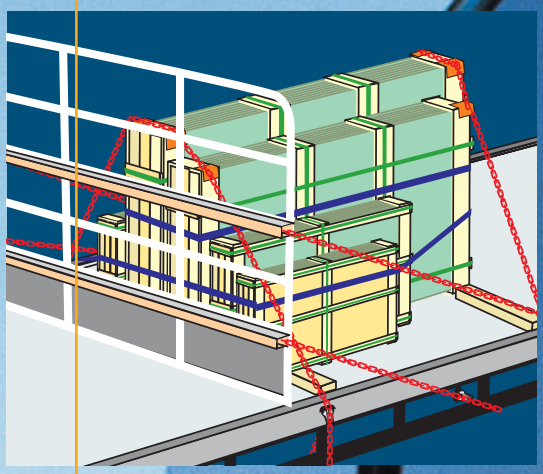
ARTSA

AUSTRALIAN ROAD TRANSPORT SUPPLIERS ASSOCIATION

Design of Vehicle Body Systems for Load Restraint Compliance



Foreword

The Australian Road Transport Suppliers Association Inc. (ARTSA) is an industry Association with over 35 members from the component and Original Equipment Manufacturers (OEM) sector. It is focused on providing technical expertise and representation to improve safety, productivity and efficiency in many aspects of the road transport vehicle industry.

ARTSAs interests cover vehicles and their components used in all aspects of the road freight transport and road passenger transport industries. ARTSA provides advice and support to members, regulatory agencies and other transport industry bodies concerning a range of issues. It also provides information in the form of explanatory codes on topics such as air suspension, braking, performance based standards, and load restraint.

This publication has arisen from a close working relationship between ARTSA and the National Transport Commission (NTC). Both organizations felt that there was a need for an easy to read guide to certifying vehicles and structures for load restraint compliance for the road transport sector. ARTSA took on this task with financial assistance from the NTC.

Ian Wright of Ian Wright and Associates undertook overall preparation and illustrated this publication from material and input supplied by ARTSA members and contributors, including Barker Trailers, BlueScope Steel, Haulmark Trailers (Australia), Krueger Transport Equipment, Loadsafe Australia, Matthews International, Maxitrans, Polyweld, Toll Shipping, and Vawdrey Australia.

ARTSA makes no claims or representations concerning the performance of any vehicle body or load restraint system, nor concerning the compliance of any such system with regulatory requirements. Systems shown in this guide are intended to be examples and illustrate load restraint principles; responsibility for the performance and compliance of all systems rest with their manufacturers and with vehicle manufacturers. All liability is expressly disclaimed. ARTSA does not guarantee the accuracy of the information on its website. Hyperlinks to other websites do not imply responsibility or approval of information contained in these websites

This guide illustrates vital innovation in vehicle body systems for restraining loads in an era of improved OH&S practices. It is hoped that this guide will encourage further innovation.

A steering committee headed by Ian Bushby of DECA Training oversaw the development of this guide and all are due considerable thanks.

Information on the Australian Road Transport Suppliers Association can be found at http://www.artsa.com.au or by contacting its Executive Officer on exec@artsa.com.au

Dr Peter Sweatman

Chairman
Australian Road Transport Suppliers Association Inc.
Melbourne

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Disclaimer:
This document is intended to guide the reader in the application of Performance Standards (as set out in the Australian Load Restraint Guide) in the design and compliance of vehicle body systems for normal on road use. Alternative, and more stringent, arrangements may be required for some applications.

ARTSA recommends specific guidance from an approved assessor. This general explanatory document cannot be relied on to prove load restraint compliance. ARTSA make no claims or representations concerning the performance of any vehicle body or example system shown. Applicants should also check with the local road authority and local legislation for the current load restraint approvals process.

Formed in 1993, **ARTSA** provides a national focus for transport suppliers, operators and government agencies to share expertise for the benefit of the Australian road transport industry.

ARTSA is the combined technical resource for improved safety, environment and productivity. This resource is available to government agencies, transport operators and standards organisations.

ARTSA values its relationships with all stakeholders in the transport industry and provides factual and balanced information.

Dr. Peter Sweatman
Chairman ARTSA

ARTSA membership is broad-based and includes:

- Truck manufacturers
- Trailer manufacturers
- Component manufacturers
- Fuel suppliers
- Driver trainers
- Vehicle repairers
- Test equipment manufacturers
- Providers of testing and compliance services
- Insurance service providers

ARTSA activities include:

- Codes of Practice
- Conference and workshops
- Research
- Scholarships

ARTSA's activities are managed by an Executive Officer who may be contacted at:

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Introduction

A common statement following a heavy vehicle accident is that the "load shifted". In recent years research has been carried out to better understand and reduce load shifting during transit on heavy vehicles.

All States and Territories now have the performance based load restraint legislation. Some of the issues in interpreting this legislation in particular cases include:

1. The intended use of the vehicle and the type of loading. Design assumes a specific strength for intended use.
2. Who is responsible, after a vehicle is sold, for continuing compliance, when operating conditions could become more demanding?
3. In-service issues.
4. Risks associated when using unmarked and uncertified "after-market" equipment.
5. Other existing codes and standards that may need to be considered in some cases. This refers in particular to loaded road vehicles carried by other transport modes such as rail and sea.
6. The ability of curtain-sided vehicles to offer load restraint and load containment.
7. Acceptable test methods for demonstrating load restraint and load containment compliance of vehicle bodies.

Purpose of Guide

The intention of this guide is to explain procedures and practices that will assist the vehicle designer; the body manufacturer and the transport operator identify options for improved safe loading before a new vehicle body purchase.

The Australian Road Transport Suppliers Association (ARTSA) membership includes not only heavy vehicle manufacturers, but also many major component manufacturers and suppliers to the Australian heavy vehicle market. ARTSA sees this guide as a positive step to improving wider understanding of vehicle body systems design as it affects load safety. ARTSA makes no claims concerning the performance or compliance of any example systems shown in the document. Systems shown are intended to illustrate load restraint principles. Regulatory compliance and performance responsibilities rest with the body and restraint systems manufacturers and with vehicle manufacturers.

Vehicle Safety & Operating Performance

All vehicle body and restraint or containment systems MUST meet vehicle manufacturers' requirements for:
(i) structural integrity of the vehicle and
(ii) safe on-road performance of the vehicle.

National Legislation

Code of Practice Heavy Vehicle Modifications – VSB6. This document is called up in National and State legislation and contains a range of requirements that should be taken into account when considering vehicle body and anchor point attachments.

Many heavy vehicles are also modified after first registration. States and Territories have developed procedures to control such modifications and a single, national code of practice serves the requirements of both Federal and State/Territory authorities.

VSB 6 sets down national technical requirements that provide the Administrator of Vehicle Safety Standards and Vehicle Registering Authorities in the States and Territories with an assurance that modifications to heavy vehicles result in continuing compliance with:

- The Australian Design Rules (ADRs) applicable at the vehicle's date of manufacture; and
- Other requirements of all Registering Authorities
- Adequate levels of vehicle operational safety.

Load Restraint Guide – Second Edition 2004. This document is called up in all State and Territory legislation. The guide not only sets out comprehensive load restraint underlying principles but also includes the performance standards (forces) that complying load restraint systems must meet for the safe carriage of all loads, with the exception of the extremely heavy permit loads.

Restraint Guide Performance Standard

The Load Restraint Guide states: Loads must be restrained or contained to prevent unacceptable movement during all expected conditions of operation. The load restraint or containment system must, therefore, satisfy the following requirements:

(i) The load should not become dislodged from the vehicle.

(ii) Any load movement should be limited, such as that in all cases where movement occurs, the vehicle's stability and weight distribution are not adversely affected and the load cannot become dislodged from the vehicle. Loads that are permitted to move relative to the vehicle include loads that are effectively contained within the sides or the enclosure of the vehicle body such as:

(a) Loads which are restrained from moving horizontally (limited vertical movement is permissible)

(b) Very lightweight objects or loose bulk loads (limited horizontal and vertical movement is permissible);

(c) Bulk liquids (limited liquid movement is permissible).

To achieve this, the load restraint system must be capable of withstanding the forces that would result if the laden vehicle were subjected to each of the following separately:

0.8 'g' deceleration in a forward direction,

0.5 'g' deceleration in a rearward direction,

0.5 'g' acceleration in a lateral direction,

and to 0.2 'g' acceleration relative to the load in a vertical direction.

Note: *'g' (the acceleration due to gravity), is equal to 9.81 metres/sec/sec for the purpose of these standards.*

Vehicle & Load Type Selection for Common Transport Applications

The range of road transport applications, as described in the Load Restraint Guide, is large and requires accurate description by the transport operator and clear understanding by the vehicle builder. The intention is to specifically address material that is usually loaded and unloaded by mechanical means, typically a fork-lift or crane, with the load to be contained by the vehicle body, or by a suitable method for blocking the load, particularly in the forward direction.

Design for Containing or Blocking

Part 2, Section F 4, Page 199 of the Load Restraint Guide sets out the following advice for assessing restraint capacity. A definition for contained loads is at page 247 Section J.

