Safe Loading on Vehicles

Contents

Preface

This guideline is jointly developed by the Container Depot Association (Singapore), Singapore Logistics Association, Singapore Transport Association, PSA Corporation Ltd and Jurong Port Pte Ltd, with support from Ministry of Manpower (MOM) and Workplace Safety and Health (WSH) Council. A Safe Loading Committee was formed to gather expertise and perspectives from these agencies and companies, and raise safety awareness and capabilities in Singapore's Logistics and Transportation sector.

This guidelines is produced for educational and informative purposes. It also serves as a resource for safe working practices for loading and unloading activities, as well as cargo securing. It is intended to be simple and easy to understand. It is not intended to be extensive or a sole substitute to the Road Traffic (Motor Vehicles, Construction and Use) Rules or the *Code of Practice for Safe Loading on Vehicles (CP30: 1985)*. Users are advised to use this guidelines in conjunction with other relevant materials or references where appropriate.

1. Introduction

1.1 Scope

This guidelines provides practical information for transport operators, drivers, and employees involved in the transport of cargo. Aside from the logistics industry, transportation is an integral operation in many other industries. Hence, any organisation that operates a transport fleet may also find this guidelines useful and practical.

The scope of this guidelines includes safety principles of transportation, cargo arrangement, restraining methods for different cargo types, and loading and unloading activities. While the content aims to be comprehensive, it is not exhaustive.

1.2 Roles and Responsibilities

There are different stakeholders involved in a logistics and transportation operation supply chain, and each stakeholder has different responsibilities in keeping their work and workplace safe. A company or person may take on more than one role and shoulder the corresponding responsibilities.

Employer Responsibilities:

- Provide vehicles and equipment suitable for type of cargo handled by company.
- Establish a schedule for equipment maintenance according to manufacturer specifications and ensure adherence to it.
- Establish and ensure standard of employees' competence through training.
- Implement a Risk Management system to mitigate risks.
- Investigate and address reported safety lapses.

Managerial and Supervisory Responsibilities:

- Ensure that staff are adequately instructed in the safe use of equipment.
- Ensure that vehicles and equipment are sent for timely maintenance and repair.
- Ensure risk assessment is carried out for each operation.
- Conduct safety briefings before starting work.
- Plan routes in advance, especially when vehicle dimensions or weight exceed road limits.
- Implement countermeasures for reported safety lapses.

Driver and loading crew responsibilities:

- Check vehicles and equipment for defects before use.
- Take measures to prevent vehicle movement during loading and unloading.
- Load and arrange cargo in a safe and stable manner before securing.
- Secure cargo to prevent movement in any direction during transporting.
- Report problems, unsafe acts or conditions, near misses and incidents.

The responsibilities above are applicable to manufacturers and suppliers that provide delivery service for their customers. Organisations that outsource delivery services to contractors are responsible for ensuring that their contractors know how to handle the cargo safely.

Manufacturer and supplier responsibilities:

- Package products for safe and easy loading, securing and unloading.
- Provide instructions on safe loading and unloading, and proper securement.

1.3 Basic Principles of Transporting

Any cargo being transported should remain safely on or within the vehicle. The cargo should not endanger the driver, passenger(s) on the vehicle, and other public road users. See Figure 1 for examples of accidents that could result from poorly secured cargo.

An accident can result in:

- loss of life and/or injury;
- loss of or damage to cargo;
- damage to vehicle; and
- damage to public property.

Figure 1: Accidents due to poor cargo securement.

When travelling, cargo is subjected to forces that shift the cargo in four directions illustrated in Figures 2 and 3. Friction and weight of the cargo are not enough to keep the cargo from moving about during transportation. Thus all cargo should be adequately contained or restrained to prevent it from shifting, or falling off during normal driving conditions.

How cargo may shift during transporting:

1. When vehicle is turning, the change in direction would cause unsecured cargo to shift sideways.
2. When vehicle accelerates, the increase in speed would cause unsecured cargo to shift backward.
3. When vehicle decelerates or brakes, the decrease in speed would cause unsecured cargo to shift forward.
4. Driving on uneven ground makes the drive bumpy, and would cause unsecured cargo to bounce.

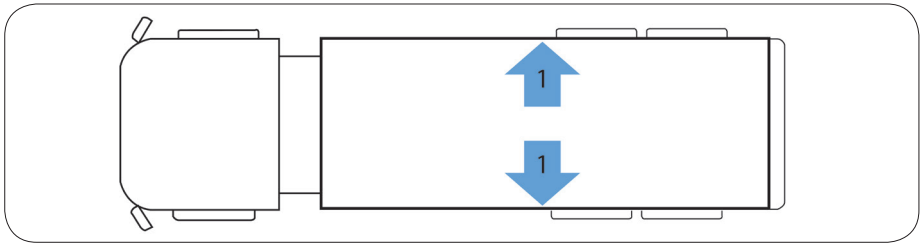

Figure 2: Top view of vehicle with lateral forces illustrated.

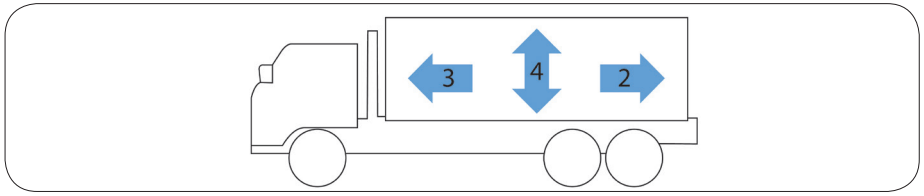

Figure 3: Side view of vehicle with forward, backward, and vertical forces illustrated.

1.4 Transport Packaging

Cargo packaging serves a number of functions: provide weather and damage protection, support cargo during loading and unloading, and facilitate cargo securing. There are three types of packaging—primary, secondary and tertiary.

Primary packaging holds information about the product and bear the product brand (e.g., an aluminium can is the primary package that contains the beverage that is the product).

Secondary packaging allows consumers to conveniently handle multiple units of the product (e.g., a carton box that holds a dozen cans of beverage).

Tertiary packaging is also known as transport packaging. The objective is to bind cargo into larger, stable units to allow loading, unloading and securing to be more effective and efficient. It also serves to make handling and securing cargo safer and easier. See Table 1 and Figure 4 for examples of tertiary packaging.

Tertiary packaging	Examples
Box	Wooden crate, plastic box, cardboard carton
Strap	Plastic strap, steel strap
Pallet	Wooden pallet, plastic pallet
Film	Stretch film, shrink film
Sheet	Anti-slip sheet, corrugated board, hardboard
Dunnage	Air bag, wooden blocks, folded cardboard, foam

Table 1: Examples of common tertiary packaging.

Figure 4: Boxed cargo wrapped in film and stacked on pallets.

2. Loading and Unloading

2.1 Cargo Arrangement

The way cargo is arranged during loading will affect the stability of both cargo and vehicle. When unstable, cargo will be harder to secure and more likely to fall off. Bigger and heavier items loaded in an unstable manner can cause vehicle to tip over. See Figure 5 for general cargo positioning that will be more stable.

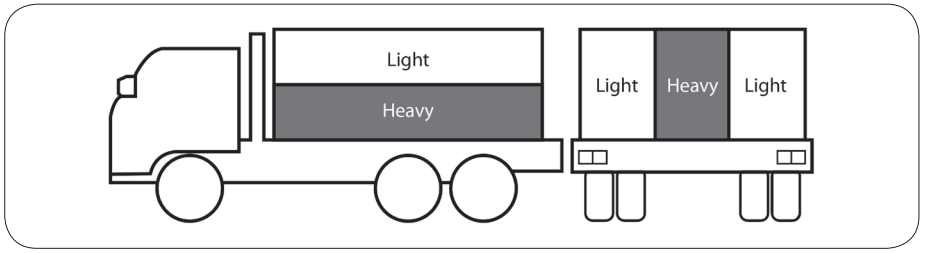

Figure 5: How to position heavy and light cargo for better stability.

Some good practices of cargo arrangement include:

- When stacking, cargo should be able to remain stable without relying on lashing. Stacks should not be higher than headboard.
- Heavier cargo should generally be loaded below lighter cargo to lower overall centre of gravity, and at the centre of vehicle to maintain balance (see Figure 5). Cargo in the lower tier should be structurally strong enough to support cargo stacked on top of it. See Figure 6 for examples of bad cargo arrangement.
- Distribute cargo weight uniformly across loading platform.
- A stronger stopping force is needed to stop a moving load than a stationary load. Hence, cargo should be loaded against the headboard. Any space between cargo and headboard allows cargo to move and gain momentum.
- Where necessary, fill empty spaces with dunnage.

When making multiple stops during a delivery, cargo that has to be unloaded earlier should be easily accessible. Empty space reserved for picking up additional cargo during the trip should not compromise securement of cargo.

Figure 6: **Examples of poor cargo arrangement (from left to right): unstable stacking, unbalanced weight distribution, cargo stacked higher than headboard.**

2.2 Common Hazards

Logistic operations are typically labour-intensive and employees frequently work around heavy machines. Thus employees are exposed to a variety of hazards daily that can cause either immediate injuries or chronic conditions. The following are some common hazards.

Slipping and tripping hazards

Slips, trips and falls often stem from floor surface and footwear. A dirty or cluttered floor presents slipping and tripping hazards respectively, while footwear with inadequate traction increases risks of slipping.

Possible incidents:

- Slipping and falling due to wet spills or dust on the floor.
- Slipping and falling due to worn-out soles.
- Falling off loading platform while working near the platform edge.
- Tripping over a pile of lashing belts on the floor.

Recommendations:

- Implement a housekeeping system to keep the work environment clean and tidy.
- Apply anti-slip coats to improve traction, especially in areas with high foot-traffic.
- Track and document near-miss or injury reports to identify unsafe work areas or procedures.
- Ensure that employees put on proper footwear.

Ergonomic risk factors

Various aspects of work such as repetitive movements, handling heavy loads, and long hours can lead to the development of chronic muscular-skeletal issues. Common symptoms are pains and aches, numbness, tingling sensations and decreased strength and mobility.

Possible incidents:

- Spraining a back muscle from over-exertion.
- Using the wrong lifting technique (i.e., employees should bend their knees, not their backs).
- Driving long hours without taking a break to stretch.

Recommendations:

- Educate employees on recognising ergonomic risks at work and how to overcome them.
- Schedule adequate breaks within shifts.
- Use equipment to reduce reliance on manual labour (e.g., using forklift versus manual handling).

