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Working Party on Intermodal Transport and Logistics

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Revision of the Code of Practice for Packing of Cargo Transport Units

Code of Practice for Packing of Cargo Transport Units

Note by the secretariat

I. Background

This document reproduces a clean version of the proposal for the updated and restructured Code of Practice for Packing of Cargo Transport Units together with its 13 supplements.

IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units

(CTU Code)

proposed Revision (2025)
consolidated text

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Preamble

The use of containers, swap bodies, vehicles or other cargo transport units substantially reduces the physical hazards to which cargoes are exposed. However, improper or careless packing of cargoes into/onto such units, or lack of proper blocking and lashing, may be the cause of personnel injury when they are handled or transported. In addition, serious and costly damage may occur to the cargo or to the equipment.

The types of cargoes carried in containers has expanded over many years and innovations such as use of flexitanks and developments allow heavy, bulky items which were traditionally loaded directly into the ships' hold (e.g. stone, steel, wastes and project cargoes), to be carried in cargo transport units.

The person who packs and secures cargo into/onto the cargo transport unit (CTU) may be the last person to look inside the unit until it is opened at its final destination. Consequently, a great many people in the transport chain will rely on the skill of such persons, including:

- road vehicle drivers and other road users when the unit is transported by road;
- rail workers, and others, when the unit is transported by rail;
- crew members of inland waterway vessels when the unit is transported on inland waterways;
- handling staff at terminals when the unit is transferred from one transport mode to another;
- dock workers when the unit is loaded or unloaded;
- crew members of a seagoing ship during the transport operation;
- those who have a statutory duty to inspect cargoes; and
- those who unpack the unit.

All persons, such as the above, passengers and the public, may be at risk from a poorly packed container, swap body or vehicle.

Chapter 1. Introduction

1.1 Scope

1.1.1 The aim of this IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units (CTU Code) is to give advice on the safe packing of cargo transport units (CTUs) to those responsible for the packing and securing of the cargo and by those whose task it is to train people to pack such units. The aim is also to outline theoretical details for packing and securing as well as to give practical measures to ensure the safe packing of cargo onto or into CTUs.

1.1.2 In addition to advice to the packer, the CTU Code also provides information and advice for all parties in the supply chain up to and including those involved in unpacking the CTU.

1.1.3 The CTU Code is not intended to conflict with, or to replace or supersede, any existing national or international regulations which may refer to the packing and securing of cargo in CTUs, in particular existing regulations which apply to one mode of transport only, e.g. for transport of cargo in railway wagons by rail only.

1.2 Safety

1.2.1 Improperly packed and secured cargo, the use of unsuitable CTUs and the overloading of CTUs may endanger persons during handling and transport operations. Improper declaration of the cargo may also cause dangerous situations. The misdeclaration of the CTU's gross mass may result in the overloading of a road vehicle or a rail wagon or in the allocation of an unsuitable stowage position on board a ship thus compromising the safety of the ship.

1.2.2 Insufficient control of humidity may cause severe damage to and collapse of the cargo and cause also the loss of the stability of the CTU.

1.2.3 The International Labour Organization (ILO)'s Declaration on Fundamental Principles and Rights at Work (1998), as amended in 2022, includes a safe and healthy working environment as one of its five principles, with the Occupational Safety and Health Convention, 1981 (No. 155), and the Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187), considered as fundamental Conventions. When packing, securing and handling cargoes and CTUs, it is the duty of all parties in the supply chain to follow the guidance of all fundamental conventions. A safe and healthy working environment in the packing and securing of cargoes and CTUs requires the active participation of governments, employers and workers through a system of defined rights, responsibilities and duties, as well as through social dialogue and cooperation.

1.3 Security

1.3.1 It is important that all personnel involved in the packing, security sealing, handling, transport and processing of cargo are made aware of the need for vigilance and the diligent application of practical procedures to enhance security, in accordance with national legislation and international agreements.

1.3.2 Guidance on the security aspects of the movement of CTUs intended for carriage by sea may be found in a variety of documents including the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended; the International Ship and Port Facility Security (ISPS) Code; the ILO/IMO Code of Practice on Security in Ports; and the Standards and the Publicly Available Specifications developed or being developed by the International Organization for Standardization (ISO) to address cargo security management and other aspects of supply chain security. Furthermore, the World Customs Organization (WCO) has developed a SAFE Framework of standards to secure and facilitate global trade.

1.4 Prevention of Pest Contamination

Minimizing pest contamination of freight containers and their cargoes is a shared responsibility and by applying practices set out in Chapter 12 and Annex 11 of this Code, all parties can help keep freight containers and their cargoes clean. This will help to prevent the introduction and spread of pests through international transport of freight containers. All clauses pertaining to the aspects of prevention of pest contamination in the CTU Code apply to freight containers in international transport. They reflect the guidance provided in the International Plant Protection Convention (IPPC) guidance.

1.5 Prohibited Cargoes

1.5.1 The CTU Code addresses the packing and handling of cargoes that are traded legally and legitimately between contracting and consenting parties to a shipment.

1.5.2 Users of the CTU Code are alerted to the existence of illicit shipments of prohibited cargoes and trade in goods that are illegal under international or national law but that may be presented for packing in CTUs or attempted to be concealed in CTUs.

1.5.3 All parties, in particular consolidators, receiving goods for packing or carriage in a CTU should take steps to prevent the shipment of cargoes from the following categories:

- Illegal wildlife, as defined in Chapter 2 (illegal wildlife trafficking)[1]
- Illicit drugs
- Firearms, subject to export restrictions
- Contraband, such as counterfeit or smuggled goods
- Goods subject to national or international sanctions legislation
- Trafficked humans and smuggled migrants

1.5.4 All parties in the supply chain have a responsibility for checking on the legitimacy of cargoes handled and, based on a risk assessment, alerting appropriate national authorities of suspicious activity.

1.5.5 If any shipments are suspected of containing cargo from the above categories, they should be thoroughly reviewed by a responsible person, which may include an inspection of the CTU.

1.5.6 With regard to wildlife, this review should involve checking the species against the Appendices to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) to determine its protected status and whether trade is permissible. Each shipment of wildlife should be accompanied by valid documentation, including where applicable a CITES permit.

1.5.7 If there is strong evidence of wildlife smuggling, such as false declarations, forged documents or permits, or prohibited items, a responsible person should report this to the relevant authorities.