> When designing for containing or blocking of loads if there is no tie-down (ie indirect restraint) to resist the vertical 0.2 "g" nominated in the Performance Standards, the effect of friction between the deck and the load and between layers of load must be neglected in assessing restraint capacity. This is because when the vehicle hits a bump, the resulting jolt can break the friction contact between the items of load. Even a load resting on very high friction rubber load mat can "walk" to the low side of the trailer during a journey, if it is not tied down.
>
> The effect of a raised side coaming rail must be neglected when assessing restraint capacity, if the load is not tied down as the load could jump over the coaming in a bump.
>
> When designing vehicle structures such as headboards, loading racks, barriers, curtain-sides, side gates and drop sides the following "loading cases" should be taken into account:

Common freight types include:

- Stable single load – restraint forces hold the lower part of the item, or the body structure supports the load evenly over the height of the load. A single load in this definition is a single item or a unitised number of items placed in a single layer on the vehicle floor. Examples would include palletised items wrapped or strapped to the pallet, or strapped packs such as bricks. Items loosely stacked on pallets cannot be considered a "single load" no matter how much friction is between them. They must be considered single items.
- Unstable single load – restraint forces distributed unevenly over the height of the load.
- Stacked load – restraint forces distributed evenly over the height of each load item. A load with a number of loose single items or unitized packs of items stacked on top of each other, including pallets stacked 2 high, loose cartons and stretch-wrapped pallets.
- Point load – restraint force acts at the point of contact with the load.
- Loose bulk load – restraint forces are evenly distributed over the height of the load. A loose load that cannot be stacked.
- Impact load – restraint forces could be very high (simulation or testing required)

> ***NOTE:*** *Granulated materials "contained" in vehicles or containers that are commonly known as bulk loads, such as tippers and tankers are not addressed in this document.*

To satisfy the Performance Standards the side restraint system must not only prevent the load dislodging from the vehicle, but also must <u>not allow</u> the load to shift in such a way that makes the vehicle unstable.

Contained loads

Contained loads should be packed tightly together within the vehicle's body or sides to prevent any horizontal movement. Where loads cannot be packed tightly together, they must be restrained or blocked if their movement could cause the vehicle to become unstable or the load to dislodge.

Load separators, such as empty pallets, tyres, shoring bars or dunnage, including dunnage bags, should be used where necessary to restrain individual items within the load and to protect fragile items from damage. Surrounding them with larger items may assist in containing smaller items.

Where a load is carried in an open body without any vertical tie-down, the top of each item of load should be well below (by approximately 300mm, depending on vehicle type, suspension type and body length) the top of the sides or gates. This is intended to prevent the load from becoming dislodged over bumps and vibration caused by rough road surfaces, especially on corners. Standard coaming rails are not high enough to ensure that loads do not dislodge under these conditions. Higher sides or gates are required for vehicles with stiff suspensions that cause a rough ride.

Loads that might 'bounce' as a result of road bumps should always be tied down. These items include vehicles and equipment on pneumatic tyres and/or springs and objects that bounce when dropped on a rigid surface.

Tarpaulins and nets can be used to provide vertical restraint for light loads contained in open sided bodies to counteract the effect of airflow and rough roads. Side curtains may be used to contain loads provided that the vehicle body and curtain system are certified for the particular application and mass.

Incorrect loading in a freight container can adversely affect the carrying vehicle's weight distribution or stability, especially if the load is able to shift during transport. The load should be arranged so that its weight is evenly distributed over the floor and packed tightly against the walls of the container. To be aware of any uneven distribution of load weights, drivers should ask the consignor for information on the packing of the container. New legislation may hold consignors legally liable for accurate description of container loading eg; load weight, uneven weight distribution.

Any general freight container with uneven weight distribution (more than 60% of the load in less than half its length) should be clearly marked by the consignor with a centre of mass cargo symbol, to enable any necessary special precautions to be made for its transport.

Lightweight objects should be placed on top of heavier objects to keep the centre of mass of the vehicle as low as possible. The load should not exceed the manufacturer' s rated load capacity of the container or carrying vehicle, or cause the vehicle to exceed the legal axle loads unless operating under a special permit.

Secondary Containment

Secondary containment is required where some commodities are capable of "separating" or breaking from packs or unit loads. A tragic and real example can be found in accident records where one single house brick vibrated loose then bounced into an oncoming car causing a serious accident.

The size and weight of items such as bricks, firewood or dunnage must be considered when designing a secondary containment system for such loads. Secondary containment is not required to hold a large amount of force and can be made up of flexible material such as netting, canvas or tarpaulin materials around the base of the load.

Load Shift & Loss of Stability

Load shift and loss of vehicle stability can cause vehicle rollover. All loads should be packed firmly and tightly in the vehicle body "containing" the load. If the load does not fill all available space, then restraint, blocking or filling the empty spaces is required.

If loads are not loaded and packed tightly inside a vehicle body such as the pallets of tiles, then substantial load shift can occur. The body type does not matter as the load can commence moving sideways, causing a rollover.

In this example there are no restraints or dunnage in this container to stop pallets of tiles from shifting.

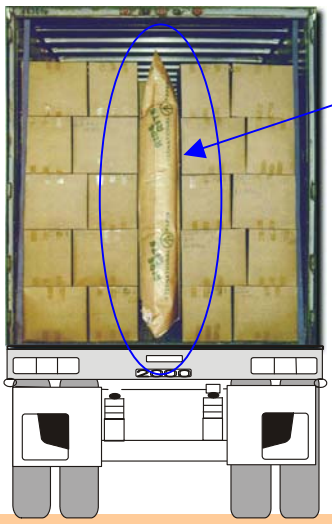
Blocking and bracing options have not been considered at all in this example. Whilst the example is from a container accident, the same principle applies to ALL loads of multiple items.

In addition to not having any restraint, blocking or bracing, the pallets themselves have been insufficiently restrained with very light strapping materials.

If boxes of tiles are unitised, the "unit" must have sufficient strength to hold itself together.

This example shows how un-restrained loading can commence movement that cannot be contained by any type of vehicle body.

Good Practice



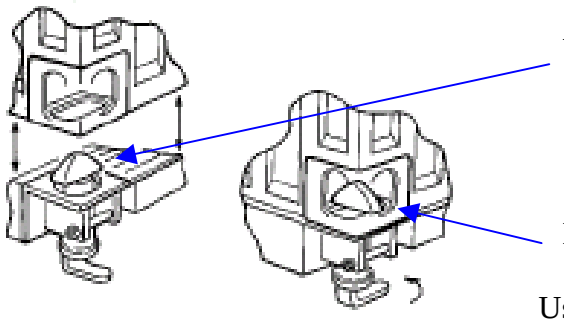
Air filled dunnage bags are an efficient and cost effective means of keeping many load types from moving and causing load shift.

A wide range of container and vehicle sidewall fittings are available, including webbing straps, bars, timber bracing and adjustable metal cross-bracing fitted with high friction ends to reduce slippage and movement.

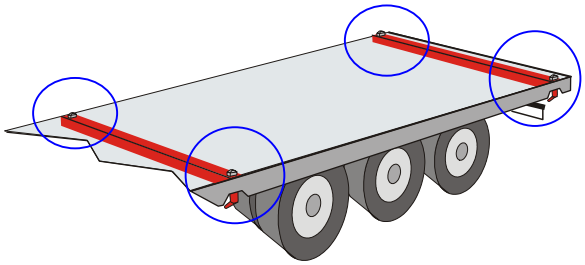
Well-blocked and braced loads do not allow load shift to start in the first place.

Design for Direct Attachment

Where a load is directly attached to a vehicle, for example using twistlocks to hold a shipping container, friction forces are not considered. The main design feature is to provide sufficient structural strength to the vehicle body cross bearers supporting the twistlocks for the proposed container weights to be carried. Container twistlocks should comply with the dimensional and other requirements of the Australian Standards AS/NZS 3711 series 1 to 10, (sec J in LRG)



Use “marked/rated” fittings.

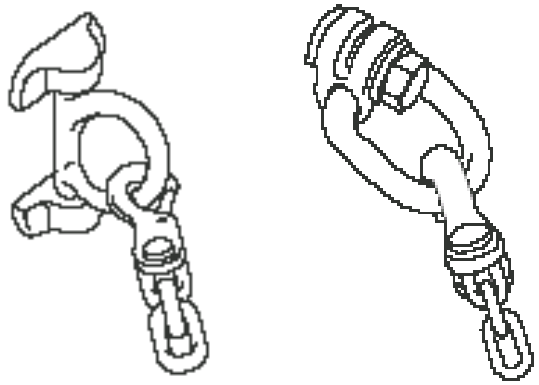


Twistlocks support the entire container and therefore require adequate structural strength to carry the total container weight on 4 points.

Tie-Rails and Load Anchor Points

To withstand restraint forces applied by lashings in normal circumstances tie-rails and anchor points should be capable of providing adequate restraint in the direction of the attached lashing. Many tie rails are not strong enough for use with chain and webbing without bending. The forces obtained with this equipment can exceed the strength of the rails particularly when using direct restraint lashings.

Lashings can be attached to a vehicle body load at any point along a tie-rail or at fixed anchor points such as lashing rings, hooks and tie-rail support points. These attachment points should have a suitable strength rating for the intended operational use of the vehicle and the methods of load restraint to be used.



Lashing points should be clearly identified by colour coding or labeling.

Vehicles, Mobile plant and machinery pose specific needs owing to higher lashing force requirements than “blocked” loads. The red items shown below are lugs and fittings for direct restraint. They can be bolted or welded to the load and the carrying vehicle. Some are designed to weld on a flat surface and others on a 90° edge or corner.