For more information, refer to *WSH Guidelines on Improving Ergonomics in the Workplace*.

Impact hazards

Injuries sustained from impacts can result in minor bruises or fatal injuries. Accidents can have different causes, depending on the work activity.

Employees may get struck by a falling object, for example, lifting cargo with cranes or forklifts can cause cargo to drop and hit employees. Employees may also get hit by moving objects such as moving vehicles and machines (e.g., forklift, reach truck) when they cross paths, especially when vehicle or machine is reversing.

Possible incidents:

- Getting struck by swinging cargo during lifting due to improper rigging methods.
- Getting struck by falling cargo due to unstable stacking or inadequate securement.
- Getting struck by machine due to equipment failure.
- Getting knocked down by a vehicle or machine because driver or operator was distracted.

Recommendations:

- Establish safe work procedures for specific work activities (e.g., stacking, rigging, lifting, storage methods) and ensure employees adhere to it.
- Implement a traffic management system at the workplace.
- Routinely maintain equipment according to manufacturer's advice.
- Ensure that employees use personal protective equipment (e.g., steel-capped boots, hard hats).

For more information, refer to:

- *Code of Practice for Safe Lifting Operations in the Workplace;*
- *WSH Guidelines on Workplace Traffic Safety Management; and*
- *WSH Guidelines on Safe Operation of Forklift Trucks.*

3. Equipment

3.1 Vehicle

General requirement

The vehicle chassis needs to be sturdy enough to support weight of cargo and withstand other directional forces (sideward, forward and backward) exerted by cargo during transporting. Hence operators should anticipate the maximum expected load before choosing a suitable vehicle.

Materials used in constructing the chassis should be durable enough to withstand frequency and intensity of use. An anti-corrosion coating can improve resistance to wear and tear. The loading platform should be kept clean (e.g., free from grease, debris, etc.) because dirt will reduce friction between cargo and loading platform and debris can fall off the vehicle and strike other vehicles or pedestrians.

Vehicle dimension

The loading platform should ideally be long and wide enough to fully contain the cargo. Any length of cargo sticking out of vehicle (i.e., overhang) should be minimised. Overhang that is more than 30 cm projecting from rear of vehicle should have a red flag tied to it as a visual warning for other road users [see Figure 7; [see Road Traffic (Motor Vehicles, Construction and Use) Rules; see full Act at Singapore Statutes Online].

Figure 7: Red flag tied to overhang.

A permit from the Land Transport Authority (LTA) is needed if the vehicle width exceeds 2.6 m, or if the overhang is greater than or equal to 40% of the vehicle length or 1.8 m, whichever is lesser. Police escorts will be required if the width exceeds 3 m, or if the height exceeds 4.5 m

Maximum laden weight

The maximum expected weight of cargo needs to be known before loading. The combined weight of the vehicle and cargo (i.e., total laden weight) should not exceed limits of roads or structures where the vehicle will be driving on or parking at. Police escorts will be required if the total laden weight exceeds 80,000kg. See Table 2 for limits on vehicle roadworthiness and requirements for exceeding them.

Requirement	Limits
LTA Permit	• Vehicle width > 2.6 m • Overhang ≥ 40% vehicle length or 1.8 m (whichever is lesser)
Police escort	• Vehicle width > 3 m • Vehicle height > 4.5 m • Total laden weight > 80,000 kg

Table 2: Limits on vehicle roadworthiness and requirements for exceeding them.

3.2 Fittings

Vehicles may come with fittings pre-installed (or require retro-fitting) on the chassis to aid securing of cargo. Similar to vehicle chassis requirements, the design, strength and integrity of fittings should withstand routine operations of loading, unloading and transporting. See common fittings and their functions below.

Headboard/ Cabin guard/ Front bulkhead

A cabin guard, commonly referred to as headboard, is installed behind the driver's cabin to serve as a physical barrier between cabin and cargo. It should be taller than and at least as wide as the driver's cabin (see Figure 8). Cargo should never be stacked taller than the headboard.

Headboards with gaps cannot adequately restrain narrow or small items (e.g., pipes), as individual pieces can fit through the gaps. Wire mesh can be used to cover those gaps without hindering driver's view in the rear-view mirror.

Vehicles with loading compartments within the vehicle chassis (e.g., van) will need a front bulkhead to separate driver cabin from cargo compartment. Front bulkheads are an internal partition that functions the same way as headboards. It is a physical barrier that protects the driver by preventing cargo from shifting forward.

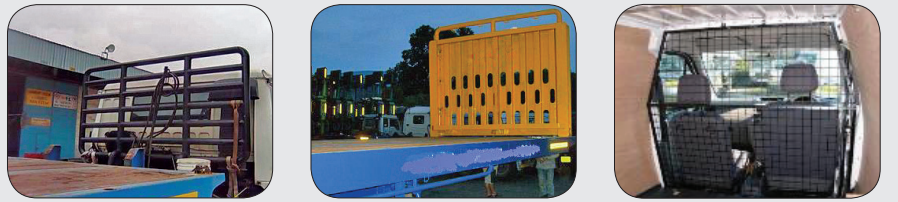

Figure 8: Cabin guards (left, middle) and front bulkhead (right).

Sideboard and tailboard

Sideboards and tailboards frame the loading platform and form part of the load restraining system (see Figure 9). All tailboards and some sideboards come with a locking mechanism. When unlocked, they swivel open to facilitate loading and unloading.

When locked in place, the boards provide some restrain for light cargo. It is not advisable to rely on them for larger or heavier goods, as the locks are not designed to withstand high stress and can fail easily. It is good practice to restrain and block loaded cargo with other methods.

Figure 9: Sideboard and tailboard of trucks.

Anchorage point

Lashing devices are secured to anchorage points to restrain cargo. Anchorage points should be integrated into the main chassis to ensure adequate strength to withstand the expected loading (see Figure 10). Operators should consult manufacturers if they wish to retrofit additional anchorage points, as drilling holes or welding attachments will weaken integrity of the vehicle frame, and reduce load capacity of existing anchorage points.

Vehicles need an excess of designated anchorage points to avoid attaching multiple lashing devices to a single anchorage point as this would put that anchorage point under greater stress. When this happens, the anchorage point is more likely to fail. If it fails, all attached lashing devices will come loose.

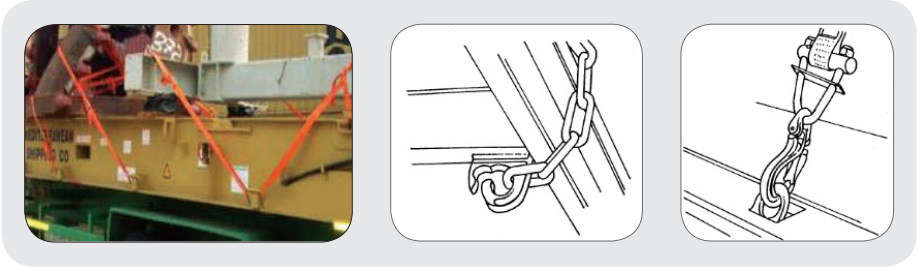

Figure 10: Examples (image left) and illustration of anchorage points.

Note: It is important to not mistake rope hooks for anchorage points (see Figure 11). Rope hooks vary in material and strength, and can deform or give way easily when subjected to high stress. To avoid such mistakes, employees should be trained to use correct lashing points. Visual cues (e.g., labels or bright paint) can help make anchorage points easier to identify.

Stanchion

Stanchions are upright metal beams welded or mounted on either sides of the vehicle or trailer chassis to provide lateral blocking, usually for cargo that will roll (see Figure 12). It should be strong enough to block the cargo should lashing devices fail.

There should be at least two stanchions on each side. Longer trailers should have more. When stacking goods, the total stacked height should not exceed height of stanchions.

Curtain-side

Curtain-side vehicles are installed with two PVC tarpaulin sheets (i.e., curtains) that cover the entire length of loading platform on its left and right (see Figure 13). The curtains provide weather protection and can also be strapped down to contain the cargo. The curtains are not designed for restraining, hence goods would still need proper restraint as though they are loaded on an open platform.

During transporting, the curtains will swell if the cargo shifts sideward. Employees should not untie the curtains when there is obvious swelling as the cargo may topple on them. They should gain access from another route (i.e., the back or opposite curtain) instead.

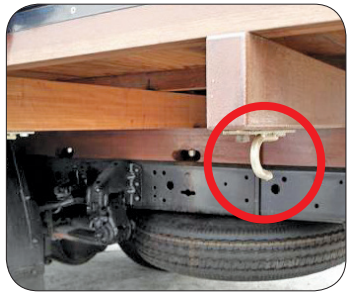

Figure 11: Rope hooks on a lorry.

Figure 12: Stanchion bars on a trailer bed.

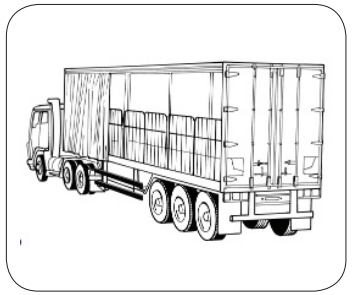

Figure 13: Vehicle fitted with curtain-sides.

3.3 Securing Equipment

Securing equipment are the main means of keeping cargo anchored to the vehicle. Operators should equip themselves with the correct securing equipment for type and composition of cargo. Additionally, the safe working load (SWL) of all securing equipment should always be clearly indicated.

Regular inspection should be carried out according to manufacturers' suggested frequency. Rope and webbing should be checked for fraying and cuts, and metal devices and components checked for rust or deformation. Any damaged or defective equipment should not be used and be replaced immediately.

To protect cargo and lashing devices (e.g., rope, webbing, chains) from damage, it is recommended to place padding between lashing and sharp corners of cargo. Any waste material (e.g., cardboard, rubber, plastic) can be used. Employees should also secure excess lengths of lashing, as it will dangle off the vehicle and pose a danger to other road users.

Load binder

A load binder is a tensioning device used with metal chains. The two known types are lever load binders (see Figure 14, left) and ratchet load binders (see Figure 14, right). Ratchet binders have two hooks threaded into a handle. The hooks can be gradually extended or retracted with a ratchet mechanism to adjust the reach of hooks and create tension. Lever binders have two hooks attached to two points along a lever. Tension is created by manually pulling the lever into a locked position.

Lever load binders are easier to install but the reach of hooks are not adjustable. As tension is stored in the lever handle, caution must be exercised when tightening and releasing the handle. The handle will recoil readily due to stored tension and cause injury.