1.6 How to use the CTU Code

1.6.1 The CTU Code follows the natural flow of tasks associated with packing CTUs and comprises 15 chapters (Tier 1) each describing a policy or key feature related to the safe packing and transport of cargo in CTUs. Many of them refer to one or more annexes (Tier 2) which is highlighted in the text where applicable.

1.6.2 The annexes (Tier 2) provide ancillary technical clauses which include technical information to accompany one of more of the chapters. This technical information is further detailed in appendices (Tier 3), hence they provide supplement technical clauses. In addition, Tier 4 covers 13 Supplements to the CTU Code which provide additional practical guidance and background information but do not constitute a formal part of the Code.

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[1] See also FAL.5/Circ.50 on guidelines for the prevention and suppression of the smuggling of wildlife on ships engaged in international maritime traffic

1.6.3 Following the introduction in Chapter 1, Chapter 2 (Definitions) lists definitions of terms which are used throughout the Code. Chapter 3 (Key requirements) provides an overview of basic safety issues related to the packing of CTUs, briefly described as "dos and don'ts". Detailed information on how to comply with these "dos" and how to avoid the "don'ts" are contained in the following chapters and in the related annexes.

1.6.4 Chapter 4 (Chains of responsibility and information) identifies the chains of responsibility and communication for the principal parties in the supply chain and is supplemented with Annex 1 on information flow and, particularly for terminal operators, with Annex 2 on the safe handling of CTUs.

1.6.5 Chapter 5 (Safe and healthy working environment) denotes key principles and policies needed to ensure that occupational health and safety is properly considered during all efforts associated with packing and unpacking CTUs.

1.6.6 Chapter 6 (General transport conditions) describes the acceleration forces and the climatic conditions to which a CTU is exposed during transport. Annex 3 provides additional guidance on the prevention of condensation damages.

1.6.7 Chapter 7 (CTU Types), Chapter 8 (CTU suitability) and Chapter 9 (Arrival, checking and positioning of CTUs) should be considered to select the appropriate CTU for the cargo to be carried and to ensure that the CTU is fit for its intended purpose. More information on the properties of the various CTU types is provided in Annex 4. Further guidance is also provided in Annex 5 (Approval plates), Annex 6 (Receiving CTUs) Annex 7 (Access to tank and bulk tops, working at height), Annex 8 (Fumigation). Also, prevention of pest contamination can be of relevance with information contained in Annex 11 (Pest contamination of freight containers and their cargo).

1.6.8 Chapter 10 (Packing cargo into CTUs) is the core chapter of this Code dealing with the actual packing operation. This chapter directs the user to the related provisions in Annex 9 and Annex 10. Annex 9 provides information on manual handling and is supported with supplements on manual handling practices and mechanical handling and techniques. Annex 10 details information on packing and securing material, bedding arrangements and load distribution, transport stability level, packing of bulk material and transport of perishable cargoes. This annex is supplemented with appendices on packaging marks, friction factors and on calculations for load distribution and cargo securing as well as a supplement on "quick lashing guide and calculation behind it". Guidance for fumigation is also referred in Annex 8.

1.6.9 Chapter 11 provides additional advice on the packing of dangerous goods, Chapter 12 provides advice and guidance on minimising pest risks associated with the freight container pathway including methods to remove and manage pest contamination**.** Chapter 13 (On completion of packing) provides packers of the action required once the CTU has been packed and all parties are satisfied by the packing and securing of the cargo. The selection, attachment and removal of seals is covered in Annex 12 supported with further technical details in appendices.

1.6.10 Chapter 14 contains advice on the receipt and unpacking of CTUs. Relevant information to this chapter is also detailed in Annex 6 (Receiving CTUs) supplemented by an Supplement on the testing of hazardous gases as well as Annex 8 (Fumigation).

1.6.11 Chapter 15 outlines the required qualification of personnel engaged in the packing of CTUs. The topics for consideration in a training programme are listed in Annex 13.

1.7 Standards

Throughout this Code and in its annexes and appendices, any national or regional standards are referenced for information only. Administrations may substitute other standards that are considered equivalent.

Table 1: Summary of contents

Tier 1		*Tier 2*		*Tier 3*		*Tier 4*	
Key clauses (chapters)		**Ancillary technical clauses (annexes)**		**Supplement technical clauses (appendices)**		**Supplements to the CTU Code**	
1	Introduction						
2	Definitions						
3	Key requirements						
4	Chains of responsibility and information	An1	Information flow				
		An2	Safe handling of CTUs				
5	Safe and healthy working environment						
6	General transport conditions	An3	Prevention of condensation damages				
7	CTU types	An4	CTU Properties			Suppl1	Detailed properties of containers
		An5	Approval plates			Suppl2	Detailed properties of swap bodies
						Suppl3	Detailed properties of road vehicles
						Suppl4	Detailed properties of railway wagons
8	CTU suitability	An4	CTU Properties				
		An5	Approval plates				
9	Arrival, checking and positioning of CTUs	An5	Approval plates			Suppl5	Testing for hazardous gases
		An6	Receiving CTUs				
		An7	Access to tank and bulk tops, working at height				
		An8	Fumigation				
10	Packing cargo into CTUs	An9	Manual Handling			Suppl6	Manual handling practice
		An10	Packing and securing cargo into CTUs	Ap10.1	Packaging marks	Suppl7	Mechanical handling and techniques
				Ap10.2	Friction factors	Suppl8	Quick Lashing Guide
				Ap10.3	Practical methods for the determination of the friction factor μ	Suppl9	Calculation behind quick-lashing guide
				Ap10.4	Specific packing and securing calculations	Suppl10	Transport of perishable cargo
				Ap10.5	Practical inclination test for determination of the efficiency of cargo securing arrangements		
		An8	Fumigation				
11	Additional advice on the packing of dangerous goods						

12	Minimizing pest risks associated with the container pathway	An11	Pest contamination of freight containers and their cargo				
13	On completion of packing	An12	CTU Seals	Ap12.1	Responsibilities along the chain of custody	Suppl11	Selection of seals
				Ap12.2	Sealing requirements for special CTUs		
14	Advice on receipt and unpacking of CTUs	An6	Receiving CTUs				
		An8	Fumigation			Suppl12	Cutting tools
		An12	CTU Seals			Suppl13	Height adjustment
15	Training in packing of CTUs	An13	Topics for consideration in a training programme				