The black items are rubber snubbing blocks that act as shock absorbers for chains to stop them breaking under impact loads

The pink items are chain link gauges for measuring link length, diameter and internal width.

Minimum Design Strength of Anchor Points:

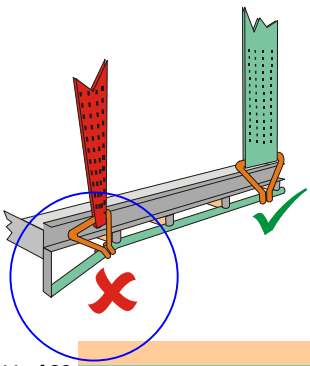
The maximum lashing tension for "tie-down" applications (where load shift is not a design intention) is the maximum pre-tension force exerted by the operator when tensioning the lashings. Lashing tension with "load shift" is higher and must not exceed the manufacturers' lashing capacity (LC) of the lashing. Steel chain and steel strapping is suitable for load shift applications, whereas rope and webbing should not be used unless part of a properly designed load restraint system.

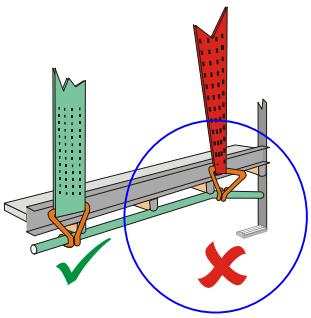
Lashing points on vehicles carried by Rail or Roll-On-Roll-Off shipping vessels require higher ratings. These specific International Standards Organisation (ISO) ratings can be found in Section J of the Load Restraint Guide or by application to rail or shipping companies. Both of these modes have higher force requirements than road transport.

Minimum anchor point capacity can be clearly and permanently marked on the vehicle and this practice is encouraged. New Zealand Standard NZS/5444 Load Anchorage Points for Heavy Vehicles contains examples of tie-rails and hook anchor points and typical capacities. Care should be taken where more than one lashing might be applied to the same anchor point. Details of standards that cover tie-rails and anchor points are set out in Sec J – Vehicle Structures, of the Load Restraint Guide.

An often-overlooked design feature of tie-rails is the need to have webbing lashing pulling evenly across all of the strap filaments. This is not a problem with "horizontal" tie-rails as they allow the lashings to be tensioned up squarely. An example is the short tie rails over and next to wheel arches.

Problems arise when some areas of the tie-rail are "angled" *(see examples below)* and a lashing is anchored to a sloping tie-rail allowing the webbing filaments to be tensioned unevenly. Such uneven tension and pulling on webbing lashing reduces the lashing capacity in a similar way to a webbing knot. A single knot will reduce lashing strength by at least 50%.





When tie-rails are fitted to the rear of a vehicle body care should be taken to ensure stop and taillights will not be obscured by lashings or tarpaulins. This unsafe practice is more often noticed on light utility and service vehicles. *See above left.*

Internal Body Anchor Points:

An often over looked load restraint feature is the fitting and use of internal floor and roof anchor points. These are available as a single fitting or as can be specifically designed anchor point tracks similar to those used on pan walls. When used for some specific types of loading internal anchor points can be a very effective means of "blocking" loads in the longitudinal direction.

Other common body types that would benefit from universal use of internal anchor points include vehicles using "drop-sides" and some tipper bodies that carry front-end loaders and other contracting items, (which are often unrestrained).

Positive Locking For Pins, Latches & Hinges:

All such attachments should be designed to prevent them from separating by road induced vibration and impact loads. These items can suffer fatigue cracking if not well designed. If failure occurs, the load can dislodge from the vehicle. An unsecured gate or door can cause severe injury and damage.

All doors, gates and drop sides, latches and pins must be capable of being positively restrained or locked in position when traveling so as to stop them falling off or allowing them to swing into the path of other road users.

Access Steps & Ladders

To reduce "falling from height" risks and comply with OH&S regulations access steps and ladders should conform to Australian Standards AS1657 with regard to step tread, depth and foot clearance requirements. In many cases drivers and loaders climb onto vehicles to fit and set the load restraint systems and dunnage in place.

Good design of vehicle access steps help to reduce OH&S risks when setting load restraints.

Winch Tracks

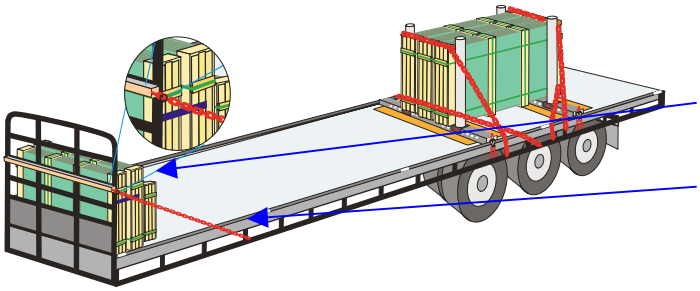
The design of winch tracks must take into account the magnitude and direction of the lashing force and the spacing of the support tracks. Track capacity should be clearly and permanently marked on the vehicle.

A typical under floor winch track.

Front Headboard & Load Racks

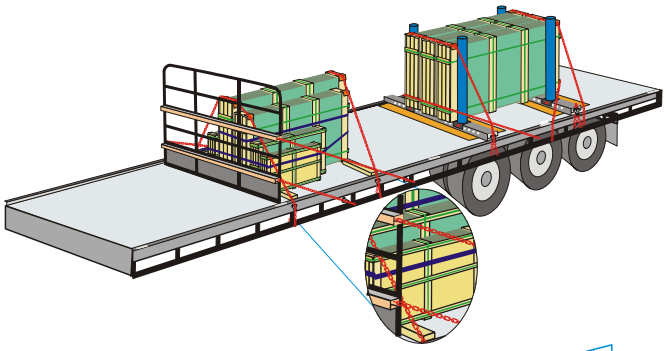
Well-designed headboards greatly reduce the number of tie-down lashings required to meet forward direction restraint. If a load is tied down to withstand 0.5g in the forward, lateral and rearward directions, a well-designed headboard can provide the additional 0.3g required to meet forward restraint. When the front headboard is used in conjunction with lashing tie-downs its strength does not need to be as great as that required for an otherwise unrestrained load.

The front headboard can easily be converted into a movable barrier or support structure by chaining each side of the headboard to the tie-rail support points. A single long chain is recommended to run from the tie-rail around the front of the headboard. Such a setup will absorb shock more effectively than two shorter chains. The chain should be kept below 30 degrees to the horizontal to maintain its effectiveness and to minimize vertical force on the chain support points.



Single chain from the tie-rail around the front of the headboard back to the other tie-rail.

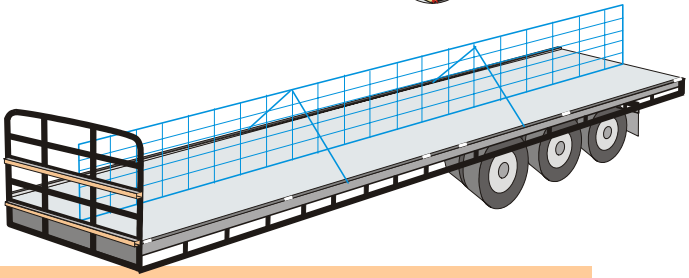
The chain angle should be kept below 30 degrees to the horizontal.



Chaining a movable load rack in a different position.

The top chain is typically 900mm above the floor and anchored 1500mm along the tie-rail.

The bottom chain is typically 300mm above floor level and anchored 500mm along the tie-rail.



Longitudinal “blocking frame”. A suitably fitted frame such as this can greatly reduce lateral load movement and keep the load a “tight fit”.

Such frames and or internal “walls” may be used for pans, curtains sides or open trailers.

Curtain-sides, Side Gates & Drop Sides

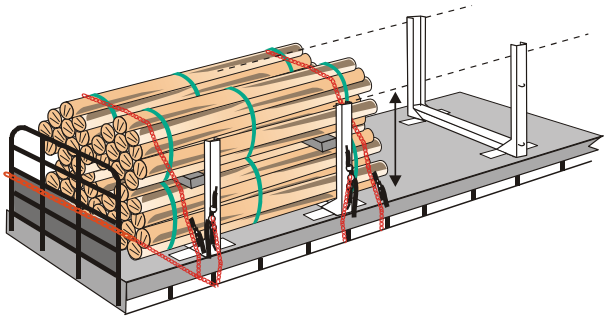
The amount of sideways deflection of any part of a curtain, gate or drop-side should not exceed 100mm when determining its load restraint/containment capacity at 0.5g sideways. Relevant material from the Load Restraint Guide Section F, page 199, sub-section 4, and set out on page 7 of this document should be taken into account when "designing for containing or blocking".

Side gates and loading racks that depend on interlinking with adjacent gates for their strength and stability should be positively locked or tied into position without relying on tie-down lashings or tarpaulins to prevent them from lifting or bowing.