Ratchet binders are safer options, as less tension is stored in the handle. The ratchet mechanism provides better control in releasing tension slowly.

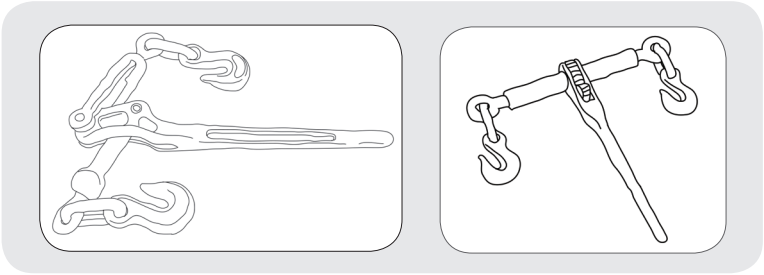

Figure 14: (Left to right) Lever load binder and ratchet load binder.

Turnbuckle

A turnbuckle is a tensioning device. It is made up of two eye bolts or hook bolts threaded in opposite directions into each end of a metal frame (see Figure 15). Tension can be adjusted by rotating the frame, which extends or retracts both bolts simultaneously, without needing to twist individual bolts.

Turnbuckles are commonly used in various applications, aside from securing loads. Hence, they come in various grades and load capacities. It is important that operators use turnbuckles that are rated for the cargo they are securing.

Figure 15: Turnbuckles.

Chains

Chains can be used for lashing goods, and secured with a load binder or turnbuckle (see Figure 16). Chains vary in thickness or grades which determine the SWL. This information is usually displayed on a tag attached to the chain. If the tag is detached, the chain should not be used. To continue using a chain without a tag, it should first be re-certified and tagged again.

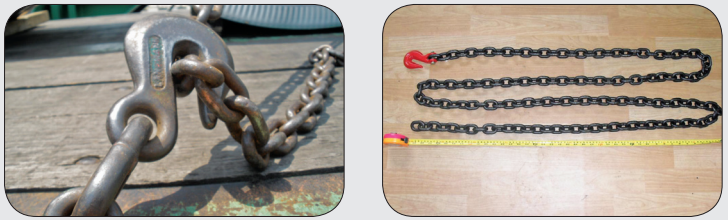

Figure 16: Steel chains with a grab hook attached on one end.

Edge protectors should be used to avoid deforming chains and damaging cargo. If chains are deformed, or have broken links, they should be replaced. Avoid trying to repair damaged links or connecting two short chains to make a longer chain, as the integrity and strength cannot be determined.

Webbing

Webbing is typically made of plastic fibre and usually comes with its own tensioning mechanism. It is also known as a lashing belt. Manufacturers may indicate the SWL in a number of ways; embossed on a metal tag (see Figure 17), printed on a label sewn directly to webbing or by colour-coding webbing material.

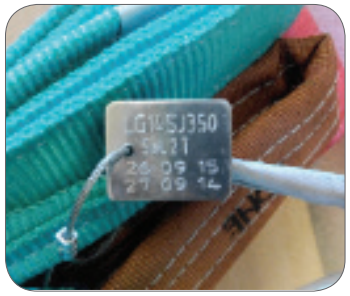

Figure 17: Webbing with tag displaying safe working load.

Frequent tightening is recommended during long-distance or multiple-stop trips because vibration generated from the engine and travel can loosen the lashings.

Regular inspection should be carried out to spot wear and tear that will reduce load capacity. Edge protectors are recommended to protect webbing from abrasion.

Ropes

Ropes can be made of either natural fibre, plastic fibre or metal wires with treated ends (e.g., plastic coat, melting, splicing, etc.) to prevent fraying or unravelling. It is important to select appropriate material and thickness for type of cargo (see Figure 18).

Figure 18: Lashing belts (webbing) and polyester rope.

Employees may attempt to tie two ropes together to create a longer rope (see Figure 19). This should not be allowed as the knot is a weak joint and can come apart easily in transit.

Regular inspection should be carried out to look out for wear and tear that will reduce load capacity. Edge protectors are recommended when lashing around sharp corners and edges, which can cut or fray the rope.

Net

Nets can be made of webbing, rope or steel wires. It is used to divide a space into compartments, or cover open vehicles if cargo does not need weather protection. They are also fitted with tensioning devices and clamps along corners and edges.

Figure 19: Bad practice of tying two lashing belts.

Common signs of wear and tear include fraying and cuts on webbing, and stitches that are unravelling. Damaged webbing should not be used, as damaged section may give way during transportation. Operators should consult manufacturers whether damaged webbing can be repaired because its load capacity would be reduced.

Sheet

There are two types of sheets; tarpaulin and purpose-made. Tarpaulin sheets: only provide weather protection, and should not be considered as part of restraint system. The sheet should be adequately tied down to prevent flapping during transportation (see Figure 20).

Figure 20: Cargo covered with sheets for weather protection.

Purpose-made sheets come fitted with lashing straps along the sides to allow them to be tied to the vehicle chassis. These sheets have been designed and tested with a rated load capacity, thus making it suitable for restraining. The entire sheet should be adequately tensioned to avoid loose flaps, which can cause danger to other road users.

ISO Freight Container

Trailers manufactured for carrying ISO freight containers are fitted with twistlocks for gripping and securing the containers at each corner (see Figure 21). Twistlocks are subject to frequent knocks and abrasion, hence should be frequently inspected for damages. All twistlocks should also be locked immediately after containers have been loaded on trailer.

Figure 21: ISO container.

Cargo loaded inside containers should be arranged in a stable manner and restrained (with lashing, blocking, nets, etc.) so that movement within the container is restricted. Dunnage is often used to fill up empty spaces and minimise shifting during transportation.

4. Securing Cargo

See Table 3 to find out how cargo are categorised in this guidelines.

Category	Examples	
General freight Standard cargo type commonly encountered in logistics.	• Bundles and bales • Sacks • Long sections • Mixed cargo • Palletised cargo	• Boxes • Wheeled cages • Skip containers • Plastic containers
Cylindrical Cargo with a round cross-section that tend to roll.	• Wire coils • Sheet metal coils • Cable drums • Tyres	• Drums • Gas cylinders • Pipes and poles
Out-of-gauge Cargo with dimensions that exceed those of the vehicle.	• Automobile • Heavy machine • Whole trees	• Structural steel • Precast concrete
Others	• ISO containers • ISO tanks	• Dangerous cargo • Glass panels

Table 3: Cargo category and examples.

4.1 Various Methods of Securing

General requirement
All cargo must be secured via a combination of lashing, blocking, and/ or friction to prevent movement during all expected conditions of transportation. The load restraint equipment and vehicle body must be strong enough for type of cargo transported.

Lashing method
Tying with lashing devices (e.g., rope, webbing, chains, cables, etc.) is the most common methods of load restraint. Lashing must be checked and retightened regularly, especially after a sudden break or sharp turn and on multiple-delivery stops. Check and ensure that the cargo are stable before lashing or loosening the straps.

There are two ways to lash: direct lashing and friction lashing.

- Direct lashing:

Direct lashing restraints the cargo by opposing movement of the cargo in a specific direction. Lashing devices can be attached to lashing points on cargo or looped around or over it. The angle of lashing should be less than 60 degrees (see Figure 22). Lashing devices need to withstand a greater force if the angle is larger than 60 degrees.

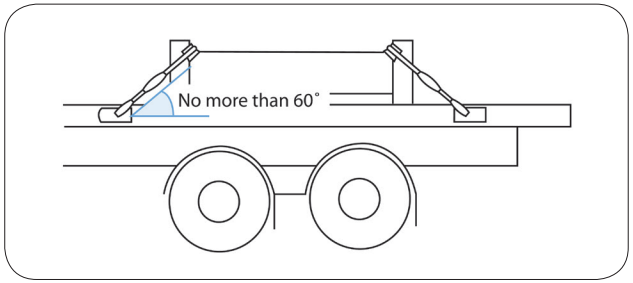

FIgure 22: Direct lashing should be angled at no more than 60°.

- Friction lashing:

Friction lashing is passed over cargo to bind it to loading platform. Tension in the lashing increases friction between cargo and loading platform to prevent tipping or sliding. The angle of lashing should be more than 75 degrees (see Figure 23) for it to be effective. Placing frictional mats can increase the effectiveness. Generally, there should be at least one lashing device every 1.5m along the length of the cargo unit.

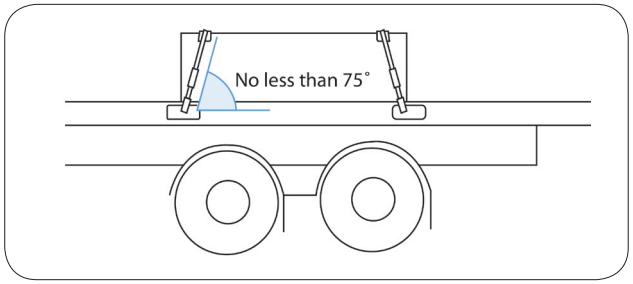

FIgure 23: Friction lashing should be angled at no less than 75°.

Sheeting Method
Sheets are usually used to contain loose cargo (e.g., construction debris) that can fall off during transit. Lashing is needed to fasten the sheet directly to the vehicle. Any excess lashing and loose flaps of sheet should be tied and secured, to avoid causing danger to other road users. Tail lights, reflectors and licence plates should not be obstructed by the sheets. Any tears or holes found in the sheets should be mended.

Operators should note that sheets can get caught by wind if not adequately tensioned and secured. Loosened sheets caught by the wind will balloon and expose cargo. Loose flaps should be tied backwards so that wind will keep the flaps closed (see Figure 24).

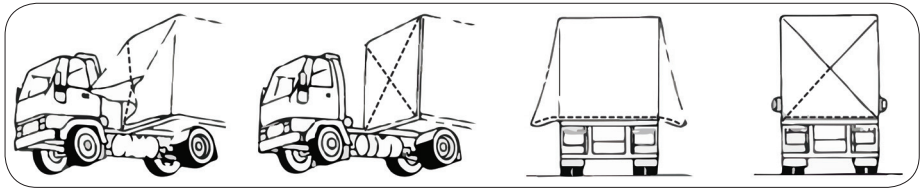

Figure 24: Securing sheet flaps at front and rear of vehicle.

If more than one sheet is needed, lay sheets starting from the rear. This ensures that the gap in the overlapping sheets is facing the rear, and will not allow rain or wind to get in (see Figure 25).