Chapter 2. Definitions

For the purpose of this Code, the following is defined:

Absolute humidity of air	Actual amount of water vapour in the air, measured in g/m^3 or g/kg.
BK1	Sheeted bulk container. An open top bulk container with rigid bottom (including hopper-type bottom), side and end walls and a non-rigid covering,
BK2	Closed bulk container. A totally closed bulk container having a rigid roof, sidewalls, end walls and the floor (including hopper-type bottoms). The term includes bulk containers with an opening roof, side or end wall that can be closed during transport. Closed bulk containers may be equipped with openings to allow for the exchange of vapour and gases with air and which prevent under normal conditions of transport the release of solid contents as well as the penetration of rain and splash water.
BK3	Flexible bulk container. A flexible container with a capacity not exceeding 15 m3 and includes liners and attached handling devices and service equipment.
Blocking	Cargo securing method where the cargo is prevented from sliding and/or tipping by being stowed against sufficiently strong permanent structures or fixtures on the CTU. Wedges, dunnage, stanchions, inflatable dunnage bags, temporary wooden structures and other devices which are supported directly or indirectly by fixed blocking structures are also considered as blocking elements.
Blocking capacity	The maximum ability of a structural member, arrangement, element or material to take the force distributed over its full height and width during sustained use.
Boundary	Refers to the edges or walls of the CTU and surrounds the cargo deck.
Bulk container	Container for the transport of dry bulk solids, capable of withstanding the loads resulting from packing, transport motions and discharging of non-packaged dry bulk solids and having packing and unpacking apertures and fittings. There are two variants: • non-pressurized dry bulk container - dry bulk container permitting packing and unpacking by gravity • pressurized dry bulk container - dry bulk container which may be packed or unpacked by gravity or pressure discharge.
Bulk materials	Materials that can move freely in a CTU or that are not otherwise secured in their position and for the purpose of this document includes liquids.
Cargo	Overpacks, packages, unit loads which can contain goods and unpackaged goods that are handled in the supply chain.
Cargo deck	The area within the CTU boundaries onto which packages may be placed and secured.

Cargo securing method	Method for preventing cargo from sliding and/or tipping in forward, backward and sideways directions by blocking, lashing, locking or a combination of these basic methods, respectively providing a pushing force, pulling force or both.
Cargo transport unit (CTU)	A freight container, swap body, vehicle, railway wagon or any other similar unit in particular when used in intermodal transport.
Carrier	The party who, in a contract of carriage, undertakes to perform or to procure the performance of carriage by rail, road, sea, inland waterway or by a combination of such modes. Can be further classified as: • Road haulier; • Rail operator; • Shipping line.
Carrier haulage	The main haulage carrier arranges the preceding and/or subsequent transport of a CTU.
Clean CTU	A CTU free from: • Any previous cargo residues; • Any noxious material • Any securing materials used from previous consignments; • Any labels, marks or placards or associated with previous cargoes; • Any detritus (waste) that may have accumulated in the CTU; Any pest contamination (*Applicable to freight containers in international transport as per IPPC guidance)*.
Closed CTU	A CTU which totally encloses the contents by permanent structures with complete and rigid surfaces. CTUs with fabric sides or tops are not considered as closed cargo transport units.
Condensation	Conversion of water vapour into a liquid state. Condensation usually starts when air is cooled down to its dew point in contact with cold surfaces.
Consignee	The party to whom a cargo is consigned under a contract of carriage or a transport document or electronic record.
Consignor	The party who prepares a cargo for transport.
Consolidator	The party performing a consolidation service for others.
Container[2] [3]	article of transport equipment which is: • of a permanent character and accordingly strong enough to be suitable for repeated use; • specially designed to facilitate the carriage of goods by one or more modes of transport, without intermediate reloading;

[2] ISO 830:2024 Freight containers – vocabulary.

[3] The International Convention for Safe Containers, 1972.

	• designed to be secured and / or readily handled, having corner fittings for these purposes; and
	• of a size such that the area enclosed by the four outer bottom corners is either:
	  • at least 14 m^2 (150 ft^2); or
	  • at least 7 m^2 (75 ft^2), if it is fitted with top corner fittings;
	  • is fitted with a CSC approval plate.
	But does not include vehicles or packaging

Corrosion threshold	A relative humidity of 40% or more will lead to an increasing risk of corrosion of ferrous metals.
Crypto climate in the CTU	State of relative humidity of the air in a closed CTU, which depends on the water content of the cargo or materials in the CTU and on the ambient temperature.
CTU Code	IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units (CTUs).
CTU operator	The party who owns or operates the CTU and provides empty CTUs to the consignor/shipper/packer.
Daily temperature variation in the CTU	Rise and fall of temperature in accordance with the times of day and often exaggerated by radiation or other weather influences.
Dew point of air	Temperature below the actual temperature at which a given relative humidity would reach 100%.
EDI	Electronic data interchange - the concept of businesses electronically communicating data and information that was traditionally communicated on paper.
EDP	Electronic data processing - the use of automated methods to process commercial data.
Flexitank	Bladder with a loading/discharging valve or valves which is installed inside a general purpose CTU and is used for the transport and/or storage of a non-regulated liquid.
Form locking	A method for cargo securing and means that the cargo is completely stowed against the boundaries of a CTU. The empty space between the cargo units and between the cargo and the boundaries should be minimized. The boundaries should be strong enough to absorb the normal forces that occur during transport.
Freight container[4]	A container that is used primarily in international maritime transport.
Freight forwarder	The party that provides services relating to the carriage, consolidation, storage, handling, packing or distribution of goods, as well as ancillary and advisory services in connection therewith including customs clearance.

