

Load Restraint Guide



PART 1 **for** **Drivers and Operators**



Section A - General Principles of Load Restraint



SECTION A

GENERAL PRINCIPLES OF LOAD RESTRAINT

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Section A - General Principles of Load Restraint

This Section describes the general principles and methods of load restraint. They are based upon the general principle that:

Any load-carrying vehicle must be loaded and driven in such a way as to prevent danger to any person, or damage to any property.

1 LOAD SHIFT

When moving, a vehicle and its load are subjected to forces caused by changes of speed, direction or slope. These forces result from braking, accelerating, cornering or travelling over cambered, undulating or uneven road surfaces and air flow.

The load can shift forward when driving forward and braking, or accelerating in reverse. (see Figure A.1).

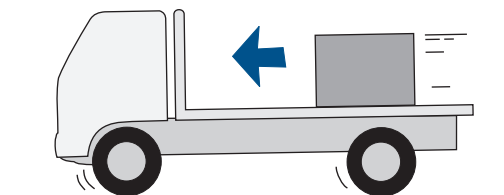


Fig. A.1

BRAKING

The load can shift rearwards when braking in reverse, or accelerating forward (see Figure A.2).

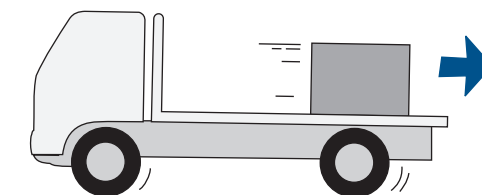


Fig. A.2

BRAKING IN REVERSE

The braking force on the load is often higher at low speed than at high speed because the brakes may grab suddenly.

The load can shift sideways when cornering. The amount of force needed to prevent the load shifting will increase as the speed increases and as the corner gets tighter (see Figure A.3).

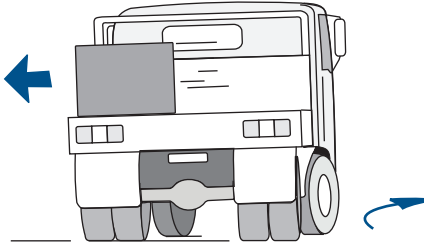


Fig. A.3

CORNERING

The force on the load when travelling over undulating or hilly roads will increase as the slope of the road increases (see Figure A.4)

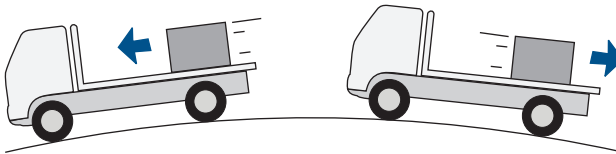


Fig. A.4

HILLS

The force on the load when travelling over cambered roads increases as the camber of the road increases (see Figure A.5).

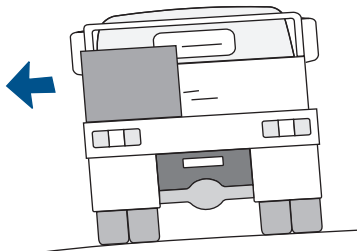


Fig. A.5

CAMBER



Section A - General Principles of Load Restraint

When a vehicle is travelling at high speed or in windy conditions, the force caused by air flow can shift a load, especially lightweight objects with large surface areas (see Figure A.6).

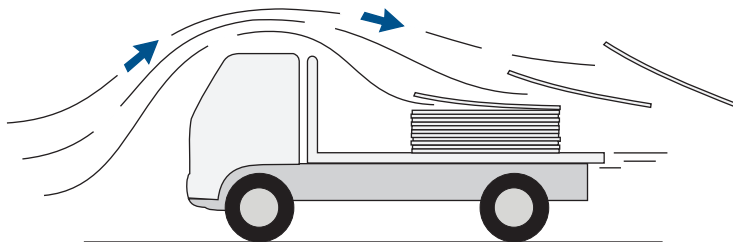


Fig. A.6

AIR FLOW

When a vehicle is travelling over rough surfaces, an unsecured load can shift or fall off the vehicle (see Figure A.7).