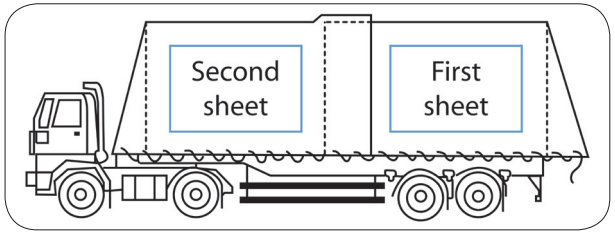

Figure 25: Using multiple sheets to cover cargo.

Netting Method

Nets can be used in place of sheets if cargo does not require weather protection (e.g., scrap metal). The mesh size must be small enough to prevent the smallest piece of cargo from falling through. It can be tensioned with lashing devices or rope to vehicle chassis. Excess netting and lashing should be securely tucked in to prevent it from endangering other road users when it hangs and flaps.

Locking Method

Locking is the most secure method, but it requires specific fittings and equipment. Examples of locking mechanisms are twistlocks for ISO containers and steel crates that hold gas cylinders (see Figure 26). Every locking mechanism should be locked immediately after loading.

Figure 26: Twistlocks in locked and unlocked positions.

Blocking Method

Cargo that are rigid enough can be blocked by fittings (e.g., stanchion, headboard; see Figure 27) or other cargo units by loading cargo against the fitting or adjacent cargo. If that is not possible, the space should be filled with dunnage. Dunnage should fit snugly and securely, so that it will not come loose and fall off during trips.

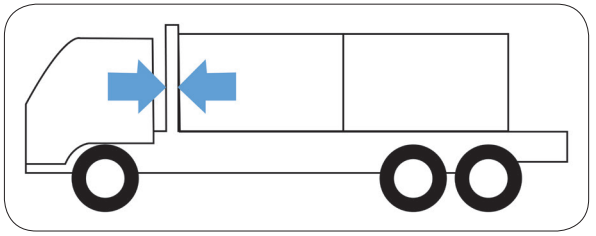

Figure 27: Blocking cargo with headboard.

Tiers of cargo can be blocked with a panel of plywood or chipboard (see part A of Figure 28) or by placing pallets to put a height difference in adjacent cargo units (see part B of Figure 28), which will block the upper layer against the lower layer.

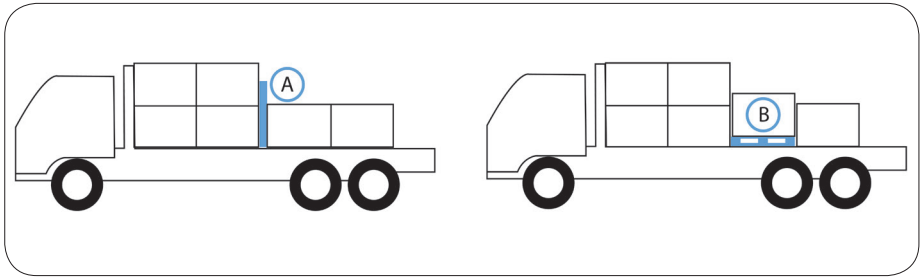

Figure 28: (from top) Blocking cargo with a board (A) or pallet (B).

Metal brackets or bracing can be used to block cargo and hold them in place. These brackets are usually customised for supporting specific types of cargo (see Figure 29).

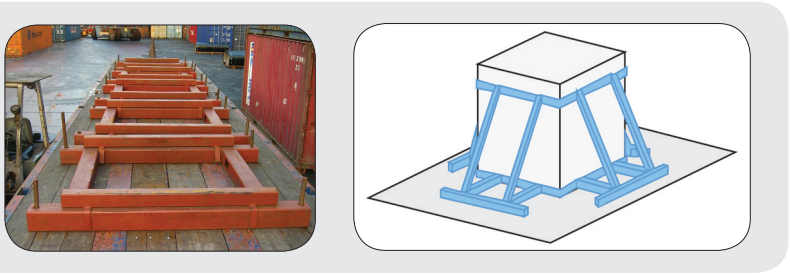

Figure 29: Examples of metal brackets for cargo support.

Wedges affixed to a loading platform prevent cylindrical cargo from rolling. The inclined edge should be in contact with the cargo. A wedge angle of 37° prevents forward rolling, and about 30° prevents backward and sideway rolling (see Figure 30).

Wedges with wedge angles around 15° cannot block effectively, but can keep spherical cargo in position during loading and unloading. The weight of cargo can lock wedges in place if vehicle is not moving.

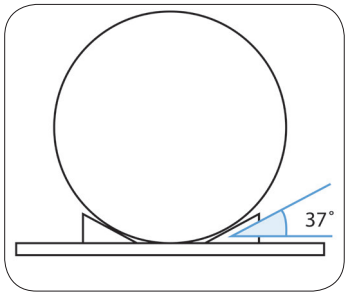

Figure 30: Blocking with a wedge angled at 37°.

4.2 General Freight

Bundles and bales

Bulk cargo (e.g., waste paper, cloth) can be packaged into a rough cube or cuboid using plastic straps or rope. Each package is referred to as a bundle or bale (see Figure 31).

Figure 31: Waste paper transported in bales.

Good practices to follow:

a) When loading one tier of bundles, an alternate arrangement creates a blocking effect (see Figure 32).

b) When loading two tiers, lash every row to vehicle. Bulk cargo requires additional securing as it usually slightly bulges so stacking will not be stable.

c) The content in a bundle may spill out of its packaging, so the entire load should be covered with a sheet after securing.

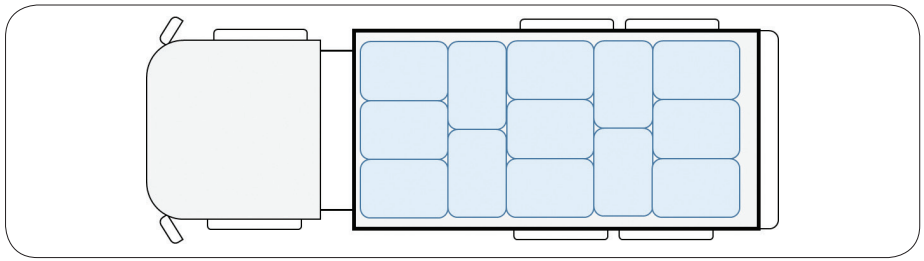

Figure 32: Alternating arrangement of cargo.

Sacks and bags

Granular cargo such as agricultural produce (e.g., rice, flour), gravel, and polymer beads are usually transported in sacks (see Figure 33). Sacks are bags made of pliable material (e.g., cloth, plastic) which makes securing a challenge because they do not hold their shape (see Figure 34). Load alternate tiers in opposite directions.

Good practices to follow:

a) Keep height of layers uniform.

b) Use tensioning devices to secure every sack length, because material in the sacks and bags (e.g., rice, polymer beads) can settle around lashing and cause it to loosen.

c) Use sheets to prevent loose material from falling off open sacks and bags.

d) Stacking on pallets and wrapping each stack with stretch film makes securing more effective.

Figure 33: Sacks loaded in alternating directions.

Figure 34: Bags on trailer.

Long sections

This category includes wooden planks, metal beams and bars, and so on. They may be transported as loose cargo or bundled up with rope (see Figure 35).

Figure 35: **Various long cargo bundled and lashed.**

Good practices to follow:

a) Load cargo against headboard. If individual pieces can fit through headboard, add a layer of wire mesh between headboard and cargo.

b) Avoid stacking cargo taller than headboard or stanchion, whichever is shorter.

c) Sections with different lengths should be loaded against headboard. Uneven ends will be pointing towards the rear. Secure longer pieces to minimise whipping.

d) Number of lashing devices depend on length of cargo (see Friction Lashing in 4.1).

e) If cargo is strapped into bulk packages, ensure that straps are not damaged. Otherwise, reinforce with lashing device to ensure that individual pieces will not come loose.

Mixed cargo

Good practices to follow:

a) Where cargo is a mix of heavy and light items, load heavier items at the base and rear. Light items can be loaded on top and in front (see Figure 36; see 2.1 Cargo arrangement).

b) Where cargo is a mix of different sizes, load big items surrounding small items to "enclose" them. Avoid having cargo sticking out the sides of vehicle.

c) Fill up empty spaces with dunnage.

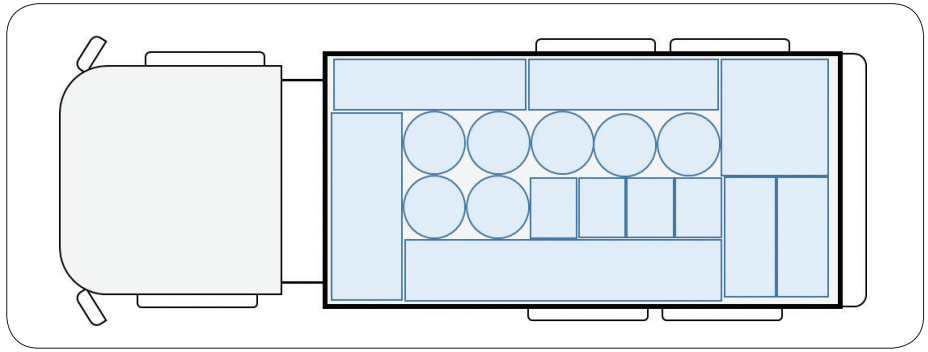

Figure 36: **Enclosing smaller cargo units with the bigger cargo units.**

Palletised cargo

There are two considerations when securing palletised cargo. First, secure cargo to the pallet, and second, secure the whole unit of pallet and cargo to the vehicle.

Figure 37: **Palletised cargo stacked.**

Good practices to follow:

a) Before loading, check pallets for damages. Do not accept damaged pallets for loading.

b) Multiple small units should be stacked in a stable manner on pallet and secured to pallet with straps or shrink wrap. Individual units should not come loose and fall off (see Figure 37).

c) Do not exceed maximum laden weight of individual pallets and vehicle.

d) Distribute weight evenly across loading platform; this may require spreading pallets apart. When spread out, lash every row of pallet and fill empty spaces with dunnage to block movement.

e) Always lash the entire unit (i.e., pallet and cargo) to vehicle to prevent movement and tipping. Lashing pallet alone is not recommended.

f) When stacking pallets, do not exceed height of headboard and lash every row. Ensure that the lower stack can withstand the weight. It may be necessary to support top stack by reinforcing lower stack with plywood to avoid crushing it.

g) Secure empty pallets to vehicle because they are light enough to be blown off vehicle.

Boxes

Boxes are one of the most common forms of cargo packaging. It can be made of cardboard, metal, wood or plastic.