	Freight forwarding services may also include logistics services in connection with the carriage, handling or storage of the goods.
Grappler arms	Hydraulically operated arms attached to a spreader device or frame that can be used to lift CTUs using specially designed grapple arm sockets built into the base frame of the CTU.
Hygroscopicity of cargo	Property of certain cargoes or materials to absorb water vapour (adsorption) or emit water vapour (desorption) depending on the relative humidity of the ambient air.
Illegal Wildlife Trafficking	Illegal transport or trafficking of wildlife.
Intermodal operator	The party who provides a service to transfer and/or stow CTUs. May be subdivided into: • Maritime terminal operator; • Rail terminal; Inland waterway port.
Inspectors / surveyors	Parties employed by governments or commercial entities to perform inspection / surveying functions to ensure the safe transport of CTUs
Insurers	Are entities / parties that provide insurances which variously cover loss or damage to cargo, CTUs, ships and other means of conveyance. Some insurances, such as Cargo or Hull, provide cover based on the value of the item insured. Others, such as Protection & Indemnity or Carrier's Liability, cover the liability under law or contract in relation to the goods being transported and other parties who may be impacted.
Label	a. A decal or panel applied to packages and/or cargo items that indicates a hazard or danger to persons or to the environment. b. A piece of material or plastic attached to, but not printed on, lashing equipment to provide information about its strength and other characteristics.
Lashing	Cargo securing method where the cargo is prevented from sliding and/or tipping by the use of bendable devices, e.g., web- or chain lashings, steel straps, wire or ropes. Lashings can be attached by different techniques such as top-over-, half loop-, straight- or spring lashings.
Lashing capacity	Maximum force for use in straight pull that a lashing is designed to sustain in use. See also the definition for Maximum securing load.
Locking	Cargo securing method where the cargo is prevented from sliding and tipping in all directions by mechanical devices, e.g. twist-locks, bolts or welds.
Mark	An applied decal or panel that provides information concerning the cargo packed.
Maximum securing load	A term used to define the allowable load capacity (expressed as a force) for a device used to secure cargo to a ship. Safe working load (SWL) may

	be substituted for MSL for securing purposes, provided this is equal to or exceeds the strength defined by MSL.
Merchant haulage	Merchant haulage is when the merchant, which may be the cargo owner consignor or shipper arranges the CTU transport through their appointed service providers
Misdeclared cargo	A cargo transported in a CTU which is different from that declared on the transport documents.
Misdeclared gross mass	A CTU where the combined mass of the cargo and the CTU is different from the mass declared on the transport/shipping documents. See also overloaded and overweight.
Mould growth threshold	A relative humidity of 75% or more will lead to an increasing risk of mould growth on substances of organic origin like foodstuff, textiles, leather, wood, ore substances of non-organic origin such as pottery.
Non-regulated goods	Substances and articles that are not covered by the applicable dangerous goods transport regulations.
Overloaded	A CTU where the combined mass of the cargo and the CTU is greater than the maximum permitted gross mass.
Overpack	An enclosure used by a single shipper to contain one or more packages and to form one unit for convenience of handling and stowage during transport. Examples of overpacks are a number of packages either: • Placed or stacked on to a load board such as a pallet and secured by strapping, shrink-wrapping, stretch-wrapping or other suitable means; or • Placed in a protective outer packaging such as a box or crate.
Overweight	A CTU where the combined mass of the cargo and the CTU is less than the maximum permitted gross mass but exceeds either: • The maximum gross mass shown on the transport/shipping documents; or • The road or rail maximum masses when combined with the tare of the container carrying vehicle.
Package	The complete product of the packing operation, consisting of the packaging and its contents as prepared for transport;
Packaging	Receptacles and any other components or materials necessary for the receptacle to perform its containment function.
Packer	The party that loads, places or fills the cargo within or on the CTU; the packer may be contracted either by the consignor, by the shipper, by the freight forwarder or by the carrier; if the consignor or the shipper packs a CTU within his own premises, the consignor or the shipper is also the packer.
Packing	The placing, loading and filling cargo into and onto a CTU.

Perishable cargoes	Cargoes that have a limited shelf life and can spoil or deteriorate over time. These perishable goods include foods such as fruits, vegetables, meat, poultry, fish, dairy products, and cooked leftovers.
Pest Contamination	Visible forms of animals, insects or other invertebrates (alive or dead, in any lifecycle stage, including egg casings or rafts), or any organic material of animal origin (including blood, bones, hair, flesh, secretions, excretions); viable or non-viable plants or plant products (including fruit, seeds, leaves, twigs, roots, bark); or other organic material, including fungi; or soil, or water; where such products are not the manifested cargo within the CTU.
Placards	Placards are a larger version of labels as defined above in a).
Reinforced vehicle body	Vehicle body, having a reinforced structure (in Europe complies with European standard EN 1262, paragraph 5.3)
Relative humidity of air	Actual absolute humidity expressed as percentage of the saturation humidity at a given temperature.
Roll-on/roll-off ship (ro-ro)	A method of maritime cargo service using a ship with ramps which allows wheeled vehicles to be loaded and discharged without cranes. Also refers to any specialized ship designed to carry ro-ro cargo.
Saturation humidity of air	Maximum possible humidity content in the air depending on the air temperature.
Scantling	A piece of sawn timber, such as a batten, that has a small cross section.
Set point	Temperature setting on the controller of the refrigeration unit.
Shelf life	The recommended period that a perishable product may be retained in a saleable condition during which the defined quality of a specified proportion of the goods remains acceptable under expected (or specified) conditions of distribution, storage and display.
Shipper	The party who concludes a contract of carriage (or in whose name or on whose behalf a contract of carriage has been concluded) with a carrier.
Shoring slot	A permanent fixture into which cargo securing bars or boards can be inserted and which will prevent cargo from placing loads in excess of the container doors' design load on the doors during sudden motion.
Shoring slot system	Is designed to restrain the cargo from forcing the door open during sudden stops of tilts of the container during transportation. It also serves to restrain dislocated cargo to prevent it from spilling out of the container when the container's doors are opened. Shoring slot systems consist of shoring slots and one or more cargo securing bars.
Siftproof	Means impermeable to dry contents including fine solid materials produced during transport
Sign (distinguishing sign)	Distinguishing sign of the state of registration used on motor vehicles and trailers in international road traffic, e.g., in accordance with the Geneva Convention on Road Traffic 1949 or in the Vienna Convention on Road Traffic of 1968.

