

Q&A:

Tipper Trucks Tipping Over

The question

What is the issue and how do we reduce the risk?

This Q&A has been produced to help Tipper Truck Drivers and their wider organisations reduce the risk of Tipper Trucks Tipping Over.

Scope of the Problem

Tipper trucks are vehicles that carry loads or commodities in a bin or tray where one side or end will lift high enough to let the loads slide or tip out.

Unloading a tipper truck can be a quick process and this task can be undertaken with a large amount of load. However, during this tipping action, there is a risk of entirely tipping the vehicle over.

Accidents and dangerous situations occur frequently because drivers of tipping vehicles fail to follow safe operating procedures. This can result in the death or serious injury of the driver and/or others.

In addition to the potential danger to life, if safe working practices are not maintained the vehicle and surrounding property may be severely damaged in the event of an accident.

This paper was developed in order to educate industry members, and the wider community, on the risks of tipper trucks tipping over.

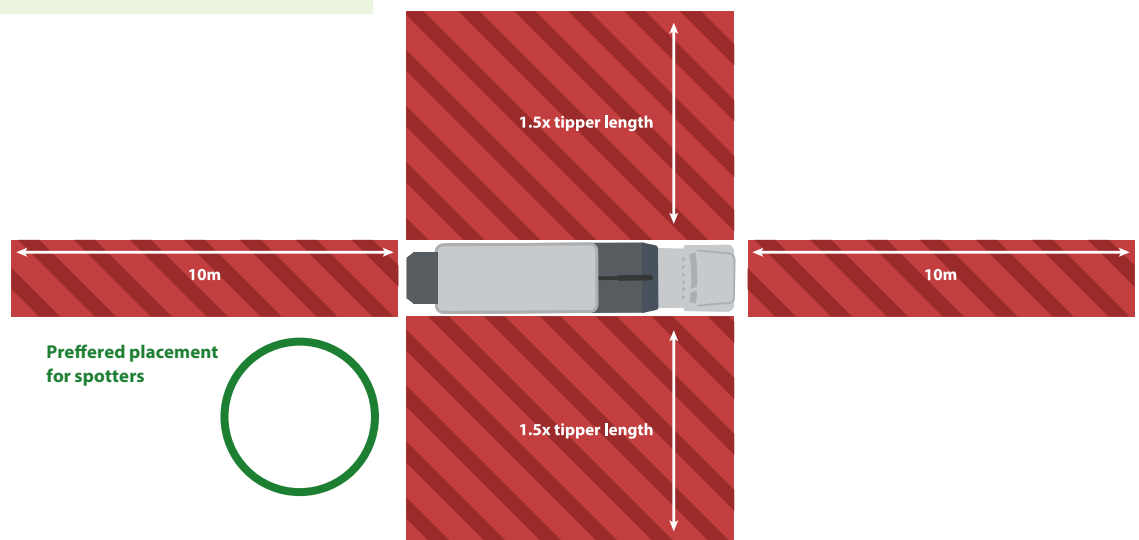
The risk of tipping over such vehicles is further complicated as:

- they are often used off-road (e.g. construction sites), on ground that may not be level or stable;
- during the unloading process, any lateral slope on the ground may cause the bin to tilt over to one side, shifting its centre of gravity closer to the point where it could topple; if unstable ground also allows the wheels on one side of the vehicle to sink, this increase the lateral tilt;
- some products, such as wet soil, may not completely slide out of the bin; remaining material at the top of the bin will increase the risk of toppling.

Tipping over is dangerous for nearby people and the driver, as well as putting equipment at risk of damage. Unfortunately, incidents are common.

Redzone

It is extremely important to understand the redzones of tipping vehicles.



Driver Training and Education

This section details the education and training that should be given to drivers who will be operating tipper trucks. Education and training are of high importance because they teach the driver how to act safely, reducing the risk to them and anyone nearby.

Drivers and subcontractors should be trained to assess the situation every time they wish to tip. If they feel there is excessive risk in tipping at a particular site, they can:

- Use different tipping techniques;
- Tip at a different location or area of ground;
- Choose not to tip.

