

# TIPPING EQUIPMENT

## RECOMMENDATION



EUROPEAN CHEMICAL TRANSPORT ASSOCIATION

*In European land transport, tipping silo trailers and tipping dry bulk containers are frequently used for transport of dry bulk chemicals, either granulates or powders.*

The unloading of this equipment is done by tipping and this places multiple requirements on the construction of the equipment, on their proper maintenance, on the unloading area conditions and unloading procedures.

Although serious accidents during unloading may be rare, these will constitute a serious safety threat to the personnel, driver or site operators surrounding the equipment and they will always cause important material costs.



>> Tipping silo trailer accident

Leads on the safety aspects involved were exchanged and issues were raised by the equipment end-users. Some insights still need to be incorporated in the equipment manufacturers' future product developments. The specific topics of rear landing legs of silo trailer equipment and the twist locks of tipping containers were discussed in depth.

This cooperative effort in improving safety over the product life cycle of equipment between several hauliers and vehicle and component manufacturers took place in the context of good product stewardship and of sustainable industrial production.

In order to limit these safety risks, ECTA, the European Chemical Transport Association, took the initiative to formulate in good faith the recommendations on the construction, maintenance and usage of this type of equipment as collected by a joint working group with representatives of equipment manufacturers (=manufacturers of rear landing legs, twist locks and trailers) and representatives of chemical transport industry.

This recommendation on tipping equipment

- does not cover the dry bulk transport equipment that is discharged without tipping
- does not cover the use of maritime containers with liner bags on tipping chassis

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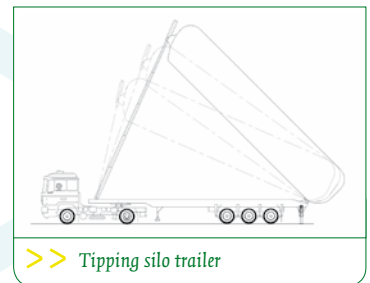
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The complexities of the issues and the numerous parties involved are described in the following table:

PARTIES INVOLVED				
	Component manufacturer	Vehicle manufacturer	Fleet/driver	Operator of facility
<b>Wear and deterioration</b>	integrated safety devices in landing gear, provision of maintenance instructions with the product	provision of maintenance instructions with the vehicle	regular maintenance acc. to maintenance instructions	
<b>Sticking and shifting of cargo</b>	additional safety spindle nut	offer special equipment (vibrating unit, spirit levels)	purchase adequate equipment, employee training	regulations for unloading
<b>Displacement during loading and unloading causing tension in the landing gear</b>	stable landing gear for lateral loads	use of adequate equipment e.g. landing gear with sufficient length	release the tension between tractor-trailer unit before unloading	regulations for unloading
<b>Deformation of chassis frame causing tensions in the landing gears</b>		chassis frame with sufficient stiffness	release the tension between tractor-trailer unit before unloading, employee training	regulations for unloading
<b>Side wind</b>	stable landing gears		release the tension between tractor-trailer before unloading	regulations for unloading, shelter from wind, wind gauges
<b>Unsuitable surface uneven ground</b>	stable foot plate	spirit levels	release the tension between tractor-trailer before unloading	suitable unloading point

>> Overview of some issues related to tipping equipment and parties involved

# RECOMMENDATIONS FOR TIPPING SILO TRAILERS



## CONSTRUCTION OF THE TRAILERS

### >> CHASSIS

It is important to ensure that the chassis of the trailer will not be subject to plastic deformation. In this context the usage of high yield strength steel chassis is not recommended. A chassis in aluminium carries the preference.

### >> ATTACHMENT OF THE SUPPORTING REAR LEGS TO THE CHASSIS BEAMS

The supporting legs should be securely fitted to the chassis. Placement of the boltholes according to state of the art techniques is

required since the perforation for boltholes at incorrect places reduces the lifespan of the chassis. (See: European Aluminium Association: publication "Good Practices in Aluminium Design and Repair")

A sufficient number of bolts (M16 minimum equivalent to quality grade 8.8) on the back plate of each leg are necessary. Eight bolts per leg is deemed a minimum attachment. Cross bracing can also provide additional support for the leg when sufficient space is still available to connect to the chassis.