Solebar	Main beam of a rail wagon/car.
Standard vehicle body	Vehicle body, without reinforced structure (in Europe, complies with European standard EN 12642, paragraph 5.2), which, depending on cargo weight and friction, requires additional securing of cargo using lashing equipment.
Storage life	The period that the product is kept at the lowest possible temperature starting soonest after picking/harvesting and ending at the time that the product is taken out the refrigerated conditions for delivery to consumers at which time the shelf life period starts.
Temperature sensitive cargo	Cargo that should be packed, stored or transported within a defined temperature range with an upper and / or lower temperature value, and outside of which may cause: • the cargo to be damaged • the state of the cargo to change • the cargo to auto ignite Temperature sensitive cargos may also need to arrive within a strict time frame or be subjected to maximum dwell times during transport.
Transport documentation	Documents required for the movement of a cargo elated to the origin, destination, nature and character of the goods transported. Electronic records are considered equivalent to paper documents when permitted by the regulations.
Unit load	Palletized load or prepacked unit with a footprint conforming to pallet dimensions and suitable for loading into an CTU. See also *unitized cargo*.
Unitized cargo	A single item or a number of items packaged, packed, or arranged in a specified manner and capable of being handled as a unit. Unitization may be accomplished by placing the item or items in an *overpack* or by banding them securely together. Also known as a *unit load.*
Unpacker	The party that unloads, removes or empties the cargo from the CTU.
Unpacking	The removal of cargo from a CTU.
Ventilated container	Closed type of container, similar to a general-purpose freight container but designed to allow air exchange between its interior and the outside atmosphere. Has a ventilating system designed to accelerate and increase the natural convection of the atmosphere within the container as uniformly as possible, either by non-mechanical vents at both the upper and lower parts of their cargo space, or by internal or external mechanical means.
Visible	Means detectable by the human eye without aid of any supporting instruments or aids such as magnifying glasses and microscopes.
Water content of cargo	Latent water and water vapour in a hygroscopic cargo or associated material, usually stated as percentage of the wet mass of cargo.
Wildlife	All species of wild animals and plants, whether alive or dead, and parts and derivatives of those species, whose international trade is regulated under the Convention on International Trade in Endangered Species of

	Wild Fauna and Flora, as well as those protected under international law, and those whose exports are restricted under national legislation implementing of the same.

Chapter 3. Key requirements

This chapter identify those actions and tasks that are key to the safe packing and transport of cargo.

3.1 General

- **Do** arrange for a safe working environment.
- **Do** use safe handling equipment.
- **Do** use appropriate personal protective equipment.
- **Do** check that the CTU and any cargo securing equipment are in sound condition.
- **Do not** smoke, eat or drink during packing, securing or unpacking.

3.2 Planning

- **Do** select the most suitable CTU type to accommodate the cargo for the intended transport.
- **Do** prepare a packing plan when deemed necessary.
- **Do** select the securing methods best adapted to the characteristics of the cargo, the mode of transport and the properties of the CTU.
- **Do not** exceed the permitted payload limits of the unit or the maximum allowed gross mass according to the CSC[5], national road and rail regulations.

3.3 Packing

- **Do** distribute heavy cargo appropriately over the floor area.
- **Do** observe all handling instructions and symbols on packages such as "this side up".
- **Do** load with the centre of gravity correctly located in the CTU.
- **Do not** concentrate heavy cargo on small areas of the floor.
- **Do not** load with eccentric load distribution.
- **Do not** build up irregular layers of packages if it can be avoided.
- **Do not** stow heavy goods on top of light goods.
- **Do not** stow goods with tainting odours together with sensitive merchandise.
- **Do not** pack wet and damp goods if it can be avoided.
- **Do not** use securing or protection equipment which is incompatible with the cargo.

3.4 Packing of dangerous goods

- **Do** check that all packages are properly marked and labelled.
- **Do** pack dangerous goods according to applicable dangerous goods regulations.
- **Do** pack dangerous goods near the door of the CTU where possible.
- **Do** affix required labels, marks and placards on the exterior of the CTU.
- **Do not** pack incompatible goods which should be segregated.
- **Do not** pack damaged packages.

3.5 Securing

- **Do** fill void spaces when necessary.

[5] International Convention for Safe Containers, 1972 (CSC) as amended

- **Do** use blocking or lashing or a combination of these methods to prevent the cargo from sliding and tipping in any direction.
- **Do** secure the cargo in a way that forces are distributed over an appropriate area of a unit.
- **Do** secure each single loaded item independently where necessary.
- **Do** use non-slip surface material to refrain packages from sliding where appropriate.
- **Do** use hooks or shackles to fasten lashings where applicable.
- **Do not** secure the cargo with devices overstressing the structure of the CTU or the cargo.
- **Do not** overstress securing devices.
- **Do not** overtighten securing devices so that the packaging or goods are damaged.
- **Do not** fasten web lashings by means of knots.

3.6 On completion of packing

- **Do** determine the correct gross mass of the CTU.
- **Do** affix a seal when required.
- **Do** include the CTU number, the correct gross mass and, when required, the seal number in the appropriate documents.
- **Do** provide a packing certificate when required.

3.7 Unpacking

- **Do** check that the identification number on the CTU and, when the CTU should be sealed, the seal serial number, are as shown on the transport documentation.
- **Do** check the exterior of the CTU for signs of leakage or infestation.
- **Do** use proper equipment to cut the seal if affixed.
- **Do** ensure the CTU is safe to enter. Be aware that the atmosphere in the CTU may be dangerous **–** ventilate before entering.
- **Do** open the CTU with caution as cargo might fall out.
- **Do** record every package as it is removed noting any markings and damage.
- **Do** remove all securing and protection material for reuse, recycling or disposal.
- **Do** clean the interior of the CTU to remove all traces of the cargo, especially loose powders, grains and noxious materials and fumigants, unless otherwise agreed with the CTU operator.
- **Do** remove all labels, marks and placards regarding the previous consignment from the exterior of the CTU once it has been cleaned.

Chapter 4. Chains of responsibility and information

Note: Definitions are given in Chapter 2.

4.1 Chain of responsibility

4.1.1 In general, transport operations using CTUs in particular, involve various parties each of whom have a responsibility to ensure that the cargo is transported through the supply chain without incident. Notwithstanding any national legislation or contracts between the involved parties the chain of responsibility discussed below identifies functional responsibilities of the parties involved.

4.1.2 Although the carrier generally, in a contract of carriage is responsible under that contract to deliver the cargo in the same condition as received, it is the shipper who should deliver a cargo which is safe and suitable for transport. Thus, the shipper remains responsible for any deficiency of the CTU that is a result of poor packing and securing. However, when the shipper is neither the packer nor the consignor, the packer and the consignor should fulfil their obligation to the shipper ensuring that the CTU is safe for transport. If not, the shipper may hold those parties responsible for any faults or deficiencies that can be attributed to poor packing, securing, handling or reporting procedures.

