load bar. Corrugated paper or plywood sheets can be placed on the floor of the trailer prior to loading to prevent lateral or circular movement of the drums.*





*The above photos illustrate trailers that are equipped with a mechanical locking system to secure freight in place.*

## Palletizing Drums

Regardless of shipping mode, drums shipped on pallets must be secured to prevent vertical and horizontal movement as specified by 49 CFR 393.100-136.



*The above photos show the use of steel and nylon banding to secure drums to a pallet. Steel and nylon banding are typically used for securing drums to pallets and tightened into place using a ratcheting device to which a clamp is crimped to hold the metal banding in place. The nylon banding typically uses a buckle for securement. Use caution when tightening the bands, over or under tightening could result in damage to the drums.*

Stretch wrap is another method that may be used to secure drums. During the application process, the stretch wrap is tightly wrapped around the drums and pallet. This method is used to prevent movement of drums when transported on pallets.



*The photo above shows the use of stretch wrap to secure drums to a pallet.*



## Closure of the Transport Container

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This section discusses methods to verify the transport container is closed and secured prior to offering the container for transportation. Review your company's transportation security plan for the use of security seals.



*The photos above show examples of commonly used security seals. The type of seal used will vary based on company requirements, mode of transportation and origin/destination regulations.*

After the freight is loaded and doors secured, see if placards required by 49 CFR 172.500 and markings required by 49 CFR 172.300 are properly affixed to the transport container.

Review the shipping documents and rules as set forth in 49 CFR 172.200 and 173.30.



*Above photo shows the required placard affixed for a shipment of TDI.*

## Additional Information

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**For further information on freight securement, consult the following sources:**

US Department of Transportation Hazardous Materials Regulations:

<http://www.access.gpo.gov/cgi-bin/cfrassemble.cgi?title=200849>

Federal Motor Carrier Safety Administration:

[http://www.access.gpo.gov/nara/cfr/waisidx\\_08/49cfrv5\\_08.html#301](http://www.access.gpo.gov/nara/cfr/waisidx_08/49cfrv5_08.html#301)

## Legal Notice

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These Guidelines were prepared by the American Chemistry Council's Center for the Polyurethanes Industry. It is intended to provide general information to professional persons who may be responsible for securing and transporting chemicals related to the polyurethanes industry. It is not intended to serve as a substitute for in-depth training or specific handling or securement 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 securing and transporting chemicals 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. These guidelines are 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. Any mention of specific products in these guidelines are for illustration purposes only and is not intended as a recommendation or endorsement of such products. Many items in this document may be trademarked, which may or may not be noted in this document. 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 manual; 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 these Guidelines. NO WARRANTIES ARE GIVEN; ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY EXCLUDED.

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