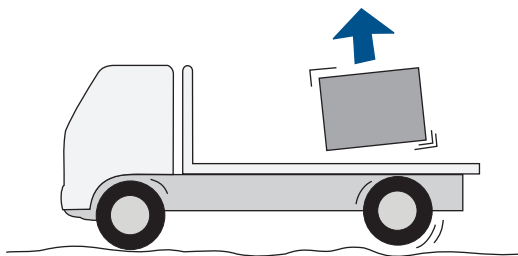


Fig. A.7

ROUGH ROADS

The weight of the load alone cannot provide enough friction to restrain it during normal driving. Additional restraint must be used.

If the load becomes dislodged from the vehicle and collides with a stationary object, the amount of damage it causes increases as its mass and the speed of the vehicle increases.

2 HOW TO CARRY A LOAD SAFELY

The following is a summary of the principles outlined in Sections B, C, D, E, F, G, and H.

2.1 Choose a Suitable Vehicle.

The vehicle must be suitable for the type and size of load (see Section B).

2.2 Position the Load Correctly.

The load must be correctly positioned on the vehicle (see Section B).

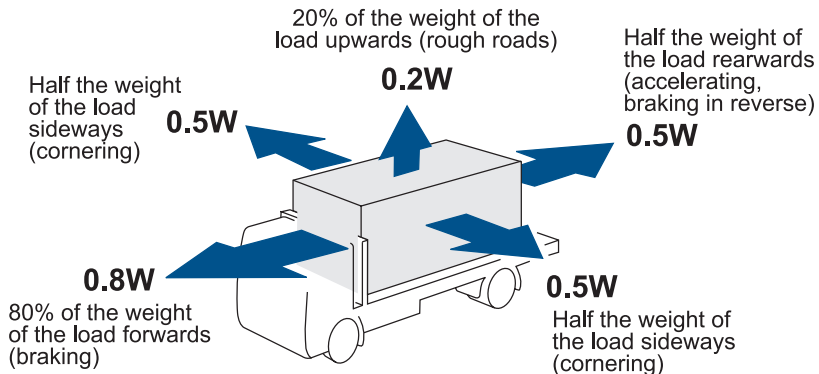
2.3 Use Suitable Restraint Equipment.

The load restraint equipment and the vehicle body and attachments must be strong enough for each type of load carried and must be in good working condition (see Sections C, G and H).

2.4 Provide Adequate Load Restraint.

Every load must be restrained to prevent unacceptable movement during all expected conditions of operation.

The load restraint system will meet the Regulation Performance Standards (see Section F), if the load doesn't shift when subjected to forces illustrated below in Figure A.8.



(W = Weight of the load)

Fig. A.8

LOAD RESTRAINT FORCES



Section A - General Principles of Load Restraint

2.5 Use Appropriate Driving Methods

If the load is correctly restrained it will not shift or fall off in all expected driving conditions, including a full braking stop.

Because a loaded vehicle might drive differently, the driver must take into account any changes in the vehicle's stability, steering and braking caused by the size, type and position of the load.

The driver should check the load and its restraint during the journey (see Section D). Loads that can settle must be checked regularly.

3 LOAD RESTRAINT METHODS

Loads can be restrained by two basic methods, either indirectly or directly. In this document, these methods are called 'Tie-down' and 'Direct Restraint' respectively.

Tie-down is when the load is prevented from moving by friction only.

Direct restraint is when the load is prevented from moving by containing, blocking or attaching it to the vehicle.

These load restraint methods are summarised below in Figure A.9, which shows restraint of forward movement of the load. These principles also apply for restraint sideways, rearwards and vertically.