The trailer manufacturers should incorporate the know-how of the

manufacturers of the rear landing legs, especially in relation to the attachment process of these legs and to the angles to the chassis and trailer.

### >> GROUND CLEARANCE

For all applications, it is recommended that a ground clearance (unloaded) of 300 mm is respected where possible. This distance is based on the knowledge that the landing leg should not have to be extended too much and that the strength of the leg diminishes upon overextension.

Specifically for ADR transports, a ground clearance (unloaded) of 350 mm is

obligatory as a minimum. An estimated 10 % of all manufactured silo trailers is designed in compliance with the ADR specifications.

Whenever possible, the height of the bumper should be aligned to the installation height of the legs for better protection of the landing legs.

For ferry transfer or due to problematic route conditions (such as very uneven roads) a higher ground clearance of bumper may be justified.

When the bumper is fixed to the tilting part of the vehicle, sufficient ground clearance must be taken into account for discharge movements.

## >> USAGE OF BLOCKS UNDER SUPPORTING LEGS

When trailers are constructed with too much ground clearance of the bumper, the landing legs are mounted high and will be used at maximum extension. This results in higher wear on the spindle and a higher risk of bending.

Sometimes such overextension of the leg is avoided by using blocks under the landing legs so that there is less wear on the rear legs and the extension of the legs' mechanism is minimised.

However, the usage of blocks under supporting legs is a potential threat to the stability of the equipment during tipping. The transfer of the weight to the ground can be compromised.

In the cases a higher ground clearance of bumper is justified, blocks under the landing legs can be used, but these blocks should be strong, monovolume blocks, either measured to fit the landing leg or minimum twice the size of the ground surface of the feet.

## >> INSTRUCTION MANUALS FROM MANUFACTURERS

The manufacturers of the silo trailers and the manufacturers of the landing legs should coordinate their instruction manuals and provide such coordinated manuals to

the transport companies who purchase the equipment.

At present, there is no clear coordination but a mere transferral of manuals, which results in instructions that are difficult and unclear.

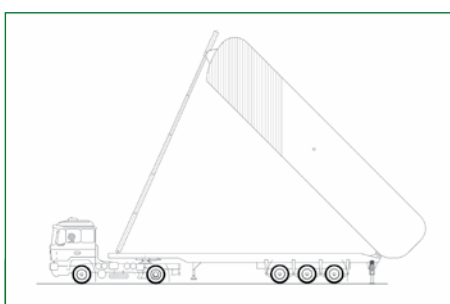
The recommended approach is to provide two manuals upon delivery of a tipping silo trailer: one manual is destined for the drivers and another manual for the maintenance specialists of the equipment. The maintenance manual coordinates all relevant instructions for the trailer and the landing legs in one text and is destined for the maintenance shop or garage.

Furthermore an alignment of all manufacturers on unloading instructions as detailed further below in these Guidelines is strongly recommended. This would eliminate different unloading procedures per type of trailer. When there are different instructions per type of trailer, it becomes very difficult for a driver to know precisely what the instruction is and to execute correctly the unloading procedure for the trailer he is driving.

## >> AVALANCHE AVOIDANCE

Sometimes certain bulk powders or bulk granulates can cause unloading accidents due to the formation of “bridges” in the powder or bulk product, causing the product to stick to the top of the silo trailer. At unloading and upon tipping of the trailer this mass can suddenly fall down by force of gravity with a sudden burst. This effect is here called “avalanche” of the product.

Such unloading incident causes a violent and sudden drop of product on the rear landing legs.



>> “avalanche” effect about to happen

Products prone to “avalanche” incidents should be transported in dedicated transport equipment equipped with vibrating or air blow devices to keep the product fluidity optimal or in equipment that is discharged without tipping.

Transport companies should take the events of avalanches seriously and reporting the product classes prone to causing such accidents to ECTA is recommended.