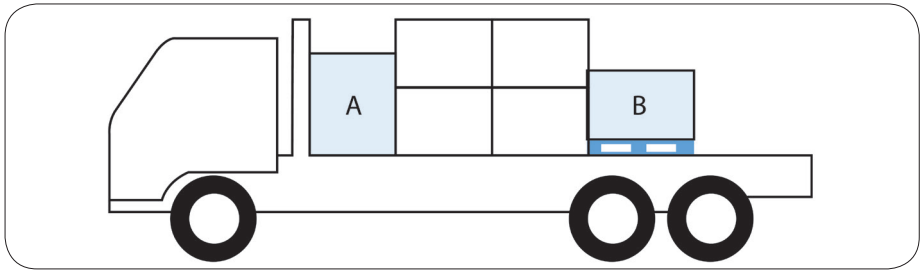

Figure 38: Blocking by using taller boxes (A) or raising boxes on pallets (B).

Good practices to follow:

a) Block upper layers by using bigger boxes, wood panels or pallets (see Figure 38 and 4.1 Various Methods of Securing).

b) Lash every row of boxes (see Figure 39).

c) Do not stack boxes beyond height of headboard. Boxes at the lower tier should be strong enough or reinforced to support boxes on top.

Figure 39: Lashing on boxes.

Wheeled Cages

Commonly used to transport food items or gas cylinders. The wheels make handling bulk cargo easier but they would also add challenge to securing the cages on a vehicle.

Good practices to follow:

a) Lock individual caster wheels after loading.

b) Use wedges to chock wheels that lack a locking mechanism.

c) Restrain the entire cage by blocking or lashing to prevent cage from toppling over.

Skip Containers

For transporting loose bulk cargo that are not packaged (e.g., scrap metal, gravel). The container may have an open top, removable lid, or drop sides that open up for loading and unloading.

Good practices to follow:

a) Cargo with small granules may settle during transport and get compacted from vehicle's vibration. It may stick to corners of container and hinder unloading when container is tipped (see Figure 40).

Figure 40: Skip container transporting construction debris.

b) Regular maintenance is required to prevent loss of material through gaps in the body of the container, especially if lids or drop sides are damaged or distorted, and no longer fit well. Loose and small material can fall through gaps.

c) Keep chassis attachment points and fittings (e.g., hinge pins, brackets, and locks) in good condition.

d) Do not load container to the brim, because material can easily spill over or get blown off.

e) Covering with a sheet can minimise loss of material. Nets may be used if cargo pieces are bigger than the mesh size of the net.

f) When making sharp turns or traveling on sloping roads, cargo may slide to one side of the container and destabilise the vehicle. Redistributing the cargo may be necessary.

Intermediate bulk containers

When using intermediate bulk containers (IBC), the entire IBC unit including the pallet should be lashed and secured (see Figure 41). Check that the discharge valve is not leaking and screw caps are tightly sealed. Adjacent IBC units may need to be spaced apart with dunnage to avoid damaging the valve.

Figure 41: Intermediate bulk containers secured with lashing.

Plastic containers

Plastic is a popular material in manufacturing containers (e.g., pallet, box). Extra caution should be taken when securing plastic containers because plastic surfaces become slippery when wet, either from rain or condensation when transporting cold cargo. A combination of different securing methods (e.g., lashing with blocking) is recommended to compensate for reduced friction.

4.3 Cylindrical Cargo

Coils

Coils (e.g., wire coil, sheet metal coil, and cable drum) can be loaded with axis of the core lying horizontally (core horizontal, see Figures 42 and 43) or standing vertically (core vertical, see Figure 44). How it is stowed depends on restrictions (e.g., paper rolls cannot be loaded on curved surface to avoid damaging the paper), and stability (lower centre of gravity).

Figure 42: Coils of wire lashed and blocked with a metal bracket at the rear.

Figure 43: **Cable drums chocked with dunnage (left) and cable drums loaded within metal brackets (right)**

Core horizontal: It is preferable to have specialised vehicles with brackets fixed to the loading platform. The coils can still move within the bracket, so lashings will still be necessary. If brackets are not available, every coil should be lashed with adequate tension, and chocked with beams of dunnage wood (see Figure 43).

Figure 44: **Coils sheet metal loaded on pallets and lashed.**

Core vertical: Securing is more difficult. Each coil will need a number of lashing. Loop lashing around the coil prevents forward, backward and sideway shifting (see Direct Lashing under 4.1). Friction lashing over the coil further secures it. The coil's curved edges makes it easy for lashing to slide and come loose so the use of a cruciform makes lashing more secure (see Figure 45).

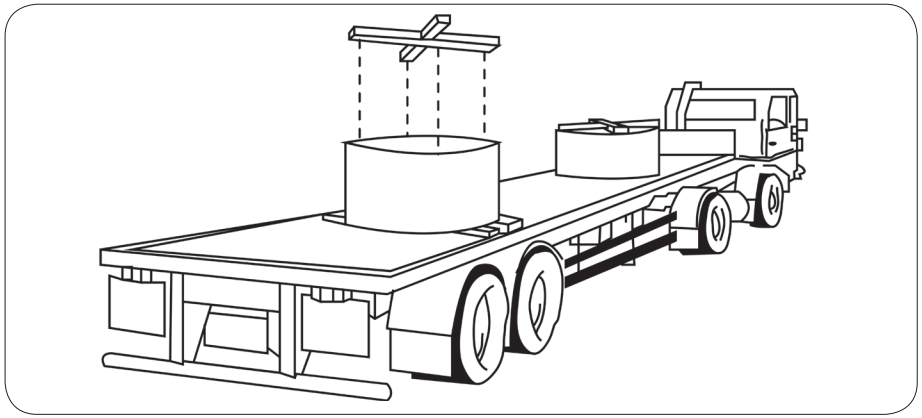

Figure 45: **Securing with the help of a cruciform.**

Tyres

Tyres are usually stacked in columns (core vertical), for easier loading and unloading.

Good practices to follow:

a) When stacking tyres, the column should not be taller than headboard.

b) All tyres stacked in one column should be bound together to prevent individual tyres from coming loose from the column (see Figure 46).

c) Each column should be lashed with adequate tension so that the lashing does not loosen.

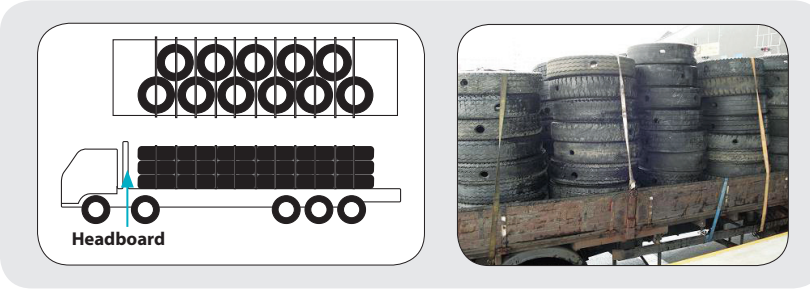

Figure 46: **Stacks of tyres lashed to loading platform.**

Drums

When drums are lying down (core horizontal), vehicles with fittings in the front and back (e.g., headboard and stanchions respectively) are necessary to contain the drums. Drums should not be stacked taller than the fittings. Lay drums across loading platform so that they will only roll forward or backward. Lash drums and chock with dunnage for additional restraint. Ensure adequate restraint so that drums can be unloaded safely.

If drums are standing (core vertical), bundle groups of drums together or lash laterally to prevent drums from tipping over. Load drums up against headboard. Friction lashing should be applied for first and last row of drums (see Figure 47).

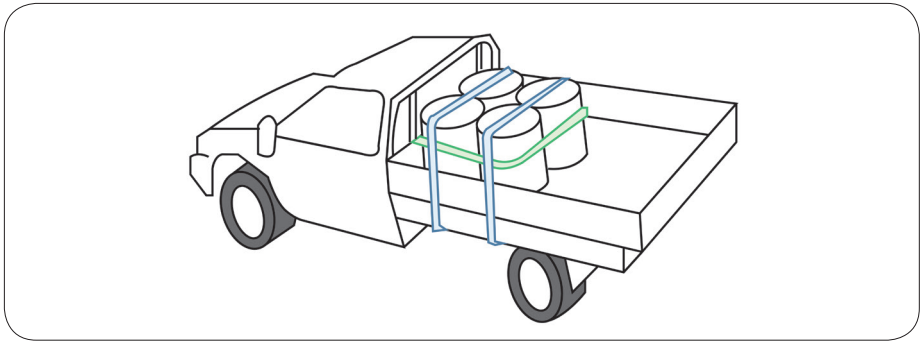

Figure 47: **Lateral lashing (green) and friction lashing (blue).**

Pipes and Poles

Good practices to follow:

a) Long cylindrical cargo should be placed up against headboard, and secured similar to long sections (see Figure 48; see 4.2 General freight).

b) Stanchions or side boards are needed for blocking cargo.

c) Additional friction lashing is recommended to restrain cargo and prevent long pieces from whipping.

d) Tie a red cloth to over-hang extending beyond rear of loading platform [see Road Traffic (Motor Vehicles, Construction and Use) Rules; see full Act at Singapore Statutes Online].

Figure 48: **Steel pipes loaded against stanchion and lashed to loading platform.**

Gas cylinders

Preferably transported in racks fitted on vehicle or in cages to avoid damaging valves and regulators. Open-air vehicles are preferred so any leaks can be dispersed without harm. Adequate ventilation must be provided if carried in closed vehicles.

Good practices to follow:

a) Gas cylinders that can stand (core vertical) should be secured in a manner similar to drums. Note that liquefied petroleum gas containers should always be transported upright. This prevents the pressure relief device from coming into contact with the petroleum and causing a malfunction.

b) Gas cylinders with rounded bottoms should be laid lengthwise across loading platform (core horizontal) so it would only roll forward or backward. If a cylinder is too long and sticks out of the sides of vehicle, load them lengthwise along loading platform. Secure them in the same way as pipes and poles.

c) When transporting cylinders in cages, the entire cage should be lashed to the vehicle. Weight of the cage and cylinders will not be enough to prevent movement during transporting.

4.4 Large Units

Vehicles

There are specially designed trailers for transporting vehicles such as cars, vans, small trucks (i.e., vehicle transporter; see Figure 49). Suspension systems and tyres of vehicles allow vehicles to bounce during a bumpy ride so employees should be extra cautious when restraining.