As an organisation you should ensure drivers know they are empowered to make an informed decision and the company will stand by them. If the driver chooses not to tip for safety reasons, they should be able to do so with confidence. The responsibility should always be on the driver to decide how best to tip, if at all.

Drivers should always tip in a straight line and should minimise moving with the tipper body in the raised position, only doing so in controlled environments.

Exclusion zones should be enforced and tippers should never be tipped side by side.

Spotters should be used and should be in constant communication with their drivers as well wearing highvisibility vests. Spotters should be mandatory in more hazardous situations, including not only ground-based but elevated hazards, such as tipping asphalt into a paver near overhead power lines.

A fall zone should be established around the vehicle, outlining any potential directions the load could spill out to, and where the vehicle could fall if it tips over. This will provide for the safety of spotters and any other workers on site. Tippers can be technologically advanced with many safety features, such as alarms, but if a driver is not trained to respond to them in an appropriate manner, then these features are not serving their purpose. Additionally, if alarms are not calibrated correctly they may go off unnecessarily. This may desensitise drivers to alarms, causing them to ignore warnings in a major risk event.

Driver education should be kept current through regular updated training sessions. Management should also complete spot checks to ensure all drivers are aware of, and are implementing, all safety practices.



As part of their Mission:Possible — Safe Position is my mission campaign, Downer Infrastructure Services (IS) — Roads have a red zone card they provide to their staff. This card is intended to be used in the following manner:

- A red zone exists in the possible direction of travel whilst the tipper is travelling. This red zone extends a minimum of 10m (both in front & rear).
- When the tipper stops to begin its tipping process, there is a No Go Zone (NGZ) which is 1.5 times the length of the unit tipping which extends either side of the tipping unit.
- So for example, if a rigid tandem tipper (i.e. 5m long) is tipping, it's a minimum distance clearance on either side of 7.5m
- If a quad dog trailer (8.5m long) is tipping off, it's a minimum clearance on either side of 12.75m
- This is to ensure that no one is within the danger zone if the process of tipping fails.

Commodities and Exposure to Risk

Tipper trucks can carry several different types of commodities, which vary in their level of risk.

- Sand and gravel are like liquid; they just flow out and have minimal risk. However, wet sand can stick to trailer bodies, increasing risk.
- Wet soil is usually lower risk; the risk depends on whether the soil gets caught at the tipper hoist wells, which does pose a risk.
- Similarly, clays and big lumps of concrete is usually lower risk, unless they get caught up around the hoist well.
- Odd sized or large lumps of material can pose risks, such as heavy rocks at the front of a tipper that can get stuck during a tip. This particularly includes demolition waste.
- Dust and some wet mix products can stick to trailer bodies, causing an imbalance during tipping.
- Off balance or poor load distribution influences road vehicle dynamics.

Driver Distraction or Inattention

Constantly unloading can become monotonous and could pose a danger if a driver focuses on other things, such as talking on the UHF, scanning smart phone updates or listening to the radio. Therefore, driver distraction and inattention pose a high level of risk to both the driver and those surrounding the vehicle.

These issues can be combatted by using a 'dead man' hoist controller. With this piece of equipment, drivers need to have their hand on the controller for the body of the tipper to move up or down. So if anything goes wrong as the tipping happens, they don't need to reach for the controller.

Walking floors can also reduce risk. They're not applicable for all uses but are generally used for asphalt with a conveyor belt that pumps out without needing to tip.

Weather Condition Effects

Weather conditions at the time of tipping, and immediately before the tipper truck arrives on site, can significantly impact the safety and risk level of the tipping process.

Site conditions, including the specific tipping area, can change quickly as a result of rain. The surface under the wheels of a tipper can get soft and become unstable, posing a danger. Additionally, rain can also effect the load. For example, if the load is a soft dirt then this will compact when damp creating a more solid item to tip.

For example, a tipper tips at a construction site on a sunny morning and then leaves to collect more commodity from a site a reasonable distance away. It starts raining at the construction site. The tipper returns in the afternoon to tip its second load and the driver elects to tip in the same area. The tipping job at the same spot, which had minimal risk in the morning, is now at risk because of bogging or undermining from water. The tipper is more at risk of tipping over.

As discussed in Driver Training and Education, the driver must assess every situation and decide the best course of action, including what to do when returning to the same site.