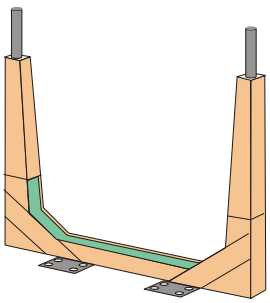
Side gates supported sideways at the top by curtains should be positively locked in position to prevent them dislodging from the bottom coaming rail supports when travelling over bumps or rough roads. Side gates and drop-sides should be high enough to "contain" the load and should be well above the base of any item of load to be carried without a tie-down. Rear overhang can magnify the effect of bumps and rough roads

Stanchions, Stakes, Pins & Posts

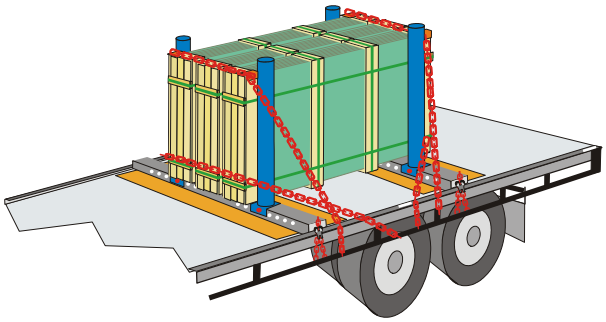
Vehicles that carry loose steel plate, sheets, boards, pipe, rods and other similar items should be fitted with pockets along the sides and across the vehicle deck, in various positions, so that stakes, pins, pegs or posts can be fitted where required to provide direct restraint. Separate removable frames that are adjustable in position (with socket provision to hold stakes, pins, pegs, posts or stanchions) can be used as an alternative to fixed pockets on the vehicle.



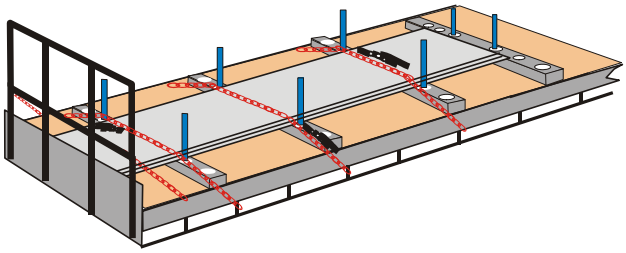
Removable fixed bolster and stanchion assemblies used for loads that have a tendency to roll.



Typical bolster and stanchion used to carry logs.



Adjustable width posts on a bolster giving control over load weight placement to ensure that vehicle stability is not compromised.

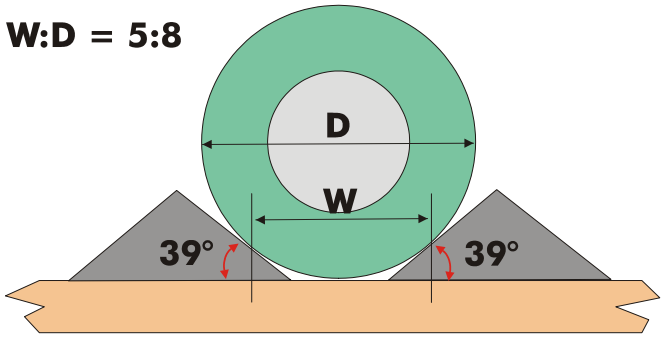


Adjustable drop in pins for “blocking” layers of steel plate.

It is important that pins can be positively locked in position, so as not to bounce out during travel.

Cradles, Chocks & A-Frames

Where cradles, chocks and A-frames are fabricated from metal, designers should take into account the low friction between them and metal decks as well as the low friction between the load and the cradles, chocks or A-frames. Provision should be made for capping or facing load-bearing surfaces with timber or rubber to increase friction.



If the cradle prevents a coil or cylinder from rolling, fewer lashings may be required.

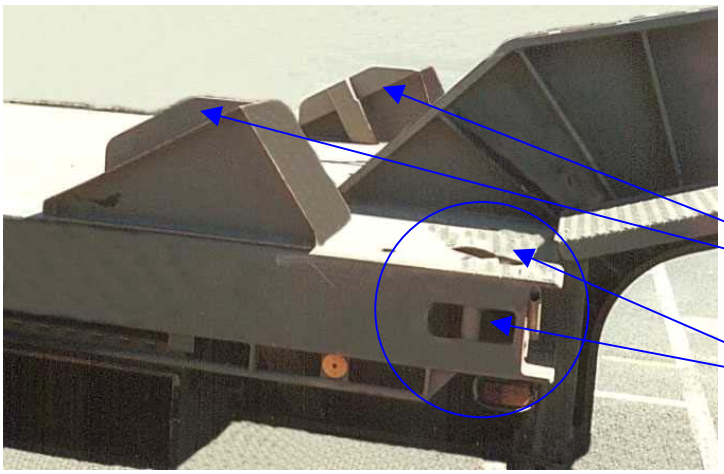
Cylindrical items will not roll if the ratio of the distance between the cradle/cylinder contact lines (W) to the diameter of the cylinder (D) is equal to or greater than 5:8 which is the equivalent to a wedge angle of 39° as shown. A rounded wedge shape is only recommended if the load is always the same diameter.

A-frames should be strong enough to hold the total load weights being carried.

A-frames must be fixed or tied to the vehicle floor. Additional high friction rubber matting is recommended, especially where A-frames are chained to the vehicle.

Forward direction blocking fittings are in place.

Each A-frame may be locked onto container twist-locks as shown.



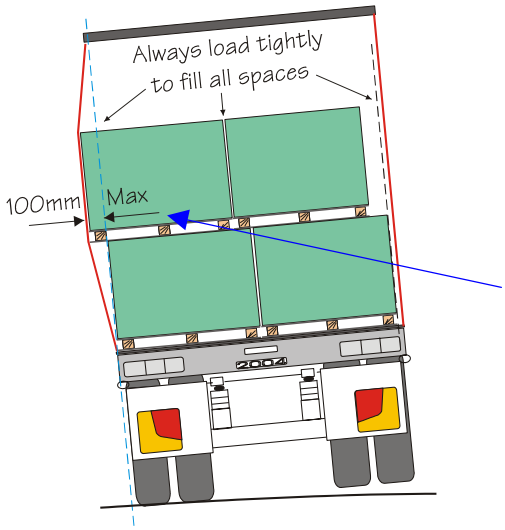
Substantial chocks on this Army tank transporter can be set in variable positions as each chock has several large round steel locating pegs.

Note the inside track locating plates that block sideways movement of tracked equipment.

Strong anchor points are required for indivisible loads where more than one chain may be tied to the same anchor point.

Curtain-sided Vehicles

This particular vehicle type has been the subject of operator concern as to how much load restraint, or more correctly load "containment" is available from such a vehicle body type. As a general principle, unless curtain-sided vehicles are certified for load restraint purposes, the load must be restrained as if the curtain did not exist, such as on an open flat top vehicle.



This very popular vehicle type must be fully assessed to confirm if any load containment capability of the finished body can be claimed and correctly certified as such.

Some curtain-side systems after testing may meet the performance standard in the lateral direction for lighter loads up to a rated load. In such cases curtain deflection must not exceed 100mm.

All loads should be firmly and tightly packed in the vehicle body to ensure load movement is kept to a minimum.

Component Selection

The range of curtain-sided vehicle body component choices is large and individual component performance is not addressed in any standards at this stage. The curtain-side system needs to be rated according to the weakest link in the chain of components.

Vehicle Task Function

One size does not fit all. Many vehicle bodies appear to be the same or similar to each other. This is not always the case. The vehicle body should be designed (from a load restraint or containment standpoint) so as to perform within the component performance specifications. Unless the body builder clearly understands and is aware of the type of load to be carried, safe loading and good body life will not be achieved. A commonly overlooked responsibility is the vehicle's second life. All too often vehicles are put into work with loads they were not originally designed to perform. This results in premature wear and tear and increased safety risk.

Material Stretch & UV Degradation

Key issues in restraining, or more correctly "containing", any load inside curtains are curtain and webbing thickness and strap material stretch. These materials lose a percentage of their strength each year from use and exposure to UV light. They will always stretch to some degree before reaching their design strength. This will allow some degree of unwanted, or possibly unsafe, load movement. Such load movement must not exceed 100mm in terms of curtain deflection in applying the 0.5g sideways measure.

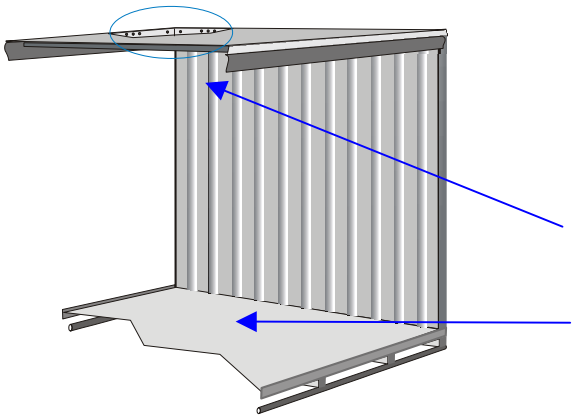
Matching Components

Not all manufacturers have tested all matched components or are able to confidently confirm test results of every combination of component mix available in assembling a vehicle body. Component strength varies greatly depending on how components are matched with each other. For example stitching, versus welding, of curtain materials affects curtain strength. Stitching versus bolts or pop rivets, the use of various washer sizes, the placement, and thickness of extruded components can all affect the strength and stretching.

Test Data Availability

Very little test data is generally available to confidently confirm equipment component performance in a particular configuration. Testing that has been carried out largely remains in the possession of each manufacturer. Manufacturers should be requested to supply strength ratings and supporting data.