Figure 49: **Vehicle transporters.**

Good practices to follow:

a) Chock both front wheels of the vehicle (see Figure 50).

b) Ensure that parking brakes of every vehicle are applied.

c) Lash vehicles directly to trailer.

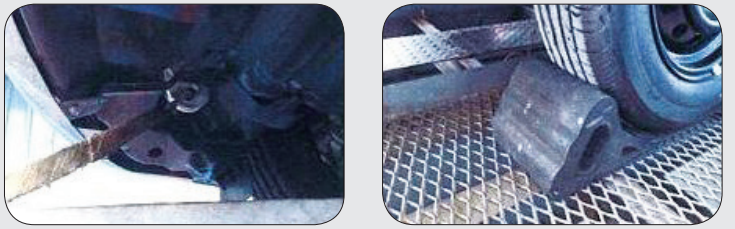

Figure 50: **Anchorage point under a car and wheel chock.**

Heavy machines

Includes excavators, crawler cranes, manufacturing equipment. Machines should be dismantled to smaller components as much as possible before loading, to keep every component contained within the trailer bed dimensions. Always check height and weight clearance of the route before transporting them (see 3.1 Vehicle).

Good practices to follow:

a) Use low bed trailers to reduce total height, and lower centre of gravity for more stability (see Figure 51).

b) Metal lashing devices are preferred for their higher load capacity.

c) Machines with hydraulic systems should have pressure in the hydraulics released before loading. Machines with wheels and tracks should have their parking brake applied.

d) If lashing points are available on the machine, lash it to the trailer directly. Lashing should be at an angle less than 60°, ideally at 45° angle, and a minimum of four anchorage points are needed per machine. Bigger and heavier machine may require more lashing points.

e) Movable assemblies (e.g., boom arm of crane, arm and bucket of excavator) should be positioned according to manufacturer recommendations so they do not stick out of trailer bed. It should be securely lashed to prevent independent movement in any direction during transit.

f) Remove any loose dirt or gravel as they can fall off while on the road and harm other road users. The trailer bed and ramp should also be free from grease.

Figure 51: **Transporting heavy machines on low bed trailers.**

Trees

When transporting whole trees, the foliage (leaves and branches) and root ball (root system and soil) should be pared down to reduce the dimensions and weight to facilitate securing and transporting.

Good practices to follow:

a) Trailer bed should have at least two pairs of stanchions on opposite sides for blocking.

b) Depending on height of tree, a minimum of three lashing devices should be used, one of which is used to bind branches that are overhanging to prevent whipping.

Figure 52: **Sawn tree branches covered with a sheet.**

c) After securing, cover tree with a sheet to prevent leaves, branches and soil in the root ball from being blown off by the wind (see Figure 52).

For more information, see *WSH Guidelines on Landscape and Horticulture Management*.

Structural steel and precast concrete

Structural steel and precast concrete usually come in big dimensions, which poses challenges to stability and securing them to trailers. If possible, always use trailers that are custom-built to transport these out-of-gauge cargo.

Good practices to follow:

a) Use purpose-built trailers that are strong enough to withstand weight and forces exerted. Even weight distribution is the priority when positioning structural steel and precast concrete on trailer bed (see Figure 53).

b) Check that delivery route has adequate height and weight clearance.

c) Trailer should have fixed frames to provide the main restraint.

d) Lashing should prevent movement and toppling, especially if units are tall. Metal lashings are preferred because webbing may be cut by sharp edges.

Figure 53: **Trailers mounted with steel frames for transporting precast concrete.**

4.5 Other Cargo Types

ISO containers and ISO tanks

ISO containers and tanks are transported on trailers with specific locking mechanisms that pairs with corner castings on the containers and steel frames.

Good practices to follow:

a) All locks should be secured immediately after loading onto the trailer.

b) For operators that load cargo into containers, the arrangement and restraints should ensure stability and prevent movement within the container. The payload should not be exceeded and the weight should be evenly distributed (see 2.1 Cargo arrangement where applicable).

c) Ensure that container door locks are in good condition and securely locked after loading is complete.

d) ISO liquid tanks are usually partially full. Changes in vehicle's speed and movement can lead to instability due to liquid swirling around in the tank. Low-bed trailers with mounted twistlocks are recommended to lower the centre of gravity (see Figure 54).

e) Tanks carrying gases or liquids will have hatches, valves and pressure relief devices. Check that all of these are not leaking and in good working condition.

Figure 54: ISO container (left) and ISO tank (right).

Glass Panels

The use of glass as a building material is increasingly popular because it is a versatile material with various uses (e.g. insulation, internal partition, structural component). However, glass may be easily damaged due to impact forces, which makes handling and transporting a challenge.

Good practices to follow:

a) Small glass panels packed into crates or pallets can be secured according to 4.2 General freight.

b) Large glass panels should be transported on vehicles mounted with A-frames. Parts of the frame that come into contact with glass should be covered with rubber to absorb vibration or shock.

c) Panels on each side of the A-frame should be lashed together (see Figure 55).

d) Additional lashing is also necessary for the entire unit of frame and glass.

e) The vehicle should have weather protection. If vehicle lacks weather protection, a sheet can be used as weather protection because glass becomes slippery when wet. The sheet can also contain glass shards if a glass panel shatter or break while in transit.

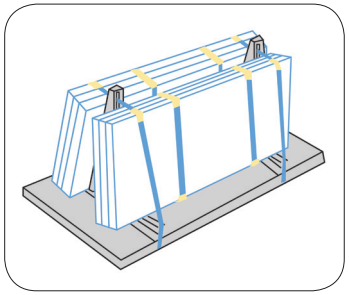

Figure 55: Large glass panels loaded on A-frame.

Dangerous cargo

Transporting cargo that are toxic, corrosive, explosive and flammable is riskier than transporting regular cargo. Thus, they are packed in containers specially designed to contain the contents safely under normal transport conditions. Operators that handle dangerous cargo should have their employees properly trained (e.g., HazMat Driver course by SCDF).

Internationally, dangerous cargo are categorised into different classes. In Singapore, the governing authorities listed in Table 4 oversee regulation of different classes of dangerous goods.

Class	Description of class	Authority
1	Explosives	SPF
2.1	Flammable gases	SCDF
2.2	Non-flammable, non-toxic gases	NEA
2.3	Toxic gases	NEA
3	Flammable liquids	SCDF
4.1	Flammable solids	SCDF
4.2	Substances liable to spontaneous combustion	SCDF
4.3	Substances which in contact with water emit flammable gases	SCDF
5.1	Oxidising substances	SPF, NEA
5.2	Organic peroxides	NEA
6.1	Toxic substances	NEA
6.2	Infectious substances	NEA
7	Radioactive materials	NEA
8	Corrosive substances	NEA
9	Miscellaneous dangerous substances and articles	NEA

Table 4: Classes of dangerous goods.

- Maritime Port Authority of Singapore (MPA): Regulates movement of dangerous goods through port terminals.
- National Environment Agency (NEA): Regulates import, storage and transportation of scheduled hazardous substances in Singapore.
- Singapore Civil Defence Force (SCDF): Regulates import, storage and transportation of petroleum and flammable materials in Singapore.
- Health Sciences Authority (HSA): Regulates transportation of radioactive materials.
- Singapore Police Force (SPF): Regulates transportation and storage of explosives and pyrotechnics within Singapore.

Good practices to follow:

a) Caged, closed, curtain-side vehicles are ideal to prevent cargo from falling off. If unavailable, use additional sheets, nets and straps for additional containment.

b) Arrange cargo such that the United Nations placards on container or packaging are easily visible to the crew during loading and unloading. Transporting dangerous cargo in bulk will require a Transport Emergency Information Panel (TEIP) prominently displayed on the left, right and back of the vehicle. See SS 586: Part 1: 2014 Transport and storage of dangerous goods.

c) Secure cargo according to type of package (i.e., drum, sack, and box).

d) Only transportation routes approved by NEA can be used, between 9.00 am and 5.00 pm on Monday to Saturday, excluding Sundays and public holidays.

e) When handling mixed cargo that are incompatible (e.g., oxidisers and flammables), it is best to transport them in separate vehicles. Otherwise, separate and secure the cargo such that they will not mix, even under accident conditions:

- Pack in separate compartments on the same vehicle;
- Pack individual containers with strong material for extra protection and containment against leakage; and
- Load incompatible containers as far apart as possible with inert cargo acting as a barrier in between).

f) Explosives are sensitive to temperature and friction (in some cases). Cargo should be secured to prevent scraping and rubbing, and avoid impact between containers. Anything carried along with explosives should be secured to prevent them from knocking into the explosive cargo container. To minimise risk of fire, avoid use of cardboard or wood as dunnage. Fire-retardant packaging foam may be a better option. See Arms and Explosives Act on Singapore Statutes Online.

5. Risk Management

Employers should carry out Risk Assessment (RA) before starting work to identify, evaluate and control risks in work activities and environment. Employers should strive to be as extensive and inclusive as possible when filling out the RA to cover all aspects of safety, health and wellbeing of employees. Companies will find the bizSAFE programme helpful in establishing their risk management system. See Figure 56 for a flow chart of a Risk Management process.

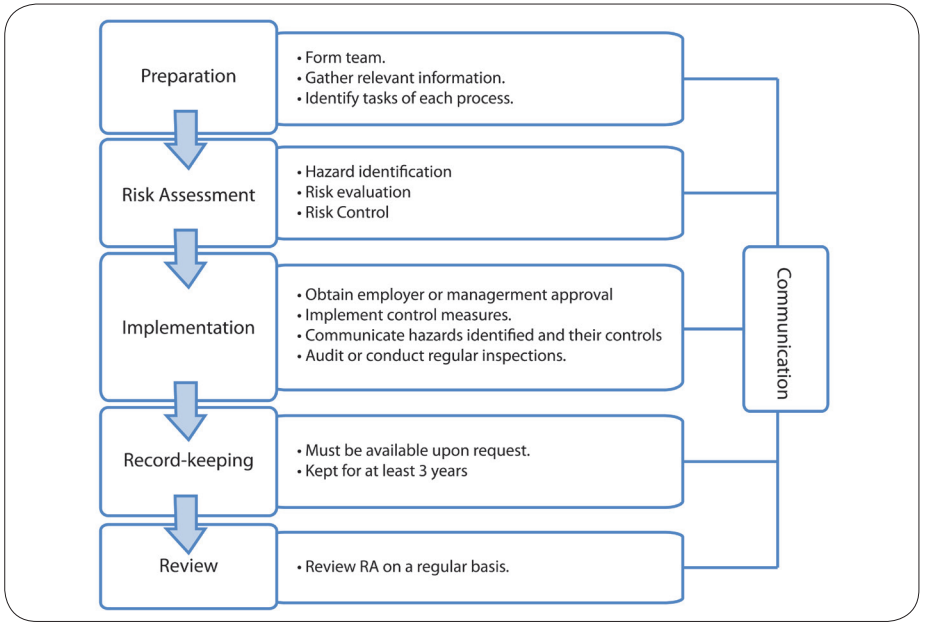

Figure 56: Risk Management process.