## REAR LANDING LEGS

### >> TECHNICAL EVOLUTIONS

Most landing legs are mechanically operated landing legs, consisting of an inner mechanism of a spindle and a nut, which is being moved up and down by a mechanical screwing action by the driver. This can be considered the main technique of extension of landing legs.

There exist hydraulically operated landing legs, but the usage of these is decreasing, since they imply extra weight and cost. These hydraulic landing legs are specifically used in cases of very heavy loads where the legs cannot be extended manually by mechanical lifting.

### >> REAR LANDING LEGS

The rear landing legs supporting the equipment were in the past not specifically designed for tipping equipment, but were legs made to carry weight of equipment at standstill.

Over the recent years, specific and dedicated rear landing legs have been developed. These have a construction and design which is technically divergent from normal landing legs used for support only. The incorporation of specific safety devices to limit the consequences of a sudden drop through the spindle of rear landing legs (example: a snapping device to stop a fall through caused by a spindle/nut failure) and designs allowing easy maintenance and checks of the landing legs' inner mechanism are such new developments. These evolutions in design aim to prevent and reduce the impact of tipping incidents

and are highly encouraged. The use of such specific rear landing legs is therefore recommended for tipping equipment.

Best practice is to ensure the leg construction protects the nut and spindle.

## MAINTENANCE OF SUPPORTING REAR LEGS

The entire maintenance procedure should be conducted according to the maintenance instructions of the manufacturer and by skilled personnel.

### >> INTERMEDIATE CHECKS

An intermediate check is recommended when the winding of the leg is stiff or after the equipment suffered the occurrence of an avalanche.

This intermediate check will consist of an inspection of the securing of the leg at the chassis and of the checking of spindle and nut mechanism inside the leg following the instructions of the manufacturers of the legs.

### >> NORMAL MAINTENANCE

Maintenance of silo transport trailers should include specific and regular maintenance of the supporting rear legs at least once a year.

Normal maintenance consists of winding the legs up and down the entire stroke in high gear, checking if there is any sign of stiff operation or deformation. Best practice is to dismantle the leg, removing the inner leg and winding the spindle out to full extension visually checking the thread for corrosion, wear and deformation.

The spindle/nut combination must be greased properly, following the instructions given by the manufacturer of the landing legs.

When the spindle is wearing down, the leg must be replaced.



>> Spindle and nut with severe rust and corrosion

Normal maintenance is also due when drivers report that the leg does not roll down easily and when the intermediate check as recommended above does not solve this problem.

A system must be in place to record the maintenance cycles of the supporting rear legs.

The manufacturers of landing legs are requested to specify the maintenance for their products in a clear and detailed manner. These instructions should be included and coordinated in the handling manuals which are provided from the trailer manufacturers.

Transport industry is interested in the tolerance levels between spindle and nut and would like the manufacturers to express the lifespan and durability of the rear landing legs in number of usages instead of in time. This way maintenance and replacement time can be optimized.



>> Bent rear leg

### >> AT TANK CLEANING STATIONS

An important factor in the reduction of the lifespan of rear landing legs is the influence of the environment on the spindle/nut mechanism.

Rust and corrosion are important causes of problems with rear landing legs and should be absolutely avoided. Protective construction around the inner mechanism of the legs and a good maintenance regime of the legs address this issue but corrosion due to external factors still remains a matter of concern.

Tank cleaning stations must be made aware that rear landing legs should be protected from water jets and detergents during cleaning. Direct high pressure jetting of rear legs should be avoided.

### >> UPON INCIDENT

Any time an avalanche occurs, the driver must report this to the maintenance shop or garage at once. A rear leg that has been in such incident should be checked to ensure integrity of the inner mechanism by an intermediate check.

It is recommended that when a leg has to be replaced and this doesn't happen at the regular maintenance place, the replaced leg should be brought back to the maintenance shop to be evaluated and to allow correct assessment of the cause for

the replacement.

In order to ensure feedback on occurrences with rear legs, a reporting of findings or returning the damaged leg to the manufacturers of rear legs is recommended.

Any landing leg that does not run smoothly up and down must be reported by the driver to the maintenance shop or garage.