Curtain & Body Component Examples – Typical Current Design

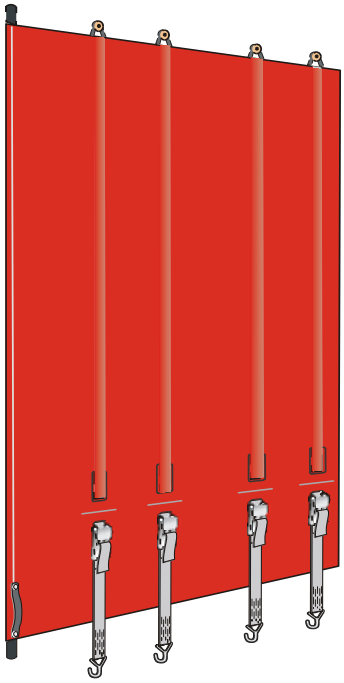


Front bulkhead strength is a very important component part of all load-carrying vehicles' load containment in the forward direction.

The operator should seek design and component testing on the vehicle body front.

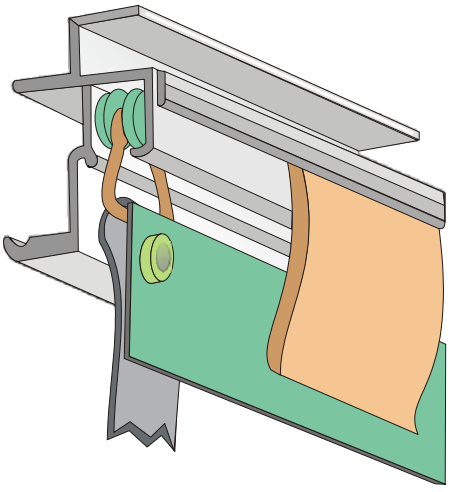
Bracing & corner gusset design adds strength.

Floor design and materials can increase friction to help reduce cargo movement.



Curtain design and component selection contain a very large range of assembly choices for both the builder and the transport operator. Critical factors include:

- Stitch pattern, welding or sewn webbing
- Bolt & washer sizes on tensioner poles
- Tensile strength & thickness of webbing straps & cam locks
- Height of curtain & strap spacing positions
- Type of coaming hook & keepers selected
- Strength & thickness of curtain material
- Number, spacing & strength of side posts

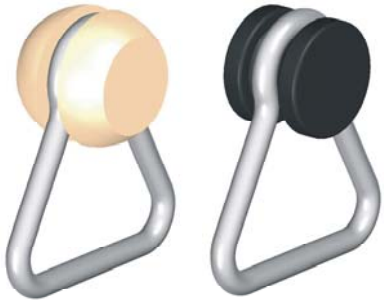


Roof track assemblies and strength are not all the same.

Tracks, roof bows and curtain attachment rollers are all critical to overall curtain strength that may give restraint (blocking) to some loads.

Design and strength of the roof structure, including the type and placement of side posts, also affects load restraint potential.

The roof structure itself has little strength & deflects when the curtain strap tension is applied.

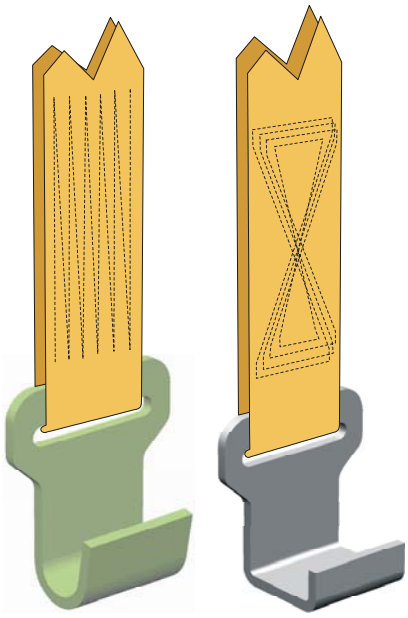


Curtain roller shape and fit to the extrusion shape of the curtain track affect strength.

Design strength, including size and materials can also vary significantly.

Top track hanger rollers are available in a range of designs and strength to match different tracks.

The difference between 2 and 4 rollers is an example of several possible variations in curtain attachment systems.

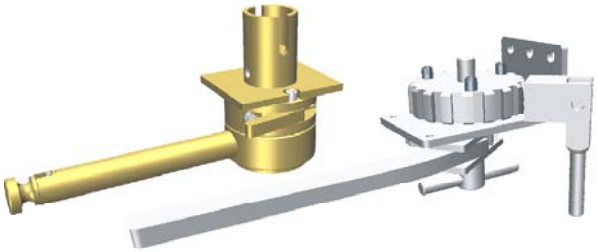


Variation in the strength of stitch patterns is not always taken into consideration with regard to strap strength.

The running stitch (far left) and the flag stitch are two high performing and popular stitches.

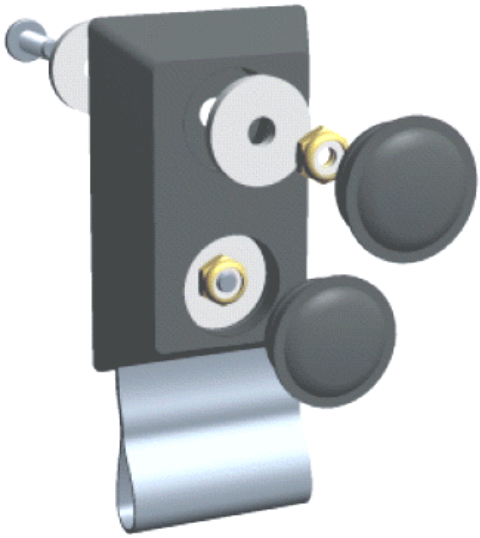
The impact of age and UV light on webbing and stitching for both curtain straps and webbing tensioners must be considered for a specific design rating. Always follow the manufacturer's recommended services and maintenance inspections or tests.

No satisfactory visual inspections are available to determine the loss of material strength.

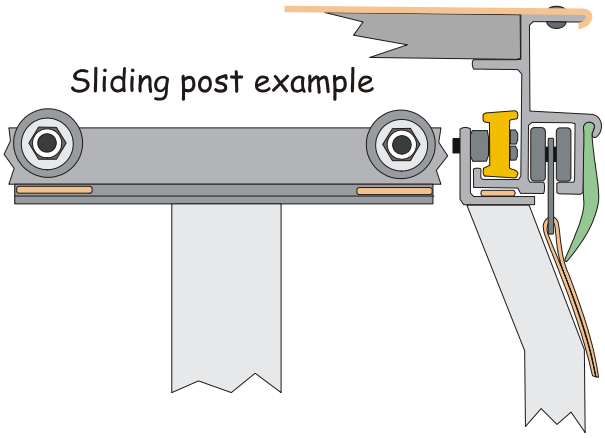


Tensioner performance and locking capability must always be taken into account in curtain sided design.

Curtain “end-posts” design is very important in maintaining an even tension across the curtain.



Example of buckle shrouds fitted with an adequate washer size.



Sliding post design and roof structures are a key feature of curtain-sided body strength.

Numbers and placement of fixed or sliding posts vary, depending on vehicle body length.

Testing a Curtain-Sided Vehicle Body - Laterally

The Load Restraint Guide sets out in section I "How to certify a load restraint system" that only a person with appropriate skills and experience should assess and certify a load restraint system. Such a person should have an understanding of vehicle design and load restraint issues. Normally a mechanical engineer with these types of skills and experience would be chosen.

Road transport authorities in each State and Territory have a list of qualified persons who can carry out engineering work of this type. Persons designing curtain-sided systems as a load restraint/containment system should also check with their State or Territory for any special requirements including other regulations such as dangerous goods and occupational health and safety.

Key Performance Measurement Results – Curtain Deflection

The key measure following a curtain side "containment test" will be how much deflection occurred when the typical or sample load in a frictionless state was pushed into the curtain.

The load restraint guidelines state that the maximum sideways deflection of a curtain-sided vehicle should be limited to 100mm. This is considered to be the maximum amount of lateral load movement that should occur before there is a serious loss of vehicle stability.

The applied load causing 100mm or less of curtain deflection determines the maximum mass of the pallets or other load units that may be contained by the curtain-side system.

What type and weight of load can a curtain-sided vehicle "contain"?

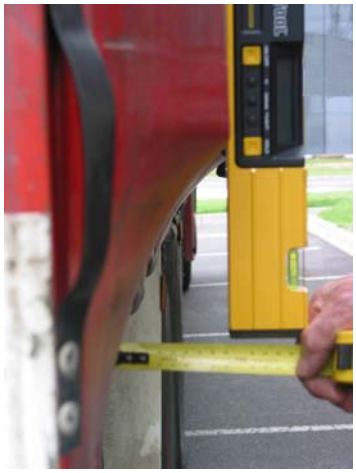
The vehicle body builder, who has designed, rated and tested not only each component, but also the completed vehicle with the intended type of load or commodity to be carried, should determine this.

Methods for Static Testing Curtains

Static test methods using air or hydraulics are cost effective, repeatable and comparable while not being dependent on a particular load. Static testing is more economic to set up than "on-road" dynamic testing, which delivers accurate results for specific loads but carries higher costs and certain risks. In addition to these physical test methods, computer simulations and calculations can generate valid information for new variants of vehicle body design without the need for practical tests.