5.1 Preparation

Form a multi-disciplinary RA team consisting of personnel from various departments, such as operations, safety, and human resource. Information (e.g., work process, equipment, audit reports, etc.) should also be compiled to facilitate the RA.

5.2 Risk Assessment

RA is a three-step process that comes after forming a team and defining the scope. Priority should be given to controlling hazards at the upstream processes to reduce the amount of exposure from those hazards. After mitigation, hazards reduced to acceptable and manageable levels are termed residual risk. A sample of a RA Form can be found in Annex A. Extracts are taken from Annex A to describe three steps of RA below.

Step 1: Hazard identification

Look at each work activity from three aspects (physical work environment and processes, work organisation and individual health factors) to identify as many hazards associated with that activity as possible (see Table 5 for examples). List out potential injuries or ill-health that could result from these hazards.

Hazard Identification		
Work activity	Hazard	Possible injury or ill-health
Loading and unloading with a forklift.	Forklift movement during loading.	Heavy concussion and possible fractures.
Driving to meet delivery orders.	Driving continuously over-time after an 8-hour shift.	Developing loss of concentration due to fatigue.

Table 5: Example of hazard identification in a RA Form.

Step 2: Risk evaluation

For every hazard identified, estimate the severity (S) and likelihood (L) of occurrence by giving it a numerical value from one to five. Multiply the two values to get a Risk Prioritisation Number (RPN). Refer to the 5x5 risk matrix using the RPN to determine if the risk is at an acceptable level (see Table 6 for examples). Hazards with higher RPN should be given priority when implementing control measures.

Hazard Identification	Risk Evaluation			
Hazard	Existing risk controls	S	L	RPN
Forklift movement during loading.	Segregate vehicular and human traffic at worksite to reduce chances of collision.	4	4	16
Driving continuously over-time after an eight-hour shift.	Provide adequate breaks during the shift work.	5	3	15

Table 6: Example of risk evaluation in a RA Form.

Step 3: Risk control

When selecting control measures, the Hierarchy of Control can be used as a guide. The control measures are not mutually exclusive and can be combined with other measures to improve effectiveness (see Figure 57).

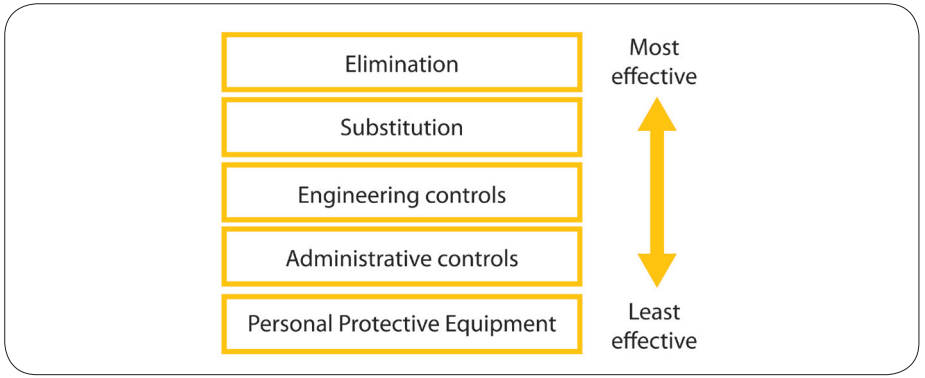

Figure 57: Hierarchy of Control.

Elimination: Elimination is the most effective form of control measure because it completely removes the hazard from the work process, and all risks associated with that hazard.

Substitution: Substitution involves replacing an element in a work process with a less harmful alternative so that the hazard presents a lower risk.

Engineering controls: These are structures or equipment that physically reduces the impact of the hazard by changing the work environment or work process, by putting a barrier between the hazard and employee.

Administrative controls: This reduces or eliminates exposure to hazards via strict adherence to specific work procedures or job instructions. Documentation should emphasise all steps in the work processes and controls needed for work activities to be carried out safely.

Personal Protective Equipment (PPE): PPE can further mitigate risks only if employees use them properly. Hence, it should be combined with other control measures. To be effective, PPE should fit employee well and be regularly maintained to keep it in good working condition.

5.3 Implementation and Review

Risk control measures should be implemented immediately once approved by the management. Managers and supervisors who oversee the work area or work activity should ensure that all persons who will be exposed (i.e., employees, contractors) are informed about the risks and their respective mitigating measures.

Regular inspections or audits should be carried out to verify effectiveness of the control measures. This will ensure that the measures are kept current and effective.

RA must be reviewed or revised under the following conditions:

- At least once every three years;
- After an accident, near-miss or occupational disease is diagnosed; and
- A change implemented in the work processes.

5.4 Record-keeping

All WSH RAs and related documents should be kept for at least three years and must be made available upon request by the Commissioner for WSH.

For more information on Risk Management, refer to *Code of Practice on Workplace Safety and Health (WSH) Risk Management.*

6. Acknowledgements

Container Depot Association (Singapore)
Jurong Port Pte Ltd
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PSA Corporation Ltd
Singapore Logistics Association
Singapore Transport Association
Workplace Safety and Health Council

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7. Annex

Annex A : Sample Risk Assessment Form

Department:	Warehousing	RA Leader:	Roy Lim	Approval	Reference number:
Work activity:	Loading and unloading cargo	RA Member 1:	Hong Qi Shun	Signature:	20141216RA006
Event / Location:	Container trucks and warehouse	RA Member 2:	Han King Siu		
Assessment Date:	16 Dec 2014	RA Member 3:	Eddie Lo	Date: 20 Dec 2014	
Last review date:	17 Dec 2013	RA Member 4:	Prakash Muthu	Name: Wong Shi Huat	
Next review date:	15 Dec 2015	RA Member 5:	-	Designation: Manager	

Ref	Hazard Identification		Risk Evaluation					Risk Control						
	Work activity	Hazard	Possible injury or ill-health	Existing risk controls	S	L	RPN	Additional controls	S	L	RPN	Implementer	Due Date	Remarks
1	Loading and unloading with a forklift	Forklift movement during loading.	Heavy concussion and possible fractures	Segregating vehicular and human traffic at worksite to reduce chances of collision.	4	4	16	Installing a reversing alarm on forklift.	4	2	8	Eddie Lo	20 Dec 2014	
		Cargo falls off forklift due to unstable stacking on pallet	Bruising and contusions.	Enforce proper stacking and shrink wrap individual stacks on pallet.	2	3	6	-	-	-	-	Hong Qi Shun	20 Dec 2014	
2	Loading and unloading manually	Handling heavy loads manually.	Muscular strains and sprains.	Instruct employees to always handle cargo mechanically where possible.	3	4	12	Pair up with a co-worker to carry loads together.	3	2	6	Han King Siew	20 Dec 2014	
		Fingers crushed between cargo items while unloading manually.	Fractured finger, bruising.	Instruct employees to always handle cargo mechanically where possible.	3	4	12	-	-	-	-	Eddie Lo	20 Dec 2014	
3	Securing cargo with lashing belt	Cargo falls off vehicle due to stacking palletised cargo.	Bruising and contusions.	Restrict height of stacking.	3	2	6	-	-	-	-	Han King Siew	20 Dec 2014	
		Struck by over-tensioned lashing device that snapped.	Bruising and contusions.	Check lashing devices for tears and frays before use.	4	1	4	-	-	-	-	Eddie Lo	20 Dec 2014	
4	Transporting cargo on public road	Cargo falls off during transportation due to lack of lashing.	Cargo strikes other vehicles on road, possible road traffic accident.	Use lashing devices on top of vehicles with fittings that block the cargo.	5	2	10	Cover cargo with tarpaulin sheet or netting after securing.	5	1	5	Roy Lim	20 Dec 2014	
		Cargo falls off during transport due to inadequate tension in lashing.	Cargo strikes other vehicles on road, possible road traffic accident.	Check lashing devices for tension before leaving loading bay.	5	2	10	Cover cargo with tarpaulin sheet or netting after securing.	5	1	5	Han King Siew	20 Dec 2014	
		Unsecured excess tarpaulin sheet flapping during transportation.	Visibility of other road users obscured, possible road traffic accident.	Check tarpaulin sheet are properly folded or tied down before leaving loading bay.	5	2	10	-	-	-	-	Prakash Muthu	20 Dec 2014	
5	Driving to meet delivery orders	Driving continuously over-time after an eight-hour shift.	Developing muscle strains from staying in same posture for long hours.	Educate and encourage drivers to stretch during their breaks.	3	5	15	Schedule routine job rotations amongst employees to vary work activities.	3	3	9	Eddie Lo	20 Dec 2014	
			Developing loss of concentration due to fatigue.	Provide adequate breaks during shift work.	5	3	15	Install fatigue management systems on vehicles.	5	1	5	Roy Lim	20 Dec 2014	
6	Releasing lashing belt for unloading of cargo	Over-tensioned belt snaps.	Bruising and contusions.	Check lashing devices for tears and frays before use.	5	1	5	-	-	-	-	Hong Qi Shun	20 Dec 2014	
		Cargo falls over after releasing tension in lashing belt.	Bruising and contusions.	Restrict height of stacking.	3	2	6	-	-	-	-	Prakash Muthu	20 Dec 2014	

Assessment of Likelihood

Level	Likelihood	Description
5	Almost certain	Continual or repeating experience.
4	Frequent	Common occurrence.
3	Occasional	Possible or known to occur.
2	Remote	Not likely to occur under normal circumstances.
1	Rare	Not expected to occur but still possible.

Assessment of Severity

Level	Ranking	Description
5	Catastrophic	Fatality, fatal diseases or multiple major injuries.
4	Major	Serious injuries or life-threatening occupational disease (including amputations, major fractures, multiple injuries, occupational cancer, and acute poisoning).
3	Moderate	Injury requiring medical treatment or ill-health leading to disability (includes lacerations, burns, sprains, minor fractures, dermatitis, deafness, and work-related upper limb disorders).
2	Minor	Injury or ill-health requiring first-aid only (includes minor cuts and bruises, irritation, and ill-health with temporary discomfort).
1	Negligible	Not likely to cause injury or ill-health.

