

LOAD RESTRAINT GUIDE

2018



National Transport Commission

Load Restraint Guide 2018

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LOADS

This module sets out **advice on specific load types**, complete with diagrams for most concepts.

Similar load types have been grouped together because similar principles and techniques apply.

All of the guidelines in this module recommend methods for you to follow **so you can make sure your load meets the Performance Standards** and keep you and others safe.

HOW TO USE THIS MODULE

Read the guidelines that most closely match your specific load type, or read through the whole module to learn more about restraint methods for different load types.

There are guidelines for restraining:

- [general freight](#)
- [dangerous goods](#)
- [packs, pallets and stillages](#)
- [rolls, reels, coils and drums](#)
- [pipes, tubes, rods and bars](#)
- [sheets and flat loads](#)
- [bales, bags and sacks](#)
- [contained loads](#)
- [large loads](#)
- [vehicles and mobile equipment](#)
- [bricks](#)
- [intermediate bulk containers \(IBCs\) and chemical tanks](#)
- [bulk bags](#)
- [livestock](#)
- [logs](#)
- [scaffolding](#)
- [turf.](#)

Diagrams in this module are indicative only.

For detail on vehicle structures and restraint equipment see [Vehicles and equipment](#).

To work out how much restraint to use, see the worked examples in the [Working out load restraint](#) module.

You can also find more information on restraint calculation in [Technical advice](#).

If you want to use different methods to those recommended in the load type guides, you will need to be able to demonstrate your load restraint system meets the Performance Standards.

PACKS, PALLETS AND STILLAGES

The guidelines below set out how you can meet the [Performance Standards](#) when restraining loads that have been bound into packs, stacked on pallets or loaded in stillages. They are intended to be used as a guide only. You can restrain using other methods. It is recommended that an engineer certifies alternative methods.

Diagrams are indicative only. For more information on restraint equipment see [Vehicles and equipment](#). To work out how many lashings to use, see the worked examples (in [Working out load restraint](#)) and [Technical advice](#).

UNITISING

- ✓ Unitise loads to simplify the restraint requirements.
- i Unitising methods include banding [Figure 18](#), strapping [Figure 19](#), gluing [Figure 20](#), stretch wrapping [Figure 21](#) and shrink wrapping [Figure 22](#).
- ✓ Make sure unitising systems, independently of load restraint, are capable of withstanding the forces described in the [Performance Standards](#) and robust enough to withstand handling (e.g. being handled by forklifts).

Rated pallets and cages may be used.

Figure 18 Banding

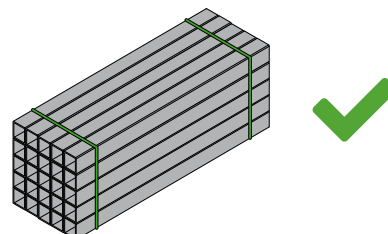


Figure 19 Strapping

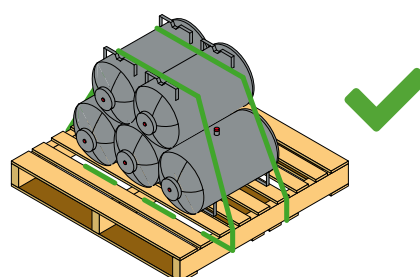


Figure 20 Gluing

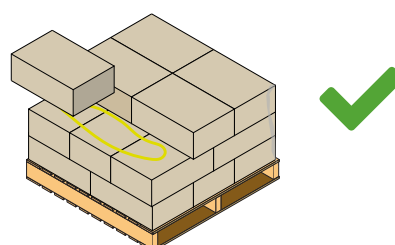


Figure 21 Stretch Wrapping

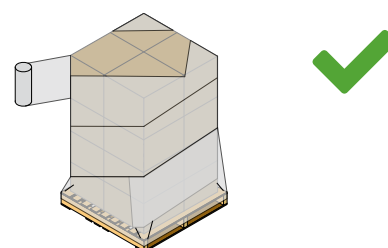
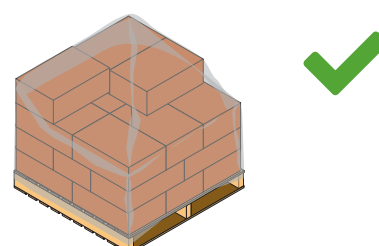
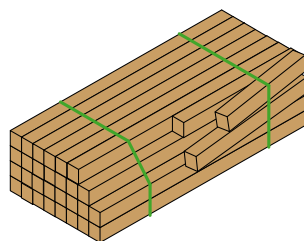


Figure 22 Shrink Wrapping



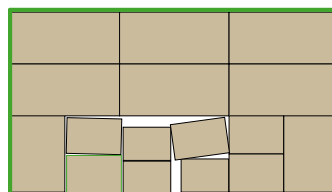
- ✓ Choose a unitising method that is appropriate to restrain all items in the pack – *Figure 23*.

Figure 23 Partially unitised pack



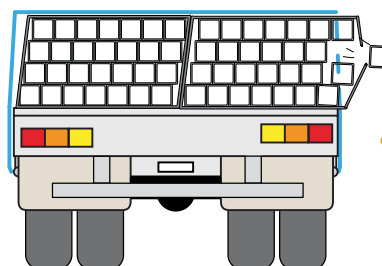
- ✓ Check all items in the load are effectively unitised – *Figure 24*.

Figure 24 Lower items loose



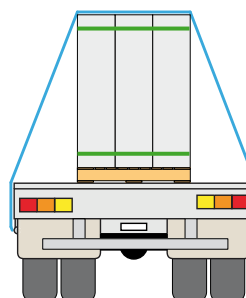
- ⚠ Items may dislodge from the vehicle if the unitising fails during transport – *Figure 25*.

Figure 25 Unitising failure



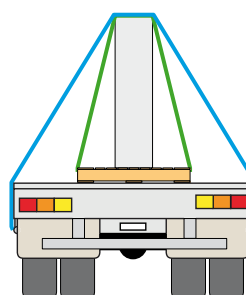
- ✓ Prevent tall items from toppling by unitising multiple items together – *Figure 26*.

Figure 26 Tall items unitised



- ⚠ Tall items may topple under heavy braking or cornering, putting extra forces upon strapping or wrapping – *Figure 27*.

Figure 27 Tall item may topple



PACKS

- i** Packs can comprise multiple layers or stacks of material *Figure 28* or bundles of individual lengths *Figure 29* unitised together.