1. Place the load on rollers or a similar system of eliminating friction between the load and the vehicle floor.

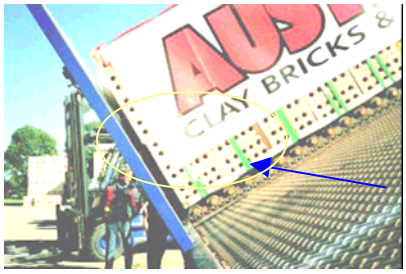
   Force is supplied by hydraulic jack in this example.



2. Apply an even horizontal force to the side curtain by pushing the proposed load type into the curtain. The pushing force can be applied via mechanical, hydraulic or pneumatic (cylinder or air-bag) methods.

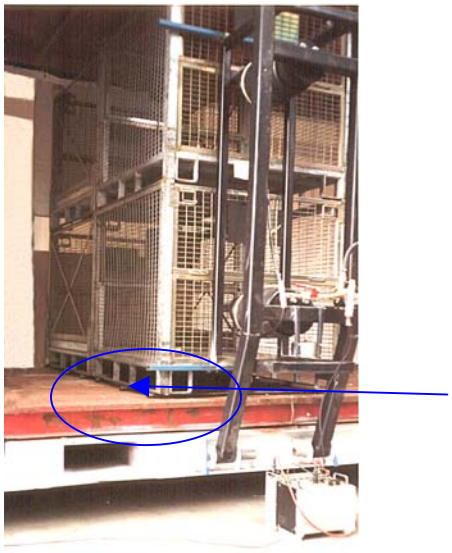
   Measure the lateral deflection

   (This particular test was measuring deflection for a solid unit load pallet cage at floor level, not stacked.)



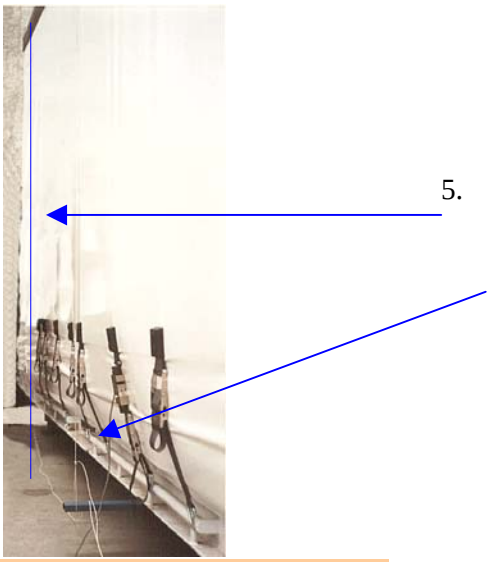
3. This example involves tilting the vehicle sideways to 30° with the load free of any friction or vibrated to simulate road shocks and travel movement.

   Note the load (although not curtains) is on rollers for zero friction.



4. A test setup showing an air operated test rig pushing evenly against 4 rigid pallet cages into a curtain-side. (far side) The required test force depends on the mass of the pallets or load units.

   Note the cages on rollers for zero friction.



5. Measuring deflection on the closed side of the curtain. The test rig is wired up to an electronic data logger and a string line is used for accurate measurement of maximum deflection.

Innovative Body Systems

The manufacturer is responsible for the testing and approval of such systems to the load restraint performance standards and provision of load mass rating. A number of innovative vehicle body systems are now available to provide load restraint and assist with OH&S objectives.

Manufacturers should also be consulted regarding in-service maintenance and component replacement to maintain continuing compliance.

Example 1 Hybrid Curtain System

Load containment is attained through special solid metal rods integrated into the curtains.

Because the rigid rods form a sliding wall, there is no requirement for the driver to attach vertical straps to help contain the load.

The entire vehicle side is positively locked quickly at each end of the containment system using a single hand operated locking feature.

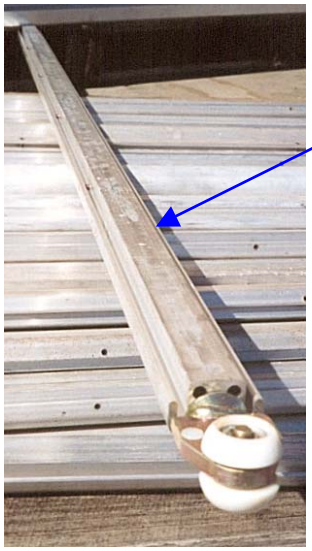
Load containment is attained through special solid metal rods integrated into the curtains.

Traditional side gates are no longer required.

Note adjustable lateral bracing can be located in particular positions to manage longitudinal forces.

A longitudinal separating feature fits from floor to roof and is often necessary for securing part loads of particular types of freight during drop-offs.

Sturdy tracks are protected from loading impacts and keep the sliding curtain wall in place.



Integrated high-tensile extruded aluminium vertical solid rods every 400mm supply sufficient lateral rigidity.

Roof deflection is no longer a factor, as the solid rods in the walls do not pull down on the roof as no curtain straps are tensioned from the roof.

Each rod has the capacity to “telescope” and therefore allows for all situations of vehicle chassis deflection.

A pair of positive locks using a hand-operated locking system is applied at each end of the side-curtain to ensure that the sliding wall cannot slide open after locking.

The single lever locking mechanisim allows the driver to very quickly secure the load at the load out dock position rather than move a short distance to a “load securing area” found at many load out distribution sites.

Example 2 - Sliding Gates & Posts

This system incorporates the side-gate and sliding roof post, removing the need to lift gates during loading. Various locking features between the floor and roof will greatly reduce the amount of lifting against the traditional drop in gates.

Each gate is fixed to a sliding roof post and is 'locked' in place on the coaming rail by 3 separate locks.

A "weightless" gate can be slid along the vehicle very easily.

A pair of positive locks are fitted to each end of the gate.

A single conventional roof post lock is fitted at the gate centre.

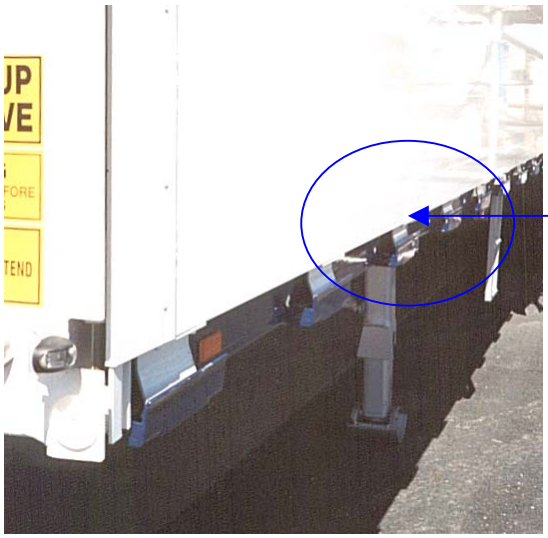
Example 3 - Folding Side Systems

Solid locking features between the floor and roof reduce the commencement of lateral “load shift” as the body assumes the solid wall characteristics of a pan.

A key operational feature of all vehicle bodies is to ensure all loads are placed tightly and firmly against the body sides. Without any space, lateral side-shift risk is greatly reduced.

An example of an open side on an empty folding sided semi-trailer.

The adjustable floor posts maintain the rigidity of the body.



Solid locking of the top and bottom hinged body sides ensure no lateral flex in the folding side-wall.

A folding side fitted on a temperature-controlled trailer.

Example 4 - Coil Containment System

This commodity specific load containment body solution for the transport of steel wire coil completely eliminates the load restraint lashing requirement at both loading and unloading points. The vehicle body design incorporates an individual cradle enclosure for each coil.

Loads are placed in each cradle are resting on wooden support surfaces that provides friction to reduce coil movement during travel. The driver has no need to climb on the load at any time.

Top coils are loaded and unloaded inside the steel frame using long prongs on the loading forklift.

Note the safety strips of white reflective tape. This assists the fork driver to load by reflecting off the loader's lights during night shift work.

All bottom coils are placed on timber lined steel framed supports.

Retracted coil stops are locked in position from the ground when the coil is loaded in position.

Example 5 – Coil Blocking System

This example shows a coil cradle system designed for coil carrying vehicle floors. Features include suitable anchor points for both the cradles and lashing points for load weights of 7 tonnes up to 20 tonnes per coil.

A general overview of a B-double fitted with the sliding 'prairie' type sliding cover.

This is an operational requirement where loading is carried out by overhead crane.

The blocking cradle system has been designed to withstand 1.0g longitudinal forward direction forces being taken on the high strength pins built into the deck

Other direction restraint forces are adequately met with this system.

High friction rubber facing is fitted to each blocking side of the cradles.

The cradle angle against the coils has been set at 45°.

Cradle weighs approximately 118 kgs.

Lashing anchor points will match the coil positions as determined by the vehicle legal axle mass distribution requirements.

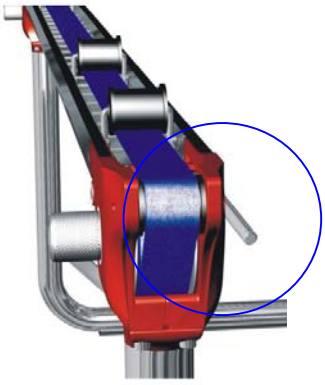
Example 6 - Light Rigid Vehicles - Load Carrier Rack

This system is incorporated into the usual load carrying supporting structure mounted on the service vehicle. *(see below)*

Loads are placed on the rack and securely fastened in the selected position by the specifically designed rack system components. The webbing and or chain lashing is “always-in-place” in the built in track system. By placing detachable flanged self-locking roller idlers close to the load items a consistent vertical down-force is applied to each load bundle across the rack or vehicle floor. A range of “quick-fixing” detachable roller idlers can be applied in several restraint methods that ensure any shape of load item is securely restrained.