5x5 Risk Matrix with Risk Prioritisation Number (RPN)

Severity \ Likelihood	Rare (1)	Remote (2)	Occasional (3)	Frequent (4)	Almost certain (5)
Catastrophic (5)	5	10	15	20	25
Major (4)	4	8	12	16	20
Moderate (3)	3	6	9	12	15
Minor (2)	2	4	6	8	10
Negligible (1)	1	2	3	4	5

Annex B: Activity-based Checklist

These are checklists for work activities relevant to logistics operations.

Activity Based Checklist

Safe Loading of Materials

Improper loading of materials on vehicles can be dangerous to you and your workers. Use this checklist+ as a guide to keep you and your workers safe. For more information on how you can keep your workplace safe, go to www.wshc.sg

Name of Company _____ Process/ Location _____

Checked by (Name/ Designation) _____ Date _____

Safety Checks		Please tick (✓) Yes No NA*	If no, action required by:
Truck's ignition key is off and brakes are applied.			Name: _____ Date : _____
Outriggers are extended fully on the ground.			Name: _____ Date : _____
Loading area is kept clear of traffic and workers not involved in the loading process.			Name: _____ Date : _____
Truck has sideboard and extension of sufficient height for the load carried.			Name: _____ Date : _____
Loads are rigged properly before being hoisted.			Name: _____ Date : _____
No one, including the truck operator, is under suspended loads during hoisting.			Name: _____ Date : _____
No one, including the truck operator, is between the load and the truck during hoisting.			Name: _____ Date : _____
Load on the truck is properly stacked and secured.			Name: _____ Date : _____

+ This checklist may not cover all aspects of work activities in your workplace. You should review the checklist when there are changes in any work activity.
* NA – Not applicable

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Activity Based Checklist

Safe Storage in Warehouse

A warehouse is a hot spot for accidents, and we must always be alert to the hazards present. Use this basic checklist+ as a guide to keep you and your workers safe. For more information on how you can keep your workplace safe, go to www.wshc.sg

Name of Company _____ Process/ Location _____

Checked by (Name/ Designation) _____ Date _____

Safety Checks		Please tick (✓) Yes	No	NA*	If no, action required by:
Objects are stacked on flat surfaces.					Name: _____ Date : _____
Bigger and heavier objects are placed on lower racks while lighter and smaller objects on higher ones.					Name: _____ Date : _____
Pallets used are in good condition.					Name: _____ Date : _____
Workers are wearing gloves when handling pallets or strapping objects.					Name: _____ Date : _____
Workers adopt proper lifting and carrying postures.					Name: _____ Date : _____
Forklifts are operated by trained and authorised personnel.					Name: _____ Date : _____
Conveyors have guards in place for their moving parts and pinch points.					Name: _____ Date : _____
Passageways are kept clear at all times.					Name: _____ Date : _____

+ This checklist may not cover all aspects of work activities in your workplace. You should review the checklist when there are changes in any work activity.
* NA – Not applicable

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Activity Based Checklist

Safe Use of Forklift Trucks

Forklift trucks are indispensable in some workplaces, but they can also be dangerous if they are not used properly. When forklift injuries occur, they can be serious given the tremendous weight of these machines. Use this checklist+ as a guide to keep you and your workers safe. For more information on how you can keep your workplace safe, go to www.wshc.sg

Name of Company _____ Process/ Location _____

Checked by (Name/ Designation) _____ Date _____

Safety Checks		Please tick (✓) Yes	No	NA*	If no, action required by:
Forklift is inspected before use. Inspection items include tyre, lighting equipment, foot brake, rear view mirror, and so on.					Name: _____ Date : _____
Forklift is operated by an authorised and trained operator.					Name: _____ Date : _____
Forklift is installed with lap-belt and operators are educated to use it.					Name: _____ Date : _____
All loads handled are in accordance with the height and weight restrictions on the forklift's load chart.					Name: _____ Date : _____
Forklift is not used as a work platform or to lift people.					Name: _____ Date : _____
Designated forklift drive-ways, stipulated in-house speed limit and convex mirrors for checking blind spots are provided.					Name: _____ Date : _____
Alight and board the forklift using three points of contact (hands and feet).					Name: _____ Date : _____
Forklift is completely shut down after use and the ignition key is removed.					Name: _____ Date : _____

+ This checklist may not cover all aspects of work activities in your workplace. You should review the checklist when there are changes in any work activity.
* NA – Not applicable

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8. References

1. Workplace Safety and Health (WSH) Act
   - Workplace Safety and Health (General Provisions) Regulations,
   - Workplace Safety and Health (Risk Management) Regulations
   - Workplace Safety and Health (Incident Reporting) Regulations
   - Workplace Safety and Health (First-Aid) Regulations
2. Arms and Explosives Act
3. Road Traffic (Motor Vehicles, Construction and Use) Rules
4. Code of Practice for Safe Lifting Operations in the Workplace
5. Singapore Standard CP 30: 1985 Code of Practice for Safe Loading on Vehicles
6. Singapore Standard SS 586: Part 1: 2014 Transport and storage of dangerous goods
7. Code of Practice "Safety of Loads on Vehicles" (3rd Edition) Department for Transport, UK
8. European Best Practices Guidelines on Cargo Securing for Road Transport
9. Driver's Handbook on Cargo Securement Department of Transportation, USA
10. Drivers' Manual for the Safe Securement of Metal Coils and Other Cargoes New York State Department of Motor Vehicles, USA
11. National Safety Code for Motor Carriers, Standard 10, Cargo Securement. Canada-US Joint Project

Useful resources

- WSH Guidelines
  - √ *Landscape and Horticulture Management*
  - √ *Safe Operation of Forklift Trucks*
  - √ *Workplace Traffic Safety Management*
- Activity Based Checklists
  - √ Safe loading of materials
  - √ Safe storage in warehouse
  - √ Safe use of forklift trucks

Useful Information

- Workplace Safety and Health Council: contact@wshc.gov.sg
- bizSAFE programme at WSH Council: www.wshc.sg/bizsafe
- MOM hotline for reporting unsafe work practices: 6317 1111
- Report accidents, dangerous occurrences and occupational diseases at www.mom.gov.sg/ireport
- Training programme at CDAS Logistics Alliance Ltd: 6376 5925/26/27/28 or visit www.cdasalliance.sg

9. Glossary

Term	Definition
Air bag	Type of dunnage for securing and stabilising purposes. A compressible bag inflated with air. Absorbs forces generated during transporting and prevents damage to cargo. Also known as dunnage bags, airbags, air cushions, and inflatable bags.
Anchorage point	Refers to structure, fitting or attachment on a vehicle chassis where lashing devices can be attached to. Forms a restraining system with the lashing devices.
Block	A structure, device, another cargo unit or material placed against or around an article of cargo to prevent its horizontal movement.
Chassis	The base structural frame of a wheeled vehicle.
Chock	Blocks used to prevent movement of the load. Commonly wedge-shaped.
Dunnage	Inexpensive or waste material (e.g., wood, cardboard, foam, plastic air pillows) used to fill up empty space. Supports and secures cargo by preventing movement of individual units of cargo, such that all cargo units would move as a single unit with vehicle.
Edge protector	An angled material placed over sharp edges of cargo to prevent pressure from lashing devices from cutting into the package, and protect lashing devices from being worn out by sharp edges.
Friction mat	A mat placed between deck of a vehicle and cargo, or in between cargo, to increase friction between surfaces.
Front bulkhead	A structural safety partition within a vehicle, to separate and protect driver's cabin from getting impacted by cargo.
Hazard	Anything with potential to cause bodily injury, and includes any physical, chemical, biological, mechanical, electrical or ergonomic hazard.
Headboard	A vertical structure behind driver's cabin. Restrains forward movement of cargo and protect driver's cabin from getting impacted by cargo. Also known as cabin guard.
Intermediate bulk container (IBC)	An industrial container used for storing and transporting bulk liquid or granular substances. It may be fitted to a pallet or with straps for mechanical handling (e.g., forklift, crane). Also known as IBC tote, or pallet tank.
ISO container	A large reusable container designed to standards from International Organization for Standardization (ISO). Fitted with at least four twistlocks at each corner.
ISO tank	A tank container designed to standards from International Organization for Standardization (ISO), fitted into a metal frame with twistlocks. Ideal for carrying liquids in bulk.
Lashing	Fastening devices, chains, cables, ropes or webbing used to restrain loads to prevent it from moving or falling off vehicle.
Loop lashing	Method of direct lashing where lashing device is circled around cargo and both ends are secured to the same anchorage point.
Out-of-gauge	Cargo that exceeds internal dimensions of loading platform or container by length, width or height.
Overhang	Sections of cargo units that protrude out of loading platform.
Pallet	A portable platform used for storing or moving cargo or freight.
Payload	Difference between maximum laden weight and un-laden weight of vehicle. The total weight of all cargo being transported.
Sideboard	A vertical structure at the side of a flat-deck body of a vehicle. Restrains sideways movement of cargo.
Shrink film	Plastic film that is covered loosely around cargo and shrinks when heat is applied. The shrinking holds cargo tightly together.
Stanchion	Metal beams mounted along sides of trailer beds to prevent sideways movement of cargo.
Stretch film	Plastic film that stretches when it is wrapped around cargo. Elasticity of film holds cargo tightly together.
Tailboard	A vertical structure at the rear end of a flat-deck or curtain-sided body of a vehicle. Restrains backward movement of cargo.
Traction	The grip of surface of a tyre or shoe on a road or floor.

Twistlock	A twistlock and corner casting together form a standardised rotating connector for locking ISO containers into position on a trailer bed.
Whip	Commonly observed in long cargo items that are slightly flexible, and secured only at one end. The free-moving end amplifies momentum transmitted from vehicle and swings suddenly and rapidly.

10. Amendments

Old edition	New edition	Changes
Introductions	Glossary	Terms and definitions shifted under Glossary.
Chapter 3	Chapter 3	Added "sheet" to Equipment.
Chapter 4	Chapter 2	Added packaging and common hazards.
Chapter 4	Chapter 4	Added "glass" and "dangerous cargo" to Cargo types.
Chapter 6	Chapter 5	Updated Risk Management 2.0.
Chapter 7	Chapter 2	Added "sheeting" to methods of securing.
Annex	Annex	Update RA form. Added activity based checklists.

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This publication is available on the Workplace Safety and Health Council website: www.wshc.gov.sg
Email: contact@wshc.gov.sg