Figure 28 Stacked material

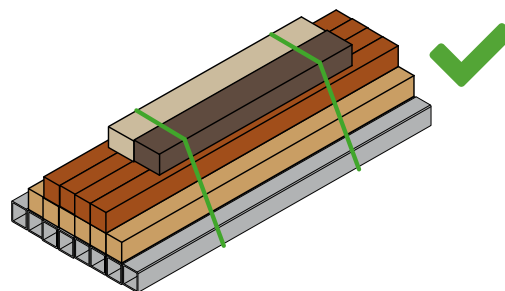
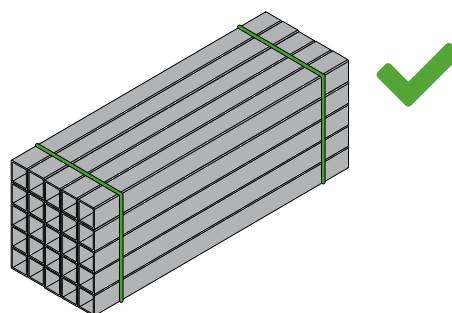
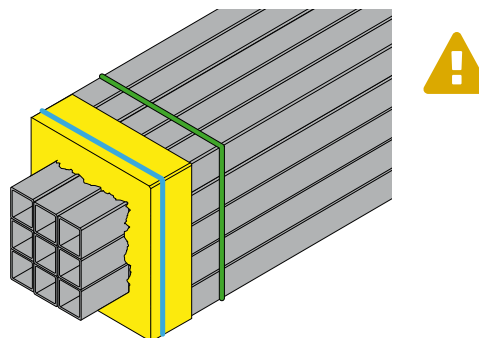


Figure 29 Bundle



- ✗** Do not rely on unitising alone to restrain all items in a pack during transport – it may not be sufficient – *Figure 30*.

Figure 30 Unitising failure



- ✓ End wrap [Figure 31](#) or block [Figure 32](#) packs that are at risk of sliding or spearing.

Figure 31 Pack end wrapped

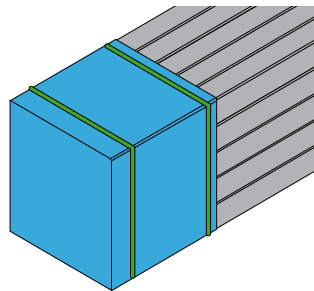
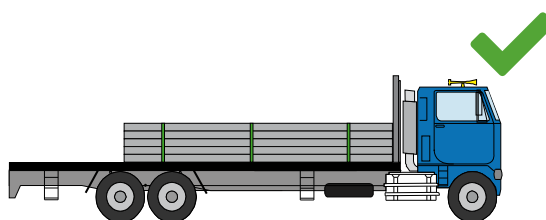


Figure 32 Pack blocked against headboard



- ⚠ Items in packs of low-friction items can slide or spear out of the pack – [Figure 33](#), [Figure 34](#) and [Figure 35](#).

Figure 33 Steel sliding

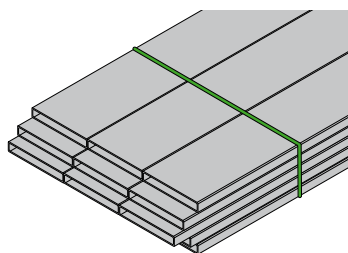


Figure 34 Steel spearing

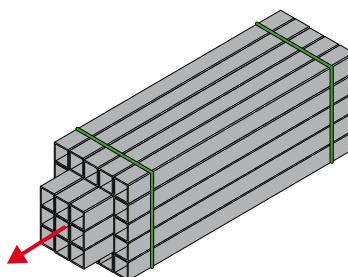
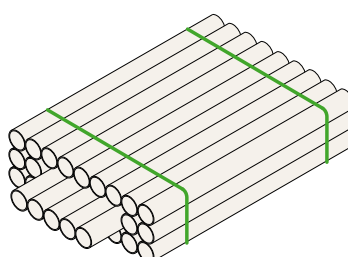
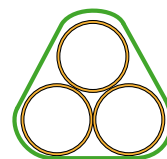


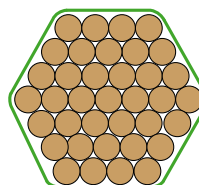
Figure 35 Plastic pipe spearing



- ✓ Unitise packs of circular items in self-supporting shapes – *Figure 36*.
- ⚠ Pack shapes may prevent all items from being adequately unitised.

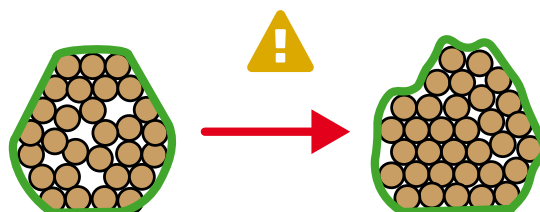
Figure 36 Self-supporting shapes

Triangular pack



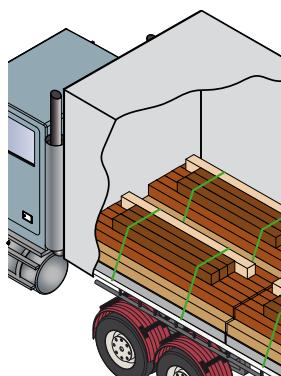
Hexagonal pack

- ⚠ Bundles of small items can change shape when subject to forces during transport – *Figure 37*.

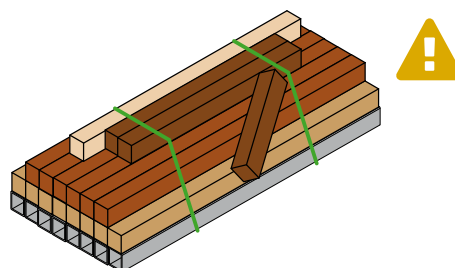
Figure 37 Pack settled during transport

Blocking and containing packs

- ✓ Block or contain packs that are inadequately unitised and/or at risk of items dislodging – *Figure 38*.

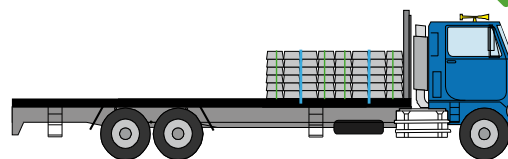
Figure 38 Contained packs

- ⚠ Items can dislodge from inadequately unitised packs – *Figure 39*.

Figure 39 Inadequately unitised pack

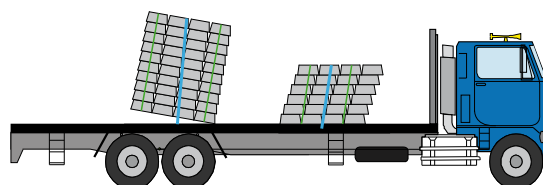
- ✓ Prevent packs tipping by blocking them – *Figure 40*.