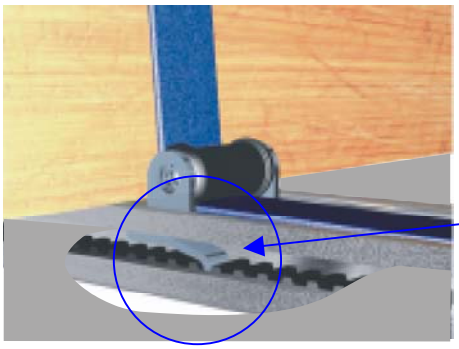
Awkward load items have excellent lashing tension applied close up against each group of items.

A range of idler positions is available at set positions along the loading rack bar.

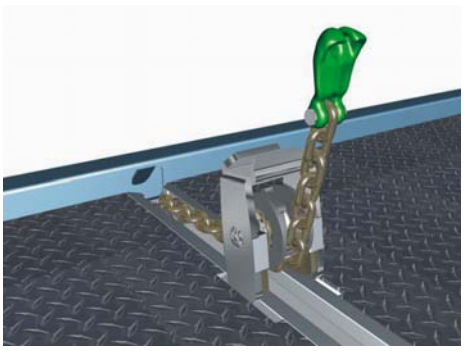


Lashing tension is applied by winding the lashing on a winch drum using a handle to apply tension.

Floor mounted adjustable track system - for webbing and chain



A “cut-away” view of the idler locking position mechanism fitted in a vehicle floor webbing system.



Example 7 – Buckle-less Curtain System

A sliding curtain wall design using rigid steel rod inserts within the curtains offers improved curtain sided wall resistance for loads having evenly distributed load against the curtain wall.

The system is suited to carrying palletised or similar goods with unit weights to be confirmed by the manufacturer. The load must be evenly distributed and the integrity of each pallet/unit of goods must be maintained by the packaging of the pallet (e.g. shrink/stretch wrapped).

The system incorporates the gates into the curtains by using steel posts between the roof track and the coaming and removes the need for curtain straps and buckles.

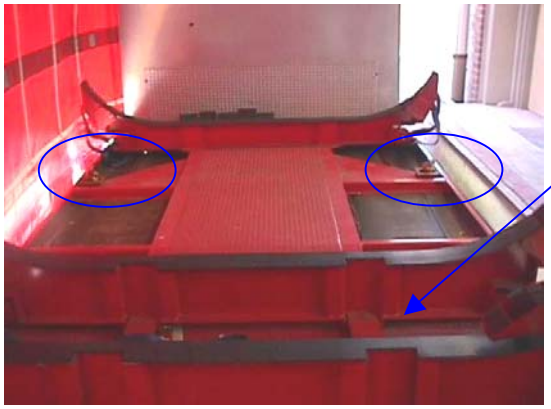
For the specified type of load, there is no need for the load to be restrained by tensioners, chains, gates or other devices.

The gates are incorporated into the curtains by using steel posts between the roof track and the coaming.

Example 8 – Paper Reel Cradle System

A specific body blocking system for the transport of large paper reels. The vehicle body design incorporates steel cradle support structures that allow the horizontally placed paper reels to be carried. A lower centre of gravity is attained of the loaded vehicle by carrying the paper reels in this layout.
Note: Such a load could be over-width and would need to be approved under a travel permit.

Two reels are placed in pairs of cradles lined with a suitable high friction material to reduce load movement. The driver can usually apply all restraint lashing from the ground as restraint adjustment is made from the floor level loading dock.



Cradles within the trailer twist lock positions are able to fold down allowing return loading of shipping containers.

Lashing is applied at a workable level from the loading dock at floor level, although steps are fitted for some other system adjustments.

Certification of Load Restraint Design

Each different manufacturer's component, when put together in a vehicle body system becomes an integral part of that vehicle body system. It is the combined system strength that may or may not meet the load restraint performance standard measures required to comply with regulations.

A transport operator seeking a curtain-sided or solid sided vehicle containment system without the use of traditional load lashings should work closely with both the vehicle body builder and the component manufacturer to ensure the highest level of load containment from the completed vehicle body, taking into account the type of load to be carried.

Final results will be in direct proportion to the design, performance and combined strength of the components. The resulting maximum load containment capability found from tests may be much less than anticipated, hence the need for design certification. Whilst not required by regulation at the time of writing, some manufacturers follow the desirable practice of plating each body with a design and test reference number, a serial number, carrier's name, date and distributed load mass capacity.

Test Reporting Requirements

The load restraint guide sets out the following reporting requirement when certifying load restraint system. Copies of all calculations, test results and test equipment data should be retained for future reference.

1. Describe the type of load and type of vehicle.
2. Describe the type of vehicle floor and other friction surface materials of the load.
3. Describe the stacking method of the load and any interlayer packing or friction materials used.
4. Specify a rated mass for the pallets, load units or commodity.
5. Set out in a drawing the location of all key vehicle body components and their location when used in an on-road loading situation. The driver to ensure the load is restrained in the same manner as tested should use this in-service.
6. Set out a statement describing how the body type is to be loaded so as to conform to the "approved or complying method". This should include items of maintenance, safety precautions and tensioning and re-tensioning procedures.

Standard Loading & Operating Procedures

It is recommended that when a product or commodity loading method has been successfully tested a "standard operating procedure" (SOP) document should be prepared for use by consignors, loading and unloading operators, carriers, drivers and enforcement officers.

A Standard Operating Procedure clearly showing all aspects of the tested loading method should be carried on each applicable vehicle.

This document (preferably illustrated with diagrams or photos) should contain all necessary information to enable all responsible persons to ensure the loading method can be confidently adhered to at all times. Enforcement officers can also easily visually confirm if the adopted operating procedure meets the Standard Operating Procedure carried on the vehicle.

Appendices taken from the National Load Restraint Guide – Second Edition 2004

1 GLOSSARY

air bag	An inflatable barrier placed between a section of the load and the vehicle to stop any movement of the load. It can be disposable or reusable.
aggregate trailer mass	The total mass of a trailer carrying the maximum load as specified by the trailer manufacturer (also called **ATM**). It includes the mass on the drawbar as well as the mass on the axles.
anchor point	Fitting or attachment on a vehicle or load to secure lashings.
baffles	Barriers fitted crosswise and lengthwise inside tanks to limit surging of fluids (or loads which behave like fluids) during acceleration, braking and cornering.
baulking	see **blocking**
billet	A solid length of raw material normally steel, bronze or aluminium.
bolster	Rigid support base commonly used to support logs on jinkers.
blocking	Material, usually timber, placed between the load and the vehicle structure, to prevent movement of the load (also see **dunnage**.)
cap tarp	A smaller **tarpaulin** fitted over the top of a load and only part of the sides.
centre of mass	The centre of balance of a load (also called 'centre of gravity').
centroid	The centre point of the cross-section of the tank.
cheater bar	Usually a length of pipe placed over the operating lever of a dog so as to extend its length. (The use of these extensions is not approved by any manufacturer and can be dangerous).
chocks	Usually wedge shaped blocks used to prevent movement of the load (also see **wedges**).
claw hook	A chain hook in the shape of a claw.
coaming	A frame border around the outside of a vehicle's loading deck.

contained load	A load prevented from dislodging from the vehicle by the vehicle structure, gates, sides, racks, headboards, stanchions etc.) or other parts of the load.
corner protectors	Material used to protect lashings and the exposed edges of loads and vehicles, and to allow lashings to slide freely when being tensioned.
cradle	A frame shaped to support a rounded object.
cribbing	A method of supporting a load on a stable column of packing of uniform thickness, stacked in pairs, with alternate layers at 90 degrees to one another.
cross-member	A support placed crosswise below the loading deck.
deck	The load carrying surface of a vehicle.
dog	A chain tensioner incorporating an over-centre locking action with a fixed or pivoting lever.
dunnage	Packing placed either between items of a load or between the base of a load and the surface of the vehicle's loading deck (also see **blocking**). (The word 'dunnage' is derived from the era of sailing ships where wood packing was used to raise the cargo above the bilge water in the hold.)
flush deck	A flat loading deck without a raised **coaming**.
gates	Permanent or removable vertical frames used at the front, sides and rear of a vehicle's loading deck to contain its load. The front gate is usually called a **loading rack** or load rack.
gluts	see **dunnage**.
Gross Combination Mass	The value specified by the manufacturer of a vehicle as being the sum of its **gross vehicle mass** plus the maximum loaded mass of any trailer (or motor vehicle) that it can tow in combination (also called **GCM**).
Gross Trailer Mass	The mass on the axle(s) of a trailer when fully loaded (also called **GTM**).
Gross Vehicle Mass	The maximum mass of a motor vehicle when loaded, as specified by its manufacturer (also called **GVM**).
headboard	Usually a permanent vertical frame used at the front of a vehicle's loading deck to contain its load (also known as a bulkhead).