Wind can also effect whether a load can be safely tipped. For example, a load of fine sand could be dangerous to tip on a windy day as the wind has the ability to carry the product. Furthermore, heavy winds may also effect the stability of the truck itself if the bin is raised and is caught by a large gust of wind.

Types of Surfaces

The type of surface on which the tipping is undertaken also has a high influence on the level of risk of the tipping process.

Unstable, uneven tipping surfaces are risky, as are cross gradients, tipping uphill and cross slopes. Unsealed surfaces are more susceptible to unwanted weather conditions and could become unstable or uneven.

Working Near Power Lines

Contact with overhead power lines is a serious risk that can result in electrocution, electric shock or burns. Other risks include fires and explosions that may damage tipper trucks.

The NSW Government Work Cover Safety Alerts outline that before starting work near power lines, take these actions to avoid incident:

- Clearly identify the height and voltage of high and low voltage power lines, including overhead service lines to buildings.
- Conduct a risk assessment of the proposed work.
- If necessary, consult with the relevant electricity supply authority about the work and comply with any special conditions imposed by them.
- Eliminate the risk by arranging for the electricity supply authority to isolate the electricity supply for the duration of the work.

If the risk cannot be eliminated, separate the electrical hazard from the mobile plant and workers by ensuring the following approach distances are maintained:

- Up to 132,000 volts – 3 metres
- Between 132,000 volts and 330,000 volts – 6 metres
- Above 330,000 volts – 8 metres.

Note: when applying the above approach distances, it is important to take into account the 'sag and swing' of the power lines, the movement of the mobile plant and the strength of the wind, as well as possible operator error or equipment malfunction.

- Ensure a safety observer is used whenever mobile plant is in motion and is likely to come closer than the above approach distances.
- Ensure an effective communication system is in place for the workers performing the work.
- Remember the safe work procedure when working near overhead power lines – LOOK UP AND LIVE.

Trailer Specific Exposures

Vehicle Maintenance

Fleet maintenance should be a high priority. This minimises the chances of a vehicle malfunction occurring during tipping. Maintenance includes checking for rust and ensuring items are bolted together properly and there aren't any weaknesses at the joints where the trailer pivots at the back. This includes the posts at the back of the trailer as well as hoist mounts on dollies. Using the correct nut and bolt assemblies, torqued to MFR specifications and top mounts of hoists, is also essential. These should be inspected on a scheduled basis.

There will be instances where a tipper does need maintenance. There are several characteristics of the tipper truck itself that influence the level of risk during the tipping process, such as the arrangement of the tipping bin, trailer length and the type of coupling and other specific pieces of equipment.

Trailer Tailgate

Trailer Tailgate Trailer tailgates can 'stick', causing a hazard if the driver exits the vehicles to try and fix it. A driver should never stand between the tailgate and the bin, or behind the tailgate if the tray is lifted, as the tailgate may open or close unexpectedly.



Rear Tipping Trailers

Among rear tipping trailers, chassis tippers usually have a lower risk than over-axle tippers because more of their structure remains on the ground when the bin is tipping. When using chassis tippers, they must be lined up in a straight line for tipping. Drivers should be trained for this.

A chassis tipper is a tipping trailer that has its bin attached with a hinge at the rear of the chassis, so the bin pivots upward, away from the chassis, when tipped.

Over-axle tippers can be used if drivers are well trained and if the unloading site allows what they are doing (such as tipping in a straight line). An over-axle tipper is a tipping trailer that tips by pivoting near the centre of its chassis, rather than having its bin hinged at the rear of the chassis.

When tipping, an over-axle tipper's rear axle wheels remain on the ground, but the first and second trailer axles, in the case of a three-axle trailer, will lift off the ground.

With truck and dogs, the king pin and drawbar holds the dog to the truck. When using semi-trailers with quick release turntables, only the king pin is holding the semi-trailer to the truck, so ballrace turntables must be used.

A quick release turntable is also known as a fifth wheel, a coupling between two vehicle units, allowing the trailing unit to rotate about the vertical axis and to pitch in response to terrain, but not to roll, in relation to the leading vehicle unit. A quick release turntable can be uncoupled by operating its release lever, enabling quick separation of a hauling unit and trailer. These are typically fitted to prime movers and converter dollies to enable coupling with semitrailers.