Figure 40 Unstable packs blocked



- ⚠ Tall packs of multiple items may become unstable during transport – *Figure 41*.

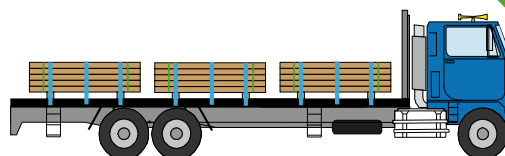
Figure 41 Unstable packs



Tying down packs

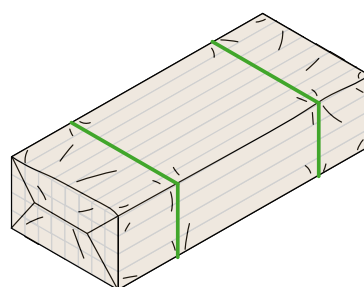
- ✓ Use tie-down to restrain packs that are well unitised – *Figure 42*.

Figure 42 Packs tied down



- ⚠ Packaging or weather protection may be low friction and therefore increase the number of tie-down lashings required – *Figure 43*.

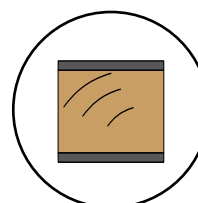
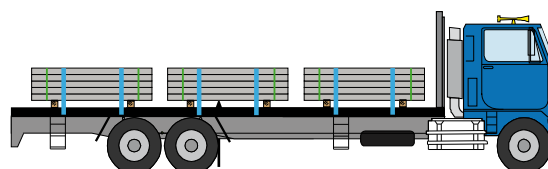
Figure 43 Low friction weather protection



- i Anti-slip rubber can reduce the required number of tie-down lashings; particularly for low-friction loads – *Figure 44*.

Figure 44 Tie-down with anti-slip rubber

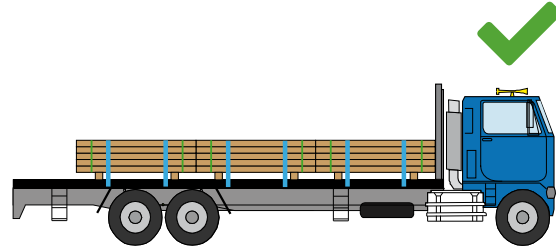
- ⚠ If you do apply fewer tie-down lashings, you may need to make the unitising system stronger to resist the forces on the load during transport (e.g. packs of slippery sheets placed on anti-slip rubber need fewer webbing straps but are prone to breaking their banding).



Rubberised dunnage

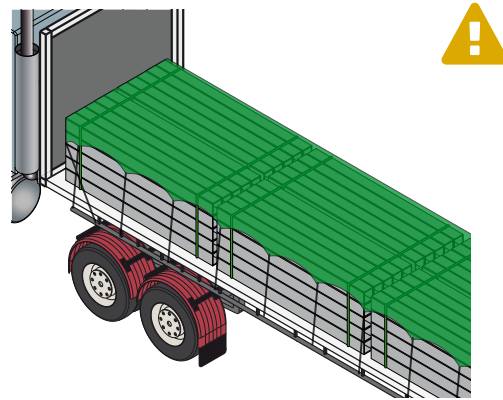
- ✓ Use forward blocking to reduce the required number of tie-down lashings and place less force on packaging – [Figure 45](#).

Figure 45 Packs blocked and tied down



- ✗ Do not use tarpaulins or curtain sides to restrain packs unless they are properly engineered for the specific load type. For more information see [Vehicles and equipment](#) – [Figure 46](#).

Figure 46 Tarpaulin without tie-down



LOADS ON PALLETS

- ✓ To simplify restraint requirements, unitise items placed on pallets to the pallet itself – *Figure 47*.
- ✓ Make sure the unitising sufficiently secures all items to the pallet during transport.
- ✓ Apply additional restraint or contain pallets if items can dislodge – *Figure 48* and *Figure 49*.

Figure 47 Items unitised to pallet

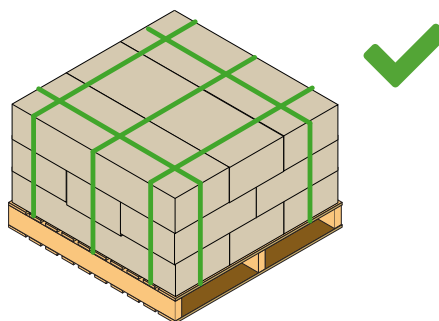


Figure 48 Additional restraint – stretch wrap

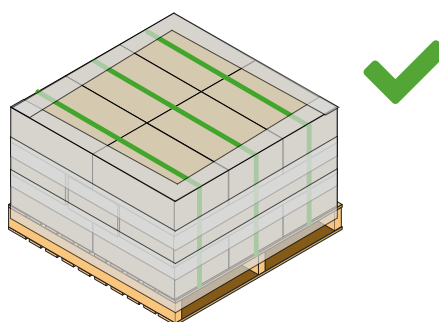
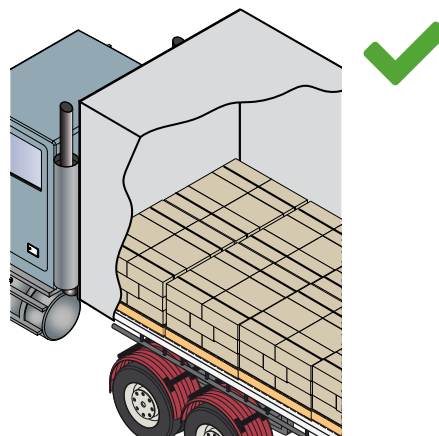
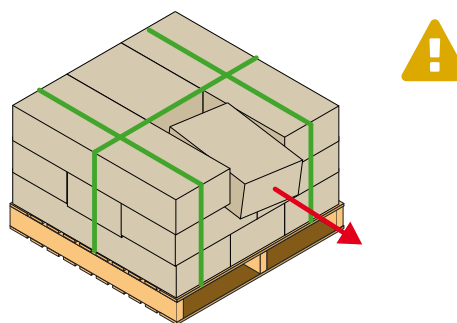


Figure 49 Contained load



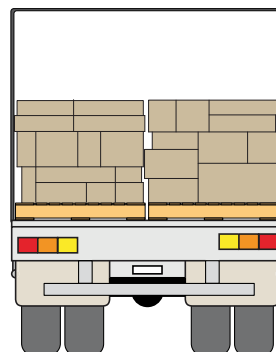
- ⚠ Items can dislodge from the pallet if the load is uncontained and the items are not sufficiently unitised – *Figure 50*.