hungry board	A rail or framework (permanent or removable) added to the sides of a truck body to increase load capacity.
lashings	Fastening devices, chains, cables, ropes or webbing used to restrain loads.
lashing capacity (LC)	The maximum force (in kilograms) that a lashing system is designed to sustain in use.
load binder	A device used for tensioning a lashing. (see **truck winch or dog**).
load capacity	The difference between the **GVM** or **GTM** of a vehicle and its **tare mass**.
load mat	A sheet of material used to increase friction and protect the load (also called anti-slip mat or friction mat).
loading rack	see **gates**.
pallet	A portable platform or tray onto which loads are placed for mechanical handling.
pantechnicon	A vehicle with a body enclosed by solid rigid sides and roof.
pawl	A lever or lock which prevents reverse rotation on a winch.
pockets	Housings or slots fixed to the vehicle to locate gates, stakes or loading pegs.
pre-tension	The initial tension in a lashing after tensioning.
rope single hitch	Refer Figure C.27
rope double hitch	Refer Figure C.27
rope hooks	Attachments fixed to the surrounds of the loading deck for securing of tarpaulin and tie-down ropes.
rope rail	see **tie rail**
shackle	A metal coupling link closed by a bolt which can be used for attaching chain fittings.
shoring bar	Adjustable metal beam used to restrain or segregate sections of load (also known as a shoring pole).
sling	A length of hemp-core rope, webbing or steel-wire rope with eyes formed at each end.

spreader	A transverse spar or frame used to support tarpaulins and side gates.
stake	An upright metal rod or section (also called a peg or pin).
stanchion	A large upright fixed to the side of a vehicle for sideways restraint.
stillage	A metal structure for containing individual items of load.
strut	A rigid member which can support loads in the direction of its length.
tare mass	The unladen mass of a motor vehicle or trailer.
tarpaulin (tarp)	A waterproof sheet used to cover and protect goods from the weather.
tensioner	A device used to tighten a lashing (**winch**, **dog**, hand ratchet etc).
tie down	Tie down is when the load is prevented from moving by friction only.
tie rail	A round rail which skirts the perimeter of the loading deck below the **coaming** rail.
truck winch	A device used for tensioning a lashing which is normally placed under the coaming rail and may be fixed in position using the tie-rail or slide on a track (also see **winch**).
turnbuckle	A tensioner consisting of a threaded sleeve and two mating threaded ends.
twist lock	A locking device with a rotating head which normally engages a corner casting on the load.
wedge	A piece of rigid material, thick at one end and tapering to a thinner edge at the other (also see **chocks**).
winch	A device for tensioning lashings via a rotating spool.

2 LIST OF RELEVANT STANDARDS

A list of all standards applicable to the transport of dangerous goods can be found in the *Australian Code for the Transport of Dangerous Goods (Road and Rail).*

Information on how to obtain the current versions of the following standards may be available from:

National Sales Centre
STANDARDS AUSTRALIA **www.standards.com.au**
GPO Box 5420
Sydney NSW 2001

Phone (from anywhere in Australia): **1300 654 646**

Fax (from anywhere in Australia): 1300 654 949

or from the nearest office of Standards Australia

Cargo Restraint Systems	- Motor vehicles - Cargo Restraint Systems - Transport Chain and Components	AS/NZS 4344
	- Motor vehicles - Cargo Restraint Systems - Transport Webbing and Components	AS/NZS 4380
	- Motor vehicles - Cargo Restraint Systems - Transport Fibre Rope	AS/NZS 4345
Motor Vehicles	- Motor vehicles - Anchorages and anchor points for securing internal cargo	AS/NZS 4384
Fibre Ropes		AS 4142 (Parts 1 & 2)
Short-link Chain for Lifting Purposes		AS 2321
Steel Wire Ropes		AS 3569
Shackles		AS 2741
Shank Hooks and Large-eye Hooks - Maximum 25t		AS 3777
Thimbles for Wire Rope		AS 1138
Packaging - Tensional Strapping		AS 2400.13
Load Anchorage Points for Heavy Vehicles		NZS 5444
Pressure Vessels		AS 1210
Storage & Handling of LP Gas		AS/NZS 1596
Anhydrous Ammonia - Storage and Handling		AS 2022
Road Tank Vehicles for Dangerous Goods - General Requirements		AS 2809 (Parts 1-6)
Freight Containers		AS/NZS 3711 (Parts 1-9)

Motor Vehicles - Cargo Barriers for Occupant Protection	AS/NZS 4034 (Parts 1 & 2)
Lashing and Securing Arrangements on Road Vehicles for Sea Transportation on Ro/Ro Ships	ISO 9367 (Parts 1 & 2)
Securing of Cargo on Road Vehicles, Lashing Points on Commercial Vehicles for Transportation, Minimum Requirements and Testing	DIN EN 12640-2001

AS	is Australian Standard
NZS	is New Zealand Standard
ISO	is International Organisation for Standardisation
DIN	is German Institute for Standardisation

3 LIST OF RELEVANT LEGISLATION AND PUBLICATIONS

Information on the availability and contact details for the following national model legislation/publications or their updates may be obtained from the NTC website: www.ntc.gov.au However, please check local State and Territory laws when establishing legal obligations as jurisdictions may have varied the national laws when implementing them.

Australian Code for the Transport of Dangerous Goods by Road and Rail
Australian Code for the Transport of Explosives by Road and Rail

These Codes are available from:

Canprint Information Services
PO Box 7456
CANBERRA MC ACT 2610
Tel: 1300 889 873
Fax: (02) 6293 8333

Road Transport Reform (Vehicles and Traffic) Act 1993
Road Transport Reform (Mass and Loading) Regulations 1995
Road Transport Reform (Oversize and Overmass Vehicles) Regulations 1995
Australian Vehicle Standards Rules 1999
The Australian Truck Drivers Manual

Other publications might be available from State and Territory vehicle registration/ regulatory authorities, trucking, motoring and industry associations such as:

A Guide to Restraining Steel: VicRoads December 1998
A Guide to Restraining Concrete Panels: VicRoads August 1999
A Guide to Restraining Rolls and Reels: VicRoads August 1999
A Guide to Restraining Bales: VicRoads September 1999
A Guide to Restraining Loads on Light Vehicles: VicRoads November 1999
A Guide to Restraining Concrete Pipes: VicRoads January 2000
A Guide to Restraining Logs and Timber: VicRoads November 2003

Cotton Restraint Guide 1999: Cotton Australia
Tel. (02) 9360 8500
Website: www.cottonaustralia.com.au

A Guide to Dogging 1994, Catalogue No 2: WorkCover NSW
Safety in Forest Harvesting Operations Code of Practice 2002, Catalogue No 1005: WorkCover NSW
Tel: 1300 799 003

National Code of Practice, Heavy Vehicle Modifications, Vehicle Standards Bulletin No 6: Commonwealth Department of Transport and Regional Services
Tel: (02) 6274 7111

4 COMMONWEALTH, STATE AND TERRITORY TRANSPORT REGULATORY AUTHORITIES

Commonwealth or National bodies:

Commonwealth Department of
Transport and Regional Services
Transport Regulation Division
GPO Box 594
CANBERRA ACT 2601
Tel: (02) 6274 7111 Fax: (02) 6274 7922
Website: www.dotars.gov.au

National Transport Commission
Level 15, 628 Bourke Street
MELBOURNE VIC 3000 AUSTRALIA
Tel: (03) 9236 5000 Fax: (03) 9642 8922
Email: ntc@ntc.gov.au
Website: www.ntc.gov.au

State & Territory bodies:

New South Wales:

NSW Roads and Traffic Authority
PO Box K198
HAYMARKET NSW 1238
Tel: 1300 137 302 Fax: (02) 9843 3821
Email: tech-enq@rta.nsw.gov.au
Website: www.rta.nsw.gov.au

Australian Capital Territory:

Department of Urban Services
Road User Services
Vehicle Inspection & Technical Unit
PO Box 582, Dickson ACT 2062
Tel: (02) 6207 7236 Fax: (02) 6207 6561
Website: www.act.gov.au

Queensland:

Queensland Transport
PO Box 673
FORTITUDE VALLEY QLD 4006
Tel: (07) 3253 4452 Fax: (07) 3253 4607
Email: fred.w.guillesser@transport.qld.gov.au
Website: www.transport.qld.gov.au

Victoria:

VicRoads
60 Denmark St
KEW VIC 3105
Tel: (03) 9854 2666 Fax: (03) 9853 0390
Website: www.vicroads.vic.gov.au

South Australia:

Transport SA
PO Box 1
WALKERVILLE SA 5081
Tel: 1300 656 243
Email: enquiries@transport.sa.gov.au
Website: www.transport.sa.gov.au

Northern Territory:

Department of Infrastructure, Planning & Environment
Vehicle Compliance
GPO Box 530
DARWIN NT 0801
Tel: (08) 8999 3163 Fax: (08) 8999 3101
Website: www.nt.gov.au/ipe/dttw/

Western Australia:

Department for Planning & Infrastructure
Vehicle Safety
21 Murray Road, South
WELSHPOOL WA 6106
Tel: (08) 9216 8000 Fax: (08) 9351 1699
Website: www.dpi.wa.gov.au

Tasmania:

Department of Infrastructure, Energy & Resources
Inquiry Service
GPO Box 1002K
Hobart TAS 7001
Tel: (03) 6233 5201 Fax: (03) 6233 5210
Website: www.transport.tas.gov.au