4.1.3 Within this chain of responsibilities, each party in the chain should comply with their individual responsibilities and in doing so increase safety and reduce the risk of injury to persons involved in the supply chain[6].

4.1.4 All parties involved in the movement of CTUs also have a duty to ensure, in accordance with their roles and responsibilities in the supply chain, that the CTU is free from pest contamination and that the CTU is not carrying illegal goods or immigrants, contraband or undeclared or misdeclared cargoes including wildlife. Parties that handle and pack cargoes into CTU[7] are also responsible for ensuring that the cargo is free from pest contamination**.**

4.1.5 The supply chain is a complex operation, and individual modes of transport may have defined terms for parties within the supply chain which are not consistent with other modes of transport.

4.1.6 A single entity may undertake one or more of the functions listed below. For example, the role of the shipper may be performed by the consignor, the freight forwarder or the consignee, depending on the terms of the trade. The flow of information between the functions is discussed further in Annex 1.

4.2 Functions within the supply chain

Between the different functions involved in an intermodal transport chain, the tasks are assigned as follows:

4.2.1 The CTU operator is responsible for providing CTUs directly or, as the case may be, via a container depot, terminal or rail yard that:

- Are fit for purpose;
- Comply with international structural integrity requirements;
- Comply with international or national safety regulations;
- Are clean, free of cargo residues, noxious materials and pest contamination;

4.2.2 The consignor is responsible for:

- Correctly describing the goods including the mass of the total payload;
- Notifying the packer/shipper of any unusual transport parameters of individual packages, for example, the offset of the centre of gravity or transport temperatures which should not be exceeded or undercut;

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[6] See MSC.1/Circ.1531 on Due diligence checklist in identifying providers of CTU-related services

[7] In accordance with IPPC guidance, the clauses pertaining to prevention of pest contamination refer to containers in international transport. In this context, CTU should be understood as container in international transport.

- Ensuring that packages and unit loads are suitable to withstand the stresses which are to be expected under normal transport conditions;
- Providing all the information that is required for proper packing;
- Ensuring that goods in packages and unit loads are adequately secured to prevent damage during transport;
- Ensuring that goods are ventilated so that any noxious or harmful gases are permitted to vent off before packing;
- Ensuring that dangerous goods are correctly classified, packed, marked and labelled;
- Ensuring the dangerous goods transport document is completed, signed and transmitted to the packer, forwarder, shipper (if not the consignor) and carrier as applicable.

4.2.3 The packer is responsible for:

- Ensuring that the CTU is checked before packing and that the condition of the CTU is suitable for the cargo to be transported;
- Ensuring that the floor of the CTU is not overstressed during packing operations;
- Ensuring that no dangerous goods are packed without transport documentation;
- Ensuring that no incompatible or damaged dangerous goods are packed. Account should be taken of all applicable dangerous goods legislations during the entire journey of the CTU from original point of dispatch to final destination;
- Ensuring that the cargo is correctly packed in the CTU.
- Ensuring that the cargo is secured in the CTU in line with this Code;
- Ensuring that the cargo is correctly distributed in the CTU and properly supported where necessary;
- Ensuring that measures are put in place to prevent pest contamination of the CTU and of the cargo packed in or on it;
- Properly closing the CTU and sealing it (see Annex 12), when required, and reporting seal details to the shipper. with a view to sharing those details with the container operator and, where different, the carrier. CTUs used for international transport should be sealed immediately upon completion of packing;
- Fitting marks and placards to the CTU as required by dangerous goods regulations;
- Fitting the fumigation mark if any fumigant has been used as part of the packing process;
- Fitting other marks and / or labels applicable to the cargo being carried, e.g., flexitank labels;
- Accurately determining the gross mass[8] of the CTU[9] and transmitting it to the shipper;
- Ensuring that the CTU is not overloaded and complies with the maximum operating gross mass indicated on the approval plate (see Annex 5)
- Providing the container/vehicle packing certificate (new document or signed statement in the dangerous goods transport documentation as appropriate) including any dangerous goods hazard class as appropriate and forwarding any documentation to the shipper with the view of sharing that information with the container operator and, where different, the carrier.

To assist with the stowing of freight containers on board ships, and as the only party who may physically see the freight container, the packer should also pass on information relating to any freight

[8] The gross mass of the CTU needs to be verified before any transport operation commences. Incorrect gross masses are a hazard for any mode of transport. Therefore, the gross mass verification should be carried out before the unit leaves the premises of the packer. Where a cargo is to be transported by road vehicle or rail wagon, and where the tare of the CTU is not known the packer needs only provide the mass of the cargo and any packing and securing material to the shipper.

[9] Where the CTU is a freight container in sea transport, the Packers should provide a gross mass as required by the International Convention for the Safety of Life at Sea (SOLAS) Chapter VI, Regulation 2 which shall be verified by the Shipper and transmitted to the Container Operator, and where different, the Carrier.

container with a reduced stacking capacity (less than 192,000 kg marked on the CSC safety approval plate)[10]. This information is critically important for the proper stowage of the CTU aboard ship; it should therefore be shared also with the freight container operator and, where different, the carrier.

4.2.4 The consolidator is responsible for:

- Fulfilling the responsibility of the packer as shown in clause 4.2.3.
- Confirming to each and every shipper / consignor using a consolidated CTU that their cargo will be packed and secured in accordance with the requirements of the shipper / consignor to ensure the safe transport of their cargo.

4.2.5 The shipper is responsible for ensuring that:

- The work distribution concerning packing and securing is clearly agreed and communicated to the consignor and carrier/carriers;
- A CTU that is specified as suitable for the intended cargo and for the intended transport is free from pest contamination and otherwise compliant with the responsibilities of the CTU Operator (see clause 4.2.1);
- The cargo to be packed in or on the CTU is free from pest contamination;
- Suitable modes of transport are selected to minimize the risk of accidents and damages for the actual cargo;
- All required documents are received from the consignor and from the packer;
- The cargo inside the CTU is fully and accurately described;
- The gross mass of the CTU is accurately determined;
- The accurate description of the cargo[11] is communicated to the carrier as early as required by the carrier;
- The verified gross mass is communicated to the carrier as early as required by the carrier;
- In case of dangerous goods, the transport document and (for sea transport) the packing certificate is transmitted to the carrier before the transport commences respectively as early as required by the carrier;
- In the case of temperature-controlled goods, the correct temperature set point is entered into the control unit and onto the transport/shipping documents;
- Ensuring that a seal, where required, is affixed immediately upon completion of the packing of the CTU;
- The seal number, where required, is communicated to the carrier;
- Any extraordinary properties such as reduced stacking capacity or out of gauge are communicated to the carrier;
- The shipper's declaration is accurate;
- Shipping instructions are despatched to the carrier on time and that the CTU meets the outbound delivery window;
- The CTU arrives at the terminal before the stated cargo cut off time;
- The information concerning the consignment, description of packages and, in the case of freight containers, the verified gross mass is transmitted to the consignee.