Figure 50 Insufficient unitising



- ✓ Restrain items loosely stacked on pallets by containment – *Figure 51*.

Figure 51 Loose items on pallet contained



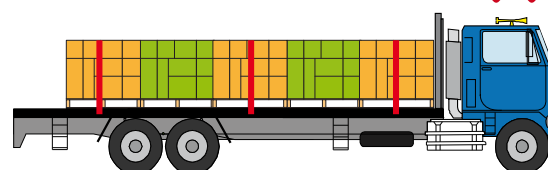
- ✓ Restrain sufficiently unitised pallets by tie-down – *Figure 52*.

Figure 52 Pallets tied down



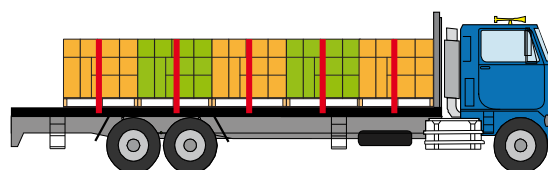
- ✓ Make sure tie-down lashings apply clamping to all pallets in the load – *Figure 53*.

Figure 53 Items in load unrestrained

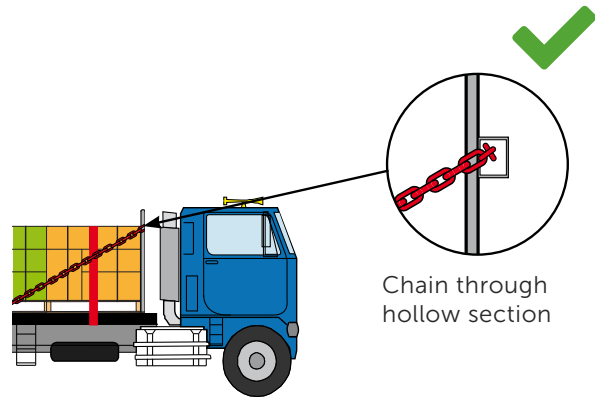


- ✓ Use suitably engineered forward-blocking surfaces to reduce the number of tie-down lashings needed – *Figure 54*.

Figure 54 Forward blocking

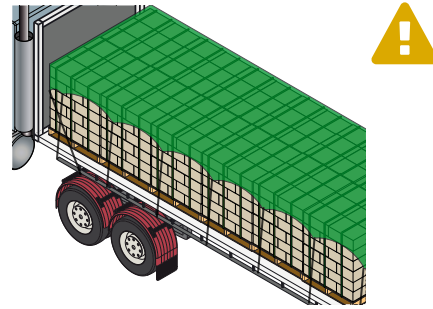


- ✓ Reinforce unrated headboards using chains (or similar) wrapped across the face of the blocking surface – *Figure 55*.
- ⚠ Unrated reinforced blocking surfaces have limited restraint capacity.

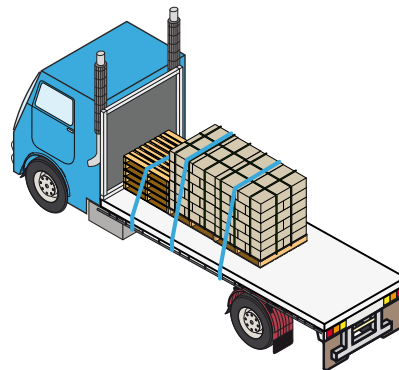
Figure 55 Unrated blocking reinforcement

Forward blocking

- ✗ Do not use tarpaulins or curtain sides to restrain packs unless they are properly engineered for the specific load type *Figure 56*. For more information see [Vehicles and equipment](#).

Figure 56 Tarpaulin Without Tie-Down

- ✓ Use several empty pallets stacked on top of each other to block both the freight and the pallet itself – *Figure 57*.

Figure 57 Blocking With Intermediate Pallet

- ✓ Stack palletised loads two high if the product is strong enough to support the upper layer without crushing.
- ✓ Tie down loads of pallets stacked two high and block them in the forward direction against a suitably engineered headboard – *Figure 58*.

Figure 58 Stacked Load

LOADS IN STILLAGES (CAGES, CRATES)

- ✓ Transport loads made up of lots of loose pieces in stillages to simplify the restraint requirements.

- i** Additional requirements from Australian Standard AS 4991-2004 Lifting Devices apply for stillages that are to be used as a lifting device.

- ✓ Make sure stillages adequately restrict the upward movement of items they contain to prevent them from dislodging – *Figure 59*.

- ⚠ Uncovered or unwrapped items are prone to bounce during the trip. If the sides of the stillage are not high enough, then a top cover or wrapping will be required.

- ✓ Only use stillages that are suitably engineered and capable of restraining all items placed within them when subjected to the Performance Standard forces – *Figure 60*.

Rated equipment is recommended, where suitable and available.

Figure 59 Stillage with vertical containment

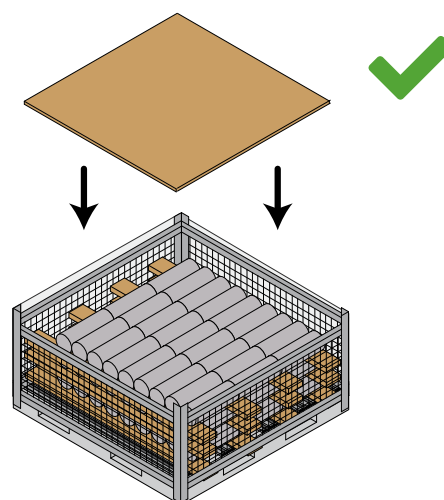
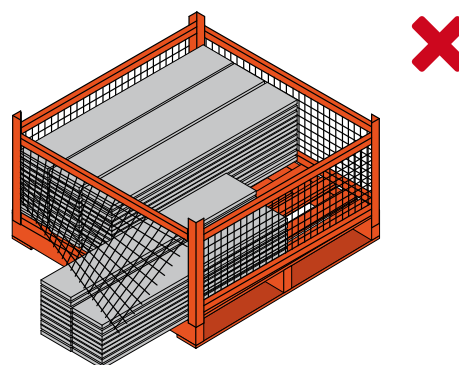
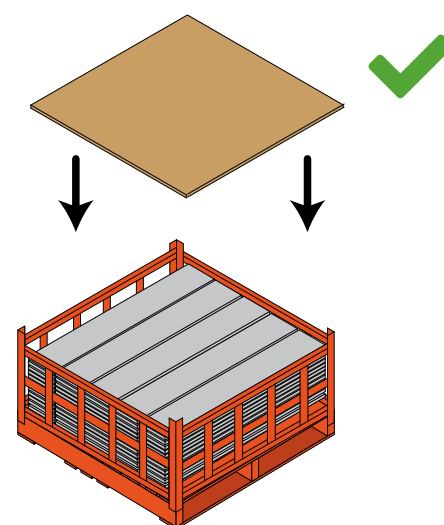