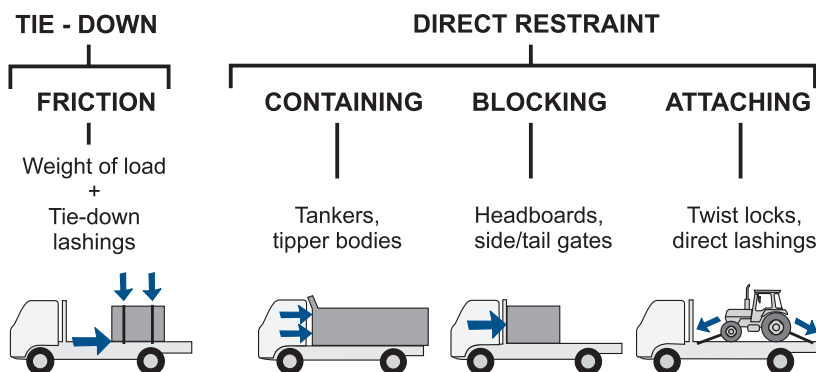


Fig. A.9

LOAD RESTRAINT METHODS (TO CONTROL FORWARD MOVEMENT)

3.1 Tie-down Method

Tie-down restraint is the most common form of load restraint and involves the use of lashings.

The load is prevented from moving by friction between the load and the vehicle.

The friction force prevents the load moving forward, rearward and sideways. The lashings are tensioned to clamp the load to the vehicle and to prevent the load from moving upwards.

The friction force comes from both the weight of the load and the clamping force of the lashings. When the surfaces are slippery, the friction forces can be very low.

Lashings that clamp the load onto the vehicle are called 'tie-down lashings' (see Figure A.10).

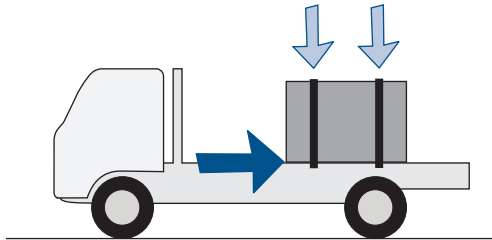


Fig. A.10 **LOAD RESTRAINED USING TIE-DOWN LASHINGS**

Friction cannot be taken into account unless the tensioned lashings provide adequate clamping of the load on the deck. Unrestrained loads, even on high friction surfaces, can bounce when travelling over uneven road surfaces and then shift during changes in speed, direction or slope.

3.2 Direct Restraint Method

A load can be directly restrained by containing, blocking or attaching without any assistance from friction.

Direct restraint by containing (see Figure A.11) or blocking (see Figure A.12) is the best method for securing loads that are difficult to tie down. Specially constructed bodies and equipment can reduce the amount of time needed to restrain loads.



Section A - General Principles of Load Restraint

3.2.1 Contained loads

Contained loads can be directly restrained without any securing devices. These include liquids in tanks, bulk solids in tanks or rigid sided bodies and mixed loads of various items in rigid sided bodies or containers (see Figure A.11). See also Section E.7, page 140.

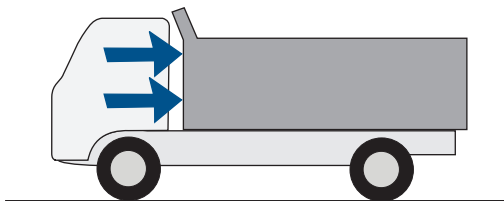


Fig. A.11

LOAD CONTAINED IN TIPPER

3.2.2 Blocked loads

Loads can be directly restrained by blocking against vehicle structures or other items of load or packing in contact with the structures. These structures include headboards (see Figure A.12), braced loading rack, drop-sides and bulkheads. The load in Figure A.12 is blocked from moving forwards by the headboard, but requires additional sideways, rearward and vertical restraint.

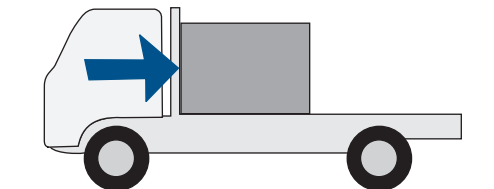


Fig. A.12

LOAD BLOCKED AGAINST HEADBOARD

Direct restraint by attaching can use lashings or mechanical locking devices (see Figures A.13 & A.14).