A rear leg that is bent should be replaced.

## >> LEASED EQUIPMENT

Any leased equipment should be provided with rear supporting legs in excellent condition and well maintained. The lessor or the equipment should include the above maintenance and replacement guidance in his service to the lessee.

The driver sent to pick up leased equipment is to be informed by the lessee how to check the legs before accepting the trailer. First indications on how to check landing legs can be found in this text under "site access control".

## SITE ACCESS CONTROL

A complete check of the condition of the inside of a rear leg is not possible since the mechanism of spindle/nut is not visually accessible due to its encapsulation.

However the following visual indications for a closer scrutiny can be useful:

- When one landing leg hangs lower than the other
- When the foot of a landing leg is heavily damaged
- When the winding down of the leg does not go smoothly

In such cases, it is recommended to check whether the leg can still be used safely.

## UNLOADING SITES

The situation at unloading sites is also a very critical part in ensuring safety in transport by silo trailer equipment.

Safety problems can be caused by: uneven surfaces, unsuitable surfaces, side wind or stormy weather conditions, aerodynamic thrusts around buildings.

To unload safely, there must be a spirit level and firm surface provided. The insertion of wooden planks between surface and the foot of the leg to cover for uneven unloading surfaces is not acceptable.

Preferably a thermo stable surface covering should be used on the unloading surface, suitable to support minimum weights of 300 Tons per square meter (2 x 12 tons per surface of the foot, eg 200 mm/300 mm). Underlying pipes or drains on the unloading place are to be avoided.

Hot weather will make soft asphalt surfaces unsuitable for unloading.

Side winds or gushes can also make unloading unsafe. In conditions above 5 Beaufort or winds of more than 30 km/h unloading is not possible. The driver will evaluate the safety of the situation. Unloading sites should respect the driver's advice and not push to unload under unsafe weather conditions.

## UNLOADING PROCEDURES

The lack of consistency in unloading instructions between the different silo trailer manufacturers decreases safety for drivers. Drivers have several trailers to drive and find instructions for unloading that differ on the sequence of application of the breaks and on air pressure release.

To align unloading procedures is a request by the transport industry for the safety of the drivers.

Unload trailer in several stages (not at once to highest level but in gradual steps)

The following procedure is considered best practice:

- Place the trailer in correct position for unloading;
- Apply brakes to both truck and trailer (if

braking is done after the landing legs are on the ground, the wheel shifts slightly thus moving the landing feet to an angle, which is dangerous and can damage them);

- Visually check legs for cracks, deformation and damage
- Extend landing legs to touch the ground;
- Air pressure in the Airbellows is let out;
- Use the landing legs to level the trailer by lowering one of them to spirit level first making sure that the legs are at approximately 90° to the ground and free of tension. If this is not the case readjust using the brakes.

## SAFE POSITION OF THE DRIVER

The driver should not remain at the side of the combination nor at the front.

The best place is at the rear area of the unit at some distance from the combination with eyes on the loading/unloading of the trailer.

The driver moves closer to tip and steps immediately back again.

Hoses and rotary valves should also be operated from the rear area of the unit.

## REPORTING BY DRIVER

The driver is expected to always report to the garage or the maintenance shop the following occurrences:

- Any difficulty in unwinding the supporting legs
- Any difficulty in conditions of loading or unloading site
- Any damage of feet of landing legs or bending of legs
- Any avalanche incident