Figure 60 Stillage selection

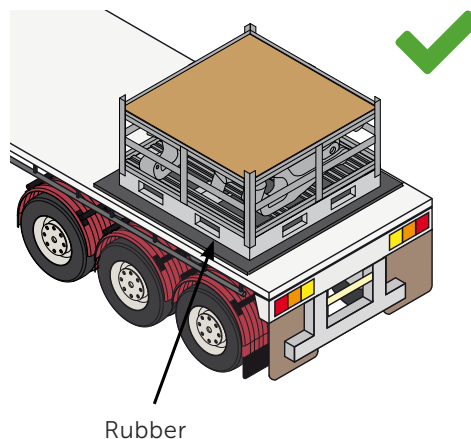


Stillage – insufficient strength

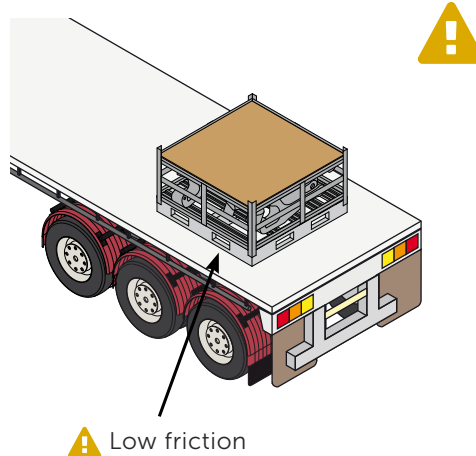


Stillage – suitable strength for freight

- ✓ When loading steel-based stillages onto a steel deck, place plywood, rubber or other suitable material on the deck to increase friction – *Figure 61*.

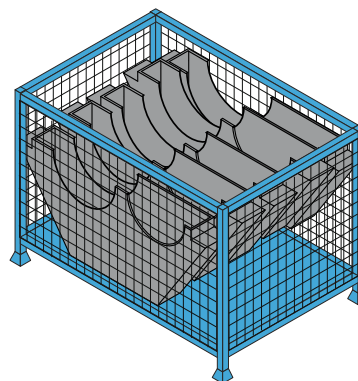
Figure 61 Steel stillage on rubber

- ⚠ Loading stillages with steel bases directly onto steel decks creates a low-friction interface – *Figure 62*.

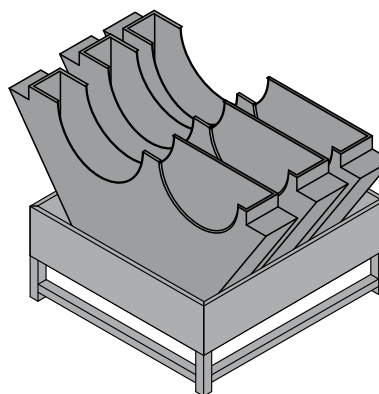
Figure 62 Steel-on-steel interface

- ✓ Use stillages that are deep enough to securely contain the freight – *Figure 63*.

Figure 63 Depth of coverage



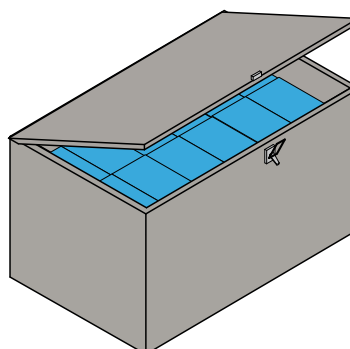
Suitable depth of coverage



Limited containment due to inadequate depth

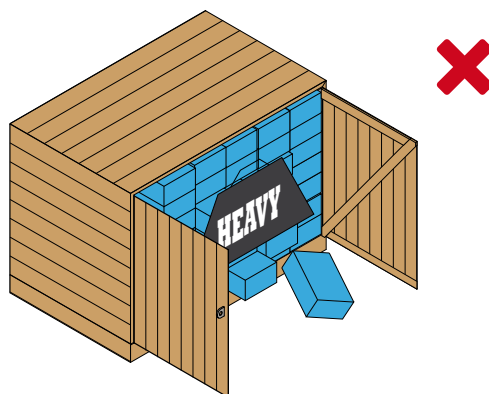
- ✓ Use lids to contain freight in stillages to prevent freight bouncing out – *Figure 64*.

Figure 64 Stillage with lid

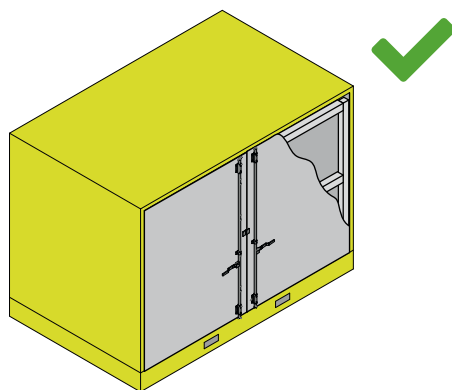


- ✓ Use suitably engineered side doors to prevent freight loss during transport – *Figure 65.*

Figure 65 Side doors



Insufficient strength for freight



Suitable strength for freight

GENERAL TIPS FOR ALL ROUND LENGTHS

- ✓ Check the number and type of lashings are appropriate for the size of the load.
- ✓ Check all items are restrained to prevent any items sliding out of the pack – *Figure 109*.
- ✓ Restrain loose pipes individually if the external lashings do not effectively clamp all pipes.
 - ⚠ Tie down lashings may not provide sufficient sideways restraint for loose pipes loaded on dunnage or nested – *Figure 110*.
- ✓ Restrain loose pipes sideways with suitably engineered stanchions.
- ✓ Use interlayer packing material (such as timber or rubber matting) to increase friction between individual sections.
 - ⚠ Items with smooth surfaces (low friction) are difficult to restrain using tie-down.
- ✓ Protect spigoted, socketed, threaded, bevelled or flanged ends using a suitable packing material.
- ✓ When tying down fragile loads, use webbing lashings or appropriate protectors if using ropes or chains, to prevent load damage.
 - ⚠ Soft or crushable loads can be damaged by restraint equipment – particularly chains – *Figure 111*.