4.2.6 The freight forwarder may perform any of the following functional roles:

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[10] As of January 1st 2012, all freight containers with reduced stacking or racking strength are required by the International Convention for Safe Containers (CSC) to be marked in accordance with the latest version of ISO 6346: Freight containers – Coding, identification and marking.

[11] A description of the cargo should include a description of the goods and the packaging, for example wine in a flexitank, hard frozen hanging beef sides or the number and type of packages. However, national and/or regional regulations may impose additional requirements for the scope and level of detail of cargo descriptions, including usage of Harmonized System (HS) codes.

- Consignor
- Packer
- Consolidator
- Shipper
- Carrier
- Unpacker
- Consignee

and should undertake the responsibilities of the roles as required by the contractual agreements between the parties concerned.

4.2.7 The road haulier is responsible for:

- Confirming that the gross mass, length, width and height of the vehicle are within the national road/highway regulations limits;
- Ensuring that the driver:
  - is qualified and / or experienced in driving the vehicle with the CTU / Cargo combination, for example: road tankers and tank container;
  - is aware of any cargoes that may influence the performance of the vehicle, for example bulk liquids on the CTU or hanging foodstuffs;
  - complies with the applicable regulations for driving times and rest periods[12]
  - secures the CTU properly on the trailer or chassis (except where the CTU is a trailer);
  - visually examines the exterior of the CTU to confirm that it is safe to move and that it is free from pest contamination;
  - confirms that there are no loose components or coverings that may become detached or damage the CTU and / or cargo during transport;
  - is aware of their responsibilities in conformance with the underlying contract between the haulier and shipper (merchant haulage) or carrier (carrier haulage) with regard to securing of the cargo and determining the status of the CTU and that the CTU is free from pest contamination;
  - moves the CTU in such a manner that there are no exceptional stresses placed on the CTU or the cargo;
  - is in possession of all documents required by the dangerous goods regulations.

4.2.8 The rail haulier is responsible for:

- Handling the CTU in a manner that would not cause damage to the cargo;
- Except when the CTU is a rail wagon, securing the CTU properly on the rail wagon.
- Ensuring that appropriate measures to prevent pest contamination are in place;

4.2.9 The intermodal operator is responsible for:

- Ensuring that appropriate pest prevention methods are in place;
- Complying with Annex 2.

4.2.10 The carrier is responsible for:

- Monitoring agreed temperatures in the CTUs where applicable and reacting to changes as appropriate;
- Securing the CTU on the means of transport;
- Transporting the CTU in compliance with agreements and all applicable regulations;

[12] See further the ILO Guidelines on the promotion of decent work on road safety in the transport sector.

- Providing trained personnel to deal with all cargo types (break-bulk, bulk wet and dry cargoes, dangerous goods, out of gauge, refrigerated, uncontainerised).
- Ensuring that appropriate measures to prevent pest contamination are in place.

4.2.11 The unpacker of CTUs is responsible for:

- Checking the seal prior to its removal on whether it conforms with information on the transport documentation;
- Correctly ventilating the CTU before entering;
- Confirming that the atmosphere within the CTU is not hazardous before permitting persons to enter it;
- Not overstressing the floor of the CTU during unpacking operations;
- Removing all cargo, securing material and other debris from the CTU;
- Applying suitable measures for detection of pest contamination and, where found, to dispose of them in accordance with any applicable rules and requirements promulgated by the local office of the National Plant Protection Organization (NPPO) or, if contamination is of animal origin, the local Animal Quarantine Office;
- Removing all labels, marks or placards regarding the previous consignments.
- Detecting any damage to the CTU and to notify the carrier.

4.2.12 The consignee of CTUs is responsible for:

- Receiving the CTU from the designated transport provider and ensuring that the information supplied by the shipper concerning the consignment matches those of the CTUs received;
- Returning the CTU to the CTU operator completely empty and clean, unless otherwise agreed.

4.2.13 The inspectors/surveyors are responsible for:

- Informing the principal of compliance and/or non-compliance of applicable codes and standards for further action where appropriate[13].
- Visually examining the CTU to ensure that it is free from pest contamination.

4.2.14 Insurers are responsible for:

- Raising awareness of the CTU Code and best practice among customers.
- Promoting the development of additional advice for specific cargo types as appropriate.

4.2.15 Shippers of empty CTUs and operators of empty CTUs are encouraged to have practices and arrangements in place to ensure that they are empty.

4.2.16 All parties identified within clause 4.2 should hold the tendering party responsible for any pest contamination of the CTU received. When in their custody, they should also minimize the risk of pest contamination of the CTU and, where applicable, the cargo to be packed in to or on the CTU.

4.2.17 All parties should ensure that the flow of information is transmitted to parties identified in the transport contract along the supply chain. The information should include:

- The identification, in accordance with a risk assessment[14], of risks to the integrity of the CTU that may be present for all or some part of the journey;
- CTU identification;
- Seal number (where required);
- Verified gross mass of the CTU;

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[13] See further MSC.1/Circ.1649 on Guidelines for the implementation of the inspection programmes for cargo transport units

[14] For example, ISO 31000 Risk management – Principles and guidelines

- Accurate description of the cargo carried in the CTU;
- The correct description of dangerous goods;
- Correct and appropriate transport documentation;
- Any information required for safety, security, phytosanitary, veterinary, Customs or other regulatory purposes.

4.2.18 All parties should check the integrity of the CTU and its seal when in their custody in order to detect possible intrusions into the CTU. Additionally, when a seal is changed the responsible party should:

- Replace seals removed with one that is at least to the same standard and complies with ISO 17712.
- Ensure that, the documentation is amended to include the inspection and its results as well as any seal removal and the affixing of new seals.