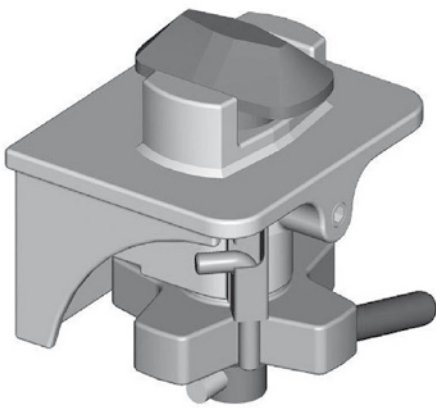
# RECOMMENDATIONS FOR TIPPING DRY BULK CONTAINERS



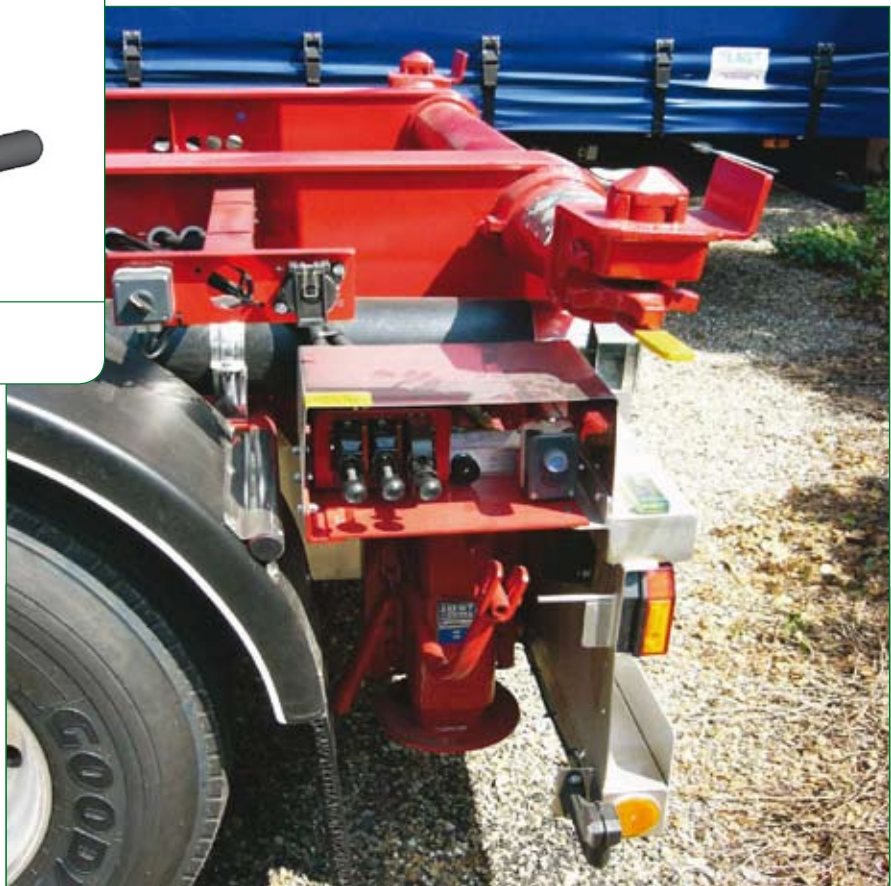
>> Tipping dry bulk container

All recommendations for silo trailers described above in this document also apply: on landing legs, unloading conditions, driver instructions, etc.

In this chapter, specific requirements for twist locks on tipper chassis and the proper training of drivers are described as contributing factors to safe loading and unloading of tipping dry bulk containers.



>> Tipper chassis twist lock



>> Tipper chassis for tipping container with “indicator” (yellow bar on twist lock) and “heel plate” (vertical steel block behind rear twist lock)

## CONSTRUCTION REQUIREMENTS

UIC and CSC regulations apply on the whole construction, including the container and the corner casting. Future inclusion of testing procedures on tipping forces in the ISO 1496/3 and 1161 norms is hereby recommended to the manufacturing industry.

It is recommended to have the twist locks of the tipper chassis connected from left to right since this can reduce impact of uneven lifts of the container.

## REAR TWIST LOCKS

Tipping of containers places strenuous conditions on the rear twist locks therefore only twist locks recommended by the manufacturer for tipping applications must be used. Front locking pins should not be used. A high tensile stem is recommended.

The twist locks should screw down.

The shear block should be a one-piece casting in cast steel or welded steel construction. Retractable shear blocks should not be used.

The interface between the container corner casting and the twist lock should be kept clean and not greased to maintain friction.

All twist locks which are used on a tipper chassis should be equipped with “indicators” which facilitate visual check by the driver of complete closure of the twist locks.