Figure 109 Smaller pipe will be clamped once lashing is tensioned

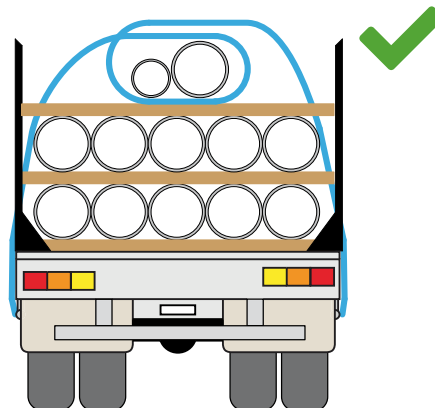


Figure 110 Limited clamping on the centre pipe

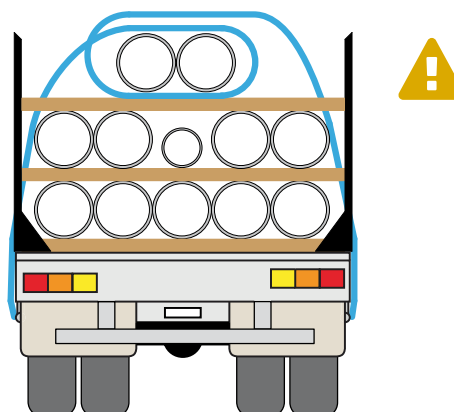
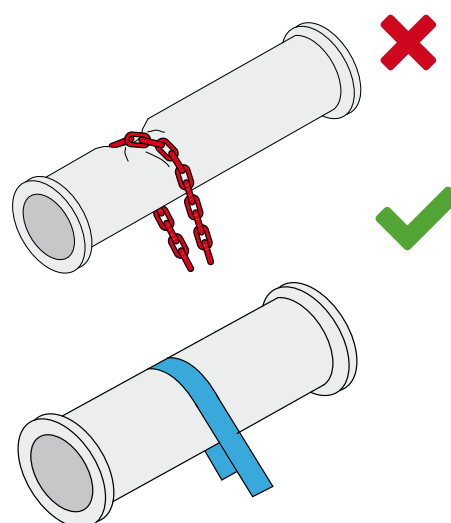


Figure 111 Fragile freight



PIPES ON SCALLOPED DUNNAGE

- ✓ Use scalloped dunnage, unitised bundles or containers if transporting large quantities regularly; this can reduce transport costs, product damage and loading/unloading time.
- ✓ Use dunnage that is scalloped top and bottom to prevent pipes rolling during transport and loading/unloading – *Figure 112*.
- ⚠ Pipes can roll sideways if the scallops are not deep enough – *Figure 113*.
- ⚠ Side pins, posts or stanchions may be required to prevent lengths rolling during loading/unloading – *Figure 114*.
- ✓ Use stanchions that are suitably engineered to withstand impacts from loading and unloading equipment in addition to restraining the load.
- ⓘ Loads on scalloped dunnage that are sufficiently tied down to resist sideways forces do not require stanchions for sideways restraint during transport – *Figure 115*.
- ✓ Load a maximum of two pipes on the top layer unless the load is blocked forwards and rearwards – *Figure 116*.

Figure 112 Scalloped dunnage

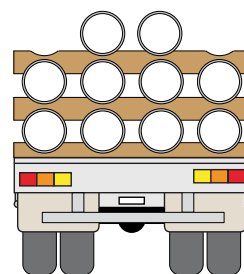


Figure 113 Scallops not deep enough

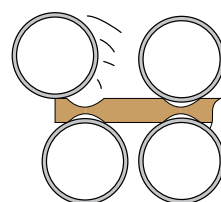


Figure 114 Side posts for loading/unloading

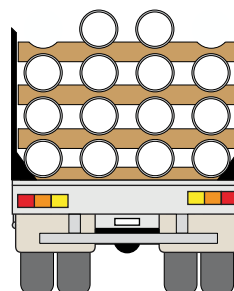


Figure 115 Crowned load

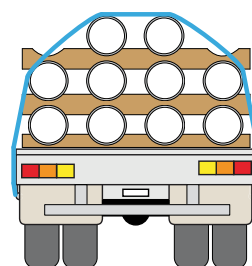
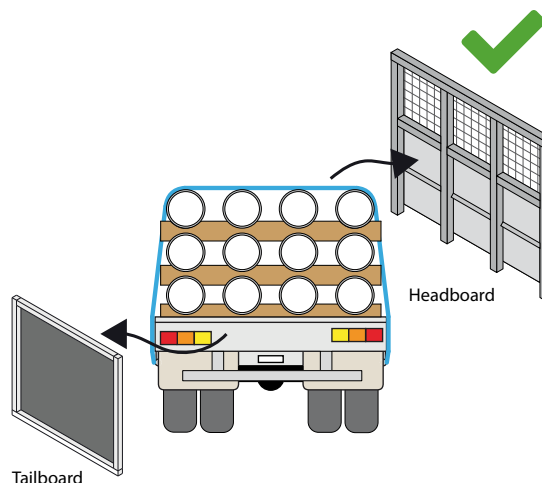


Figure 116 Flat load with blocking

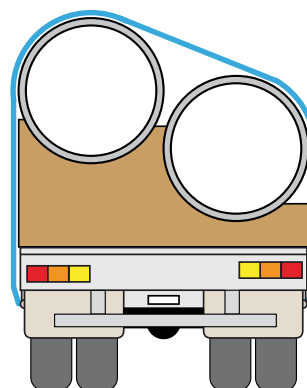


More than two pipes can be loaded on top when blocking is used

CRADLED PIPES

- ✓ Tie down large diameter pipes on specially fabricated cradles or racks to prevent rolling and to distribute the weight evenly over the vehicle – *Figure 117*.
- ⚠ Pipe cradles and racks may need to be secured independently of the load because the tie-down lashings may not prevent the rack toppling.
- ✓ To determine the dimensions of scallops and cradles see [Chocks, cradles and A-frames](#).
- ✓ Reduce cornering speeds when transporting high-centre-of-mass loads.
- ⚠ Loads with a high centre of mass are less stable and more prone to causing vehicle rollover.