A ballrace turntable is a coupling between two vehicle units that allows the trailing unit to rotate about the vertical axis, but not pitch or roll, in relation to the leading vehicle unit. A ballrace is typically employed above the first axle(s) of a full trailer (dog trailer), allowing the body of the trailer and the rear axles to articulate as the vehicle negotiates turns. A ballrace is typically not able to be uncoupled without the use of tools. A ballrace turntable can also be employed on a prime mover if its semi-trailer is intended to remain permanently attached.

Side Tippers

Side tippers are capable of dramatically reducing the risk of tipping over, but they have to be designed properly. It is possible to design a side tipper so it keeps its centre of gravity almost constant during the entire unloading operation, but a cheaper and lighter design allows the centre of gravity to shift laterally during unloading, increasing the risk that the trailer will roll over.

Of course when this happens, the consequence may be less severe than a reartipping bin falling from a great height, but it is still a major incident. It is up to the industry, based on the specific loads they are tipping, to determine whether side-tippers are appropriate to use.

Trailer Lengths

The transport industry is moving towards longer bin lengths with quad dogs that are still shorter than a semi-trailer. Organisations should be mindful that longer trailers are more at risk of tipping over.

Quad dogs are recommended by industry experts as they find the right balance, or 'sweet spot', between safety and productivity.

Quad dogs are safer on-road because they have more axles. This provides improved on-road stability and vehicle dynamics, making them more stable when changing lanes or swerving to avoid obstacles in an emergency. They can also operate at 48-57.5t gross, whereas 3-axle dog trailers are limited to 45-49.5t gross (these ranges encompass different limits in different states). As far as stability when tipping, their pair of front axles provides a heavier ballast at the front of the trailer to keep it stable when the bin is raised. In contrast, the single axle and smaller dolly structure at the front of a 3-axle dog trailer weighs about 1000kg less than the front of a quad dog.

A quad-dog tipper would present less tipping risk than a five- or six-axle dog trailer because its bin is not as long, so it doesn't rise as high. The tipping risk comes from the movement of the centre of gravity outside the vehicle's contact points on the ground.

A super-dog trailer is a three-axle dog trailer, incorporating one front axle and a tandem rear axle group, but with a longer wheel-base or s-dimension than a conventional three-axle dog trailer.

Load Distributions

Always ensure a load is distributed evenly and that the load does not exceed the carrying capacity of the vehicle or axle loadings.

If a material is likely to flow poorly, the load should be lightened at the top end of the bin. A slightly smaller load will be safer than a full load for a material that flows poorly.

Coupling Types

Bolted-down ballrace turntables should be used for semitrailers. When this is not possible, a slide rail ballrace should be used in preference to a quick release coupling.

A quick release coupling is likely to be adequate for use in good conditions in a straight line, with no slope or cross gradient and where drivers are well trained and tippers are well maintained.

The likelihood of ideal conditions every time is very low and this limits their use.

The drawbar eye and automatic pin coupling are safety-critical components of these types of heavy vehicle combinations.

If you operate a dog trailer, pig trailer or road train dolly fitted with these types of coupling systems, you should inspect them regularly to ensure their integrity. Automatic or air operated couplers should have a failsafe or redundancy, such as an air shut off or isolation control.



Common Aids Used in Tipper Trucks and Their Link to Tipping Risk

Bin Liners

Bin liners are being trialled in the transport industry as they can help unload loads faster. They reduce friction and lower operating heights improve stability (some operators have made them mandatory in their fleet of quads and longer).

A bin liner is a replaceable surface added to the floor and lower half of the sides of a tipper bin to protect the metal bin surface from sharp stones and to reduce sliding friction and allow product to pour out more easily. Some bin liners can achieve full unloading at much lower tipping angles than a bare bin surface. Bin liners are usually made of thick acrylic or some other polymer material.

Cameras

Rear-facing cameras can be used on the truck and on the dog, and forward-facing cameras can be used at the cabin. This increases the driver's awareness of what is happening outside the tipper. However, the camera may not be able to see all of the surroundings. No technological solution can replace a spotter or a walk-around.