The “indicator” can be an iron bar that is being welded to the bolt of the twist lock and that sticks out showing the angle of insertion of the bolt and allowing a visual control by the driver that the bolt is turned correctly.

### >> MUSHROOM (TOP PART OF THE STEM)

The mushroom head of the bolt should be completely embedded in the twist lock when the twist lock is closed properly. This means that the bolt is properly inserted.

### >> HEEL PLATES

It is recommended to install heel plates behind the rear twist locks.

## LOADING PROCEDURES

It is recommended to load in a horizontal stable condition; therefore loading in elevated position to increase the payload is not recommended.

## UNLOADING PROCEDURES

The majority of incidents that occur during bulk tipping container unloading are due to driver error in failing to close the twist locks correctly before unloading.

Before unloading it is recommended that the driver should screw down the handnut of all twist locks tightly with a spanner.

The spanner is any suitable tool that allows the clamping of the handnut to be done by the driver.

Before unloading a visual check of the direction of the bolt (stem) should be done.

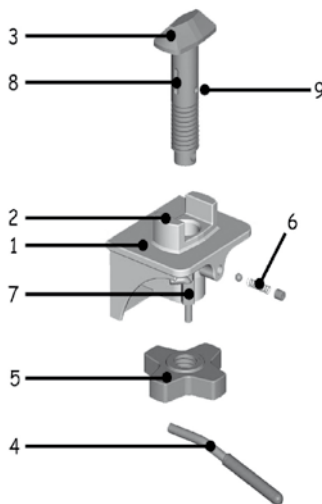
This is possible when the twist lock is equipped with an “indicator” as described above.

The recommended position of the driver is at the rear area of the combination with sufficient distance to the equipment and with his eyes on the discharging.

If the twist locks are semi-automatic then the drivers should always be instructed that the handnuts still need to be manually tightened. There is a danger that semi-automatics can give a false sense of security in that drivers might feel that they do not have to leave their cabs.

If additional safety devices have been fitted then the relevant operating instructions should always be adhered to.

1. Top Plate
2. Shearblock
3. Stem / mushroom (top part)
4. Handle
5. Handnut
6. Ball and Spring
7. Safety Locking Device
8. Vertical Recess
9. Dimple



>>> Exploded view of tipper chassis twist lock



## 10 TIPS FOR UNLOADING WITH TIPPING EQUIPMENT

1. **UNLOADING SURFACE** is level and firm, providing sufficient support during the unloading operation. Avoid unloading on unstable surfaces, such as soft asphalt in hot temperature. Avoid using blocks under rear supporting legs to compensate uneven unloading surface.
2. **WEATHER CONDITIONS** can prevent safe unloading (e.g. strong winds). When the driver indicates that the weather conditions are unfavorable for unloading, postponing the unloading should be considered.
3. **UPWARD CHECK OF UNLOADING PLACE:** sufficient free space should be available above the equipment so that tipping is not obstructed e.g. no electricity lines, no piping or any other obstacles.
4. **BEFORE UNLOCKING THE UNLOADING PIPE** the customer verifies whether the information on the transport documentation corresponds with the vehicle or container number.
5. **PRODUCT UNLOADING PIPE** has a padlock. The customer controls the locking and unlocking of the unloading pipe. **DISTANCE** between unloading truck or container and unloading pipe of silo does not exceed 6 m.
6. **EARTHING POINTS** for the container or trailer and unloading equipment are present and are clearly indicated. **ELECTRICITY** connection is present.
7. **TYPE AND SIZE OF THE CONNECTION COUPLING** on the unloading pipe should have been communicated to the transport company beforehand.
8. **PRODUCT INTEGRITY** is best served when the unloading site has suitable compressor, product-dedicated couplings and hoses available which are maintained and checked regularly for proper functioning.
9. **WORKING AT HEIGHT** requires appropriate measures or procedures in addition to handrails and walkways on transport equipment. The handrails must not be used to attach the protection gear of a fall arrest system.
10. **DRIVER AND OPERATOR** follow the ECTA-Cefic Behaviour Based Safety (BBS) Guidelines for Loading/Unloading where appropriate.