Figure 117 Cradled pipes



LOOSE LENGTHS BETWEEN STANCHIONS

- ✓ Use suitably engineered stanchions that can restrain the whole load sideways – *Figure 118*.
- ✓ Restrain every pipe in the load with a minimum of two stanchions on each side of the load.
- ✓ Check the pipes extend at least 300 mm beyond the outer stanchions in the forward and rearward directions – *Figure 119*.
- ✓ Place longer lengths towards the outside of the stack and shorter lengths in the centre.
- ✗ Don't extend the top pipes more than half their height above the top of the stanchion.
- ✓ Block loads forwards and rearwards because clamping may not be effective for all pipes – *Figure 120*.

Figure 118 Trailer with stanchions

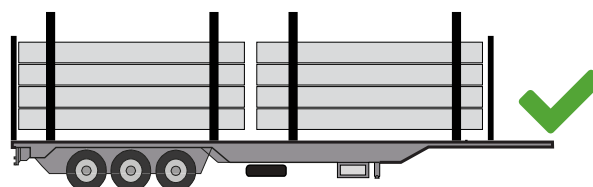


Figure 119 Minimum engagement

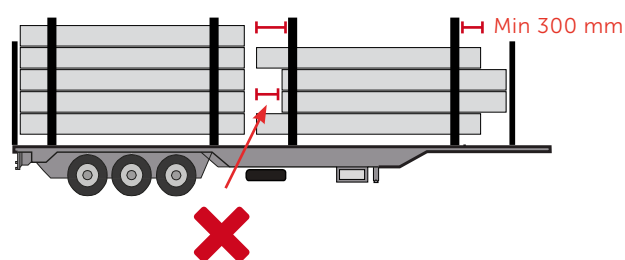
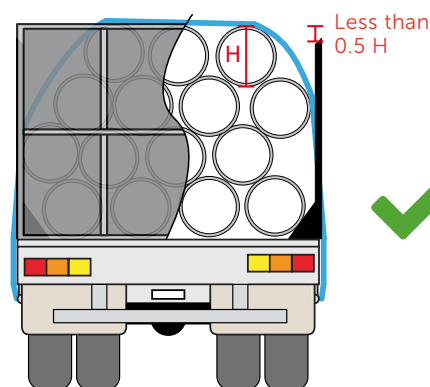


Figure 120 Blocking



Load blocked, top lengths less than 0.5 H above stanchions

PIPES ON FLAT DUNNAGE

- ✓ Check stanchions used with tie-down lashings are suitably engineered to accept sideways forces.
- ✓ Crown the load (i.e. ensure there are no gaps in the top layer), and check all pipes are clamped by tie-down lashings – [Figure 121](#)
 - ⚠ If crowning is not used, some pipes on the top layer may be unrestrained – [Figure 122](#).
- ✓ Loads contained sideways should be blocked forwards and rearwards.
 - ⚠ If loads are unblocked forwards and rearwards, apply belly-wrapped [Figure 123](#), opposed loops [Figure 124](#) or load-choked [Figure 125](#) lashings.
 - ⚠ Friction between the pipes should be high if pipes are not blocked forwards and rearwards.

Figure 121 Crowned load

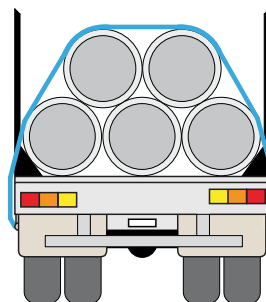


Figure 122 Flat-topped load

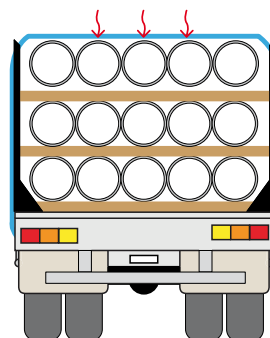


Figure 123 Belly-wrapped load

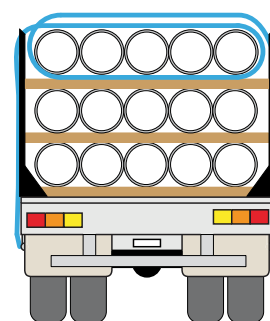


Figure 124 Opposed loops

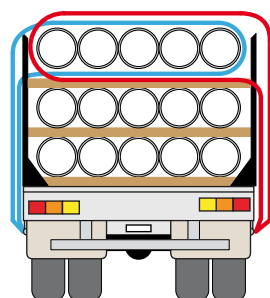
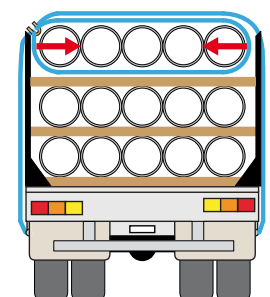


Figure 125 Load choked



UNITISED PIPES, BARS AND RODS

- ✓ Unitise items by packaging with appropriate strapping – *Figure 126*. Dunnage can help prevent items from regrouping.
- ⚠ Slippery or crushable lengths are not suitable for unitising with packaging strapping.
- ✓ Strapping can be used to prevent individual lengths spearing out from the group.
- ✓ Use packaging strapping to attach items to slotted dunnage for ease of handling if required – *Figure 127*.
- ✓ Use belly wrapping with at least two lashings to further unitise and restrain small quantities of loose items.
- ✓ Restrain packs unitised with steel wire loops by applying belly-wrapped lashings.
- ✓ Loop belly-wrapped lashings over the top of the load to provide tie-down – *Figure 129*.
- ✗ Don't use twisted steel wire loops as the only form of unitisation on a pack – *Figure 128*.

Figure 126 Unitised lengths

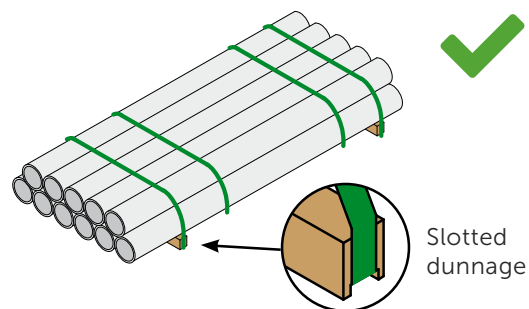


Figure 127 Unitised lengths – end view

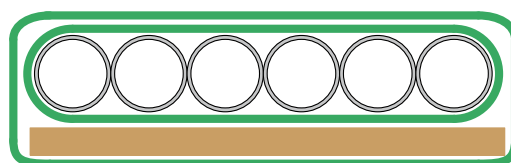
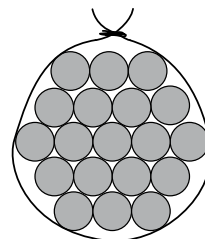
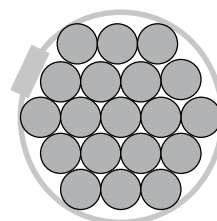