Roll Away Emergency Park Brakes

Spring brakes can be installed to stop rolling on inclines. Maxi brake door alarms should be installed to prevent a driver leaving their vehicle without applying the brakes.

Inclinometers

Industry experts have determined inclinometers to be unreliable because they don't make sound when the tipper is unsafe or when the device itself isn't working correctly, which adds another possible fail point. So if the device breaks or is faulty, the driver won't know and could go ahead with dangerous activity.

Direction should instead be focused towards Electronic Stability Control (ESC), which is often built into many of these types of vehicles. It is more reliable and gives alerts if there is something wrong with the system.

Walking Floors

Walking floors are mechanical floor surfaces comprised of several parallel rectangular floor sections that slide forward and back in an alternating manner – that is, sections 1, 3, 5 and 7 slide backward while sections 2, 4, 6 and 8 remain stationary; then the reverse occurs, and the process is repeated – 'walking' the product out of the bin. With a walking floor, the bin doesn't need to tip, or can be tipped to a very small angle, to achieve full unloading.

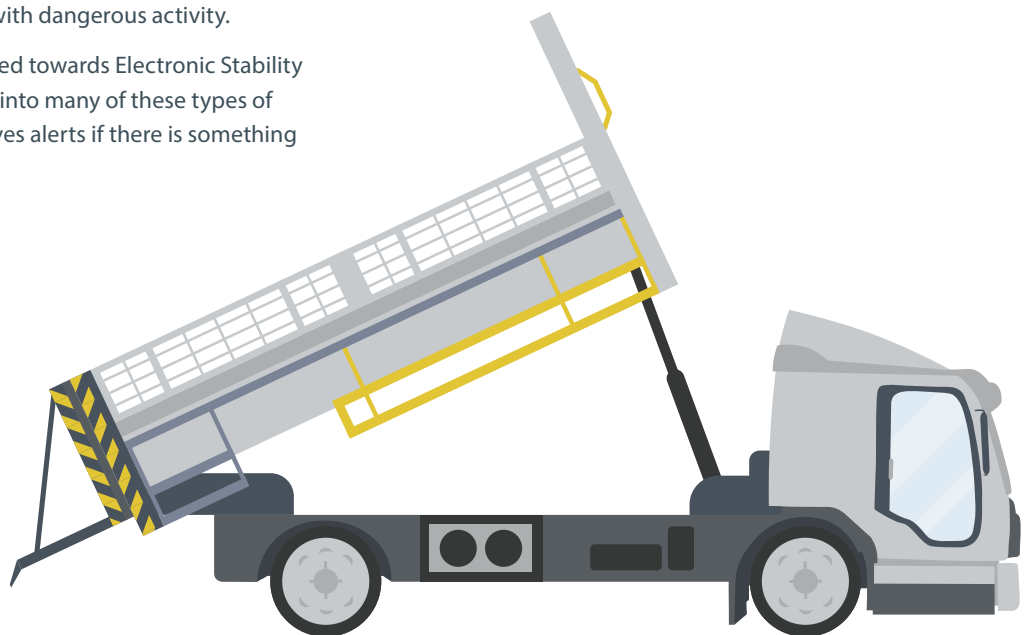
They aren't applicable for all uses but can be used for unloading asphalt with a conveyor belt without needing to tip. Anything that can be done to reduce the need to tip should be done.

Body-up Alarms

Body-up alarms let the driver know when the bin is in the raised position via a light and loud alarm in the cab. This reduces the chance of overhead collisions and other safety issues with raised dump bodies.

Indicators

A new indicating system using green LED lights can be used to help drivers confirm the position of the tailgate lock before elevating their tipper to offload. Drivers can see these from the driver's seat as they are not in the rear of the vehicle. If indicators are connected to an electronic roll stability control system, it can indicate when the tipper bin is uneven.



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For more information

System for Preventing Tipper Truck Overturning

National Heavy Vehicle Regulator (NHVR), Safety Compliance Alert 1a/2014 – 5 September 2014, Inspection of couplings for dog trailers, pig trailers and road train dollies

Texas Department of Insurance – Dump truck tip over prevention fact sheet