3.2.3 Attached loads

Attached loads can be directly restrained by lashings that provide all the necessary restraint (see Figure A.13).

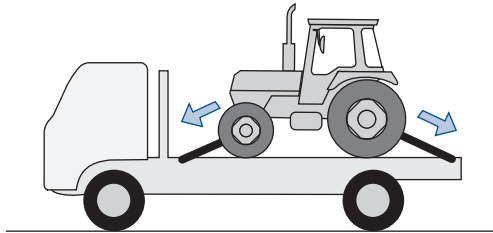


Fig. A.13 **LOAD ATTACHED USING DIRECT LASHINGS**

Attached loads can be directly restrained by mechanical locking devices that provide all the necessary restraint. Figure A.14 shows a shipping container restrained by twist locks. The twist locks do not rely on friction between the load and the deck.

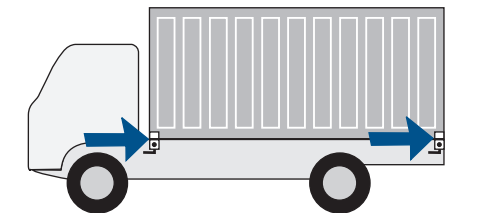


Fig. A.14 **LOAD ATTACHED USING TWIST LOCKS**



Section A - General Principles of Load Restraint

3.3 Combined Tie-down and Direct Restraint Method

Combined tie-down and direct restraint uses both friction and direct restraint.

Figure A.15 illustrates load restraint provided by:

- friction force from the weight of the load, plus
- friction force from tie-down lashings, plus
- blocking (the front part of the load is blocked by the headboard and the rear part of the load is then blocked by the front part).

The load is prevented from moving forwards by a combination of friction force from the weight of the load and the lashing tension, and also blocking against the headboard.

The load is prevented from moving rearwards and sideways only by friction.

The load is prevented from moving upwards by the lashings.

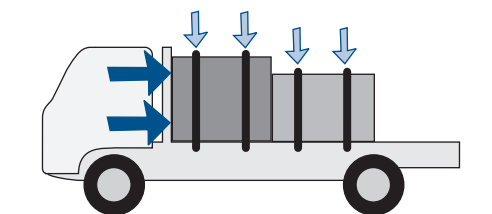


Fig. A.15

FRICION + BLOCKING

Figure A.16 illustrates load restraint provided by:

- friction force from the weight of the load, plus
- friction force from the downward force from the lashings, plus
- direct restraint from lashings that are attached to the load.

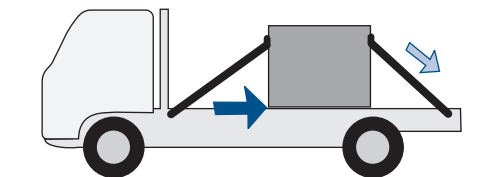


Fig. A.16

FRICION + DIRECT RESTRAINT



A tarpaulin alone cannot restrain this load of concrete blocks.



There were no lashings on this load and the plastic wrapping did not adequately hold the load together. (The enforcement officer is holding a leaning pallet of boxes on the truck while the driver is getting some restraint equipment from the toolbox).



How high can you go? Relying on hydraulics to restrain a load is a dangerous practice particularly if the load in the skips is compressible and can settle.



There aren't enough ropes to restrain all of this load of fruit and vegetables. Such loads are best restrained, packed inside gates or enclosed vehicles where they can't be damaged by ropes or straps.



Airflow could lift and dislodge this large sheet. All of the load must be properly restrained. *(Photo courtesy John Brentnall).*



The strength of the bullbar could provide greater driver safety if placed at the front of the load (see page 73 and 74).



This vehicle lost a poorly restrained lightweight roll of plastic 'bubble wrap'. An oncoming concrete agitator rolled (see below), when swerving to avoid the obstacle on the road. (Photo courtesy Mick Simpson, Wales Truck Repairs).





The pipes on both these vehicle were unrestrained and rolled from side to side during cornering.





Section A - General Principles of Load Restraint