Figure 128 Unitising bundles

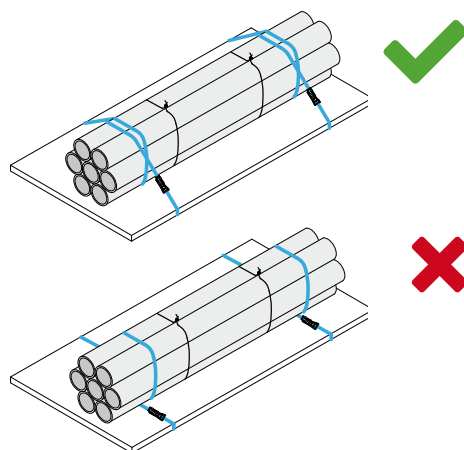


Bundles secured with twisted wire may not prevent spearing of loose lengths



Bundle unitised with packaging straps

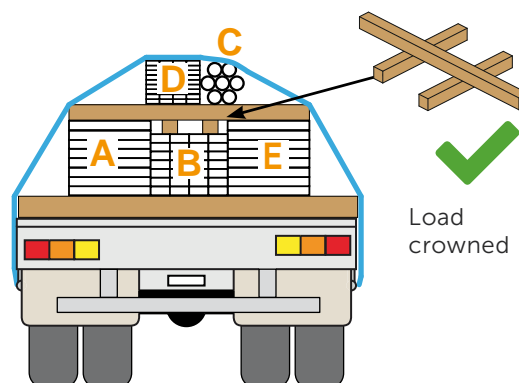
Figure 129 Belly-wrapped load



MIXED LOADS OF BUNDLED LONG ITEMS

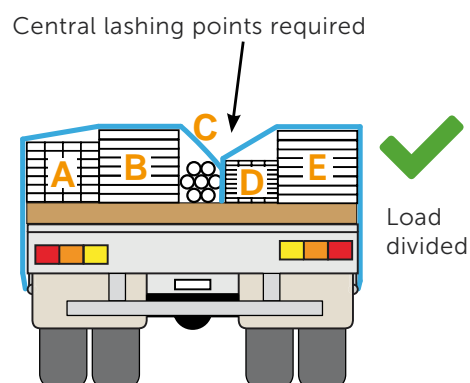
- ✓ Crown loads composed of multiple odd-sized bundles to apply even downward pressure across the load – *Figure 130*.
- ✓ Unitise bundles using belly-wrapped lashings and apply tie-down lashings over the top of the load.
- i** Chains are most effective for belly wrapping.

Figure 130 Odd-bundle loads

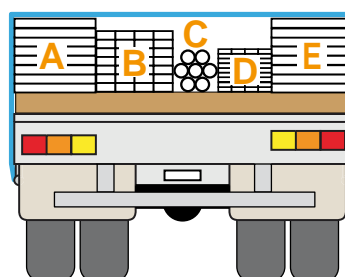


- ✓ Divide loads to achieve more effective crowning if required – *Figure 131*.
- ⚠ Lashing points along the middle of the deck may be required for divided loads.

Figure 131 Divide loads



B, C & D have no vertical clamping



LONG-LENGTH ITEMS

Long flexible items

- ✓ Make sure long items are carried on sufficiently long vehicles to meet allowable length and overhang regulations, and to provide adequate support.
- ⚠ Loads of flexible long items may reduce the trailer capacity if dunnage is located away from the axle groups and/or kingpin – *Figure 132*.
- ✓ Support flexible long items (e.g. small-diameter pipes, timber, rod and rolled steel sections) at frequent intervals – *Figure 132*.

Figure 132 Reduced trailer capacity

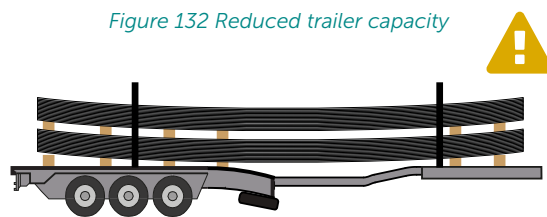
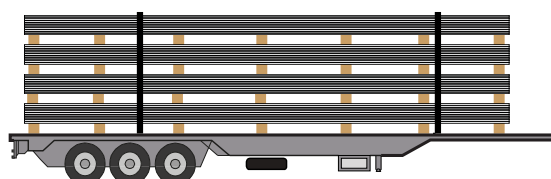


Figure 133 Flexible long lengths



Lengths supported at frequent intervals

Long rigid items

- ✓ Support long rigid items (e.g. large-diameter metal pipes, concrete beams and heavy rolled steel sections) at only two points when transported on extendable trailers to allow the trailer to flex.
- ✓ Support long rigid items at two positions approximately 20% of the length of the item from each end – *Figure 134*.
- ✓ Locate supports above the axle group and kingpin.

Figure 134 Rigid long lengths

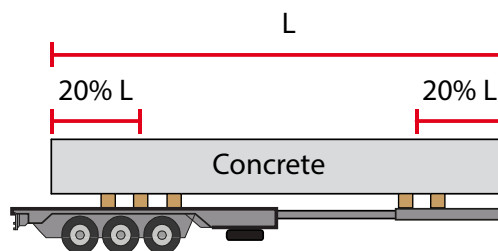
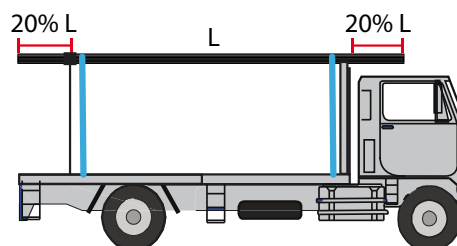


Figure 135 Long lengths on roof racks



Roof and ladder racks

- ✓ Restrain long items transported on roof or ladder racks by at least two lashings.
- ⚠ Long items transported on roof or ladder racks must not overhang the rack by more than 20% in length – *Figure 135*. Ensure vehicle dimension limits are not exceeded.

- i** The load support points table provides indicative measurements for the required distance between supports and maximum overhang for items of different lengths.

Load support points

Length	Distance between supports	Maximum overhang
2,500 mm	1,500 mm	500 mm
3,000 mm	1,800 mm	600 mm
4,000 mm	2,400 mm	800 mm
5,000 mm	3,000 mm	1,000 mm
6,000 mm	3,600 mm	1,200 mm
7,000 mm	4,200 mm	1,400 mm
8,000 mm	4,800 mm	1,600 mm