4.2.19 All parties should set up a procedure to report all suspicious cases or incidents of misdeclared or undeclared wildlife shipments with customs and law-enforcement authorities. It is important that any incidents with shippers and/or consignors misdeclaring or trying to conceal wildlife shipments be identified and reported on arrival.

Chapter 5. Safe and healthy working environment

5.1 Introduction

Recognizing the inseparable, interrelated and mutually supportive nature of all ILO fundamental principles and rights at work is critical to effectively prevent and mitigate risks in the working environment. The prevention of accidents or injury to health arising out of, linked with, or occurring in the course of packing, handling and transporting of CTUs should be the concern of all those responsible for the packing and securing of the cargo and by those whose task is to train people to pack such units. The main guiding principles in the prevention of accidents or injury in the packing of CTUs are contained in this chapter and should generally be organized in accordance with ILO Conventions, Recommendations and Protocols and ILO guidelines and codes of practice listed in clause 5.9.

5.2 General

5.2.1 Safety and health in the packing of CTUs is the responsibility of everyone who is directly or indirectly concerned with this work and those who need to cooperate to develop safe and healthy systems of work and ensure that they are put into practice. Parties should adopt practices and procedures that minimizes the risk of injury or fatalities to workers and other parties.

5.2.2 Effective occupational safety and health (OSH) systems require social dialogue, joint commitment and consultation between the competent authority, employers, workers and their representatives. The parties should cooperate in a constructive manner to ensure that the objectives of this code are achieved. This code recognizes that the full implementation of the principles of freedom of association and the effective recognition of the right to collective bargaining are enabling conditions for the attainment of the strategic objective of social dialogue and tripartism.

5.2.3 Women are part of the workforce in the packing, handling and transporting of CTUs. As such, employers, in consultation with worker representatives and in accordance with national laws, should develop gender sensitive OSH policies and programmes based on sex-disaggregated data and ensure that all workers have equal treatment and access to OSH services, including participation in OSH decision-making at all levels.

5.2.4 The design, implementation and application of OSH management systems should be guided by the Guidelines on occupational safety and health management systems: ILO–OSH 2001 and also by the 10 Keys for gender sensitive OSH practice – Guidelines for gender mainstreaming in occupational safety and health (ILO, 2013).

5.2.5 In accordance with the provisions of the Violence and Harassment Convention (No. 190) and Recommendation (No. 206), 2019, cooperation between competent authorities, employers and workers and their representatives is essential in developing and implementing appropriate policies and procedures to minimize the risk of violence and harassment.

5.2.6 Adequate welfare facilities should be provided and be available at all times to workers involved in the packing, handling and transporting of CTUs at or near the area in which they work. All facilities should be clean, dry and smoke free. These include decent toilets, sanitary and washing facilities, cloakrooms, messrooms, canteens, waiting rooms and any other personnel welfare facilities.

5.3 Duties and responsibilities

5.3.1 Employers have a duty to protect and should promote the safety and health of all workers. Cooperation between management and workers and/or their representatives within the undertaking shall be an essential element of organisational and other measures taken in pursuance of the actions included in this clause 5.3.

5.3.2 Occupational safety and health measures shall not involve any expenditure for the workers.

5.3.3 A worker who has removed himself from a work situation which he has reasonable justification to believe presents an imminent and serious danger to his life or health shall be protected from undue consequences in accordance with national conditions and practice.

5.3.4 It is the duty of employers to:

- Ensure that, so far as is reasonably practicable, the workplaces, machinery, equipment and processes under their control are safe and without risk to health;
- Ensure that, so far as is reasonably practicable, the chemical, physical and biological substances and agents under their control are without risk to health when the appropriate measures of protection are taken;
- Provide, where necessary, adequate protective clothing and protective equipment to prevent, so far as is reasonably practicable, risk of accidents or of adverse effects on health; and:
- Provide, where necessary, for measures to deal with emergencies and accidents, including adequate first-aid arrangements.

5.3.5 There shall be arrangements at the level of the undertaking under which:

- Workers, in the course of performing their work, co-operate in the fulfilment by their employer of the obligations placed upon him or her;
- Representatives of workers in the undertaking co-operate with the employer in the field of OSH;
- Representatives of workers in an undertaking are given adequate information on measures taken by the employer to secure occupational safety and health and may consult their representative organisations about such information provided they do not disclose commercial secrets;
- Workers and their representatives in the undertaking are given appropriate training in occupational safety and health;
- Workers or their representatives and, as the case may be, their representative organisations in an undertaking, in accordance with national law and practice, are enabled to enquire into, and are consulted by the employer on, all aspects of OSH associated with their work; for this purpose technical advisers may, by mutual agreement, be brought in from outside the undertaking; and
- A worker reports forthwith to his/her immediate supervisor any situation which he has reasonable justification to believe presents an imminent and serious danger to his life or health; until the employer has taken remedial action, if necessary, the employer cannot require workers to return to a work situation where there is continuing imminent and serious danger to life or health.

5.3.6 Workers have the responsibility, in accordance with their training and the instructions and means given by their employers, to:

- Comply with prescribed OSH measures on the elimination or control of hazards or risks to themselves and others, including through the proper care and use of the protective clothing, facilities and equipment placed at their disposal for this purpose;
- Report promptly to their immediate supervisor or safety and health representative any unusual conditions at work which they believe could present a hazard or risk to their safety or health or that of other people; and
- Cooperate with the employer and other workers in order to ensure compliance with OSH requirements and participate in the development and implementation of the OSH management system at the workplace.

5.3.7 All workers in the functional roles detailed in the CTU Code should be given proper supervision and adequate instruction or training as to the potential risks attaching to their work and the main precautions to be taken.

5.4 Functional safety and health

5.4.1 In addition to the functional responsibilities detailed in Chapter 4 those involved in the packing, handling and unpacking of CTUs have a personal and professional responsibility to ensure that they work in a safe and healthy working environment. Contractors and labour or service providers should cooperate to protect the safety and health of all persons who may be affected by their activities and to establish a preventative safety and health culture. Self-employed persons are responsible for the safety and health of themselves and others who may be affected by their actions.

5.4.2 Both packers and unpackers should be aware of potential risks associated with

- working at height when packing / filling bulk cargoes,
- opening the CTU
- a hazardous internal atmosphere due to previous cargo before opening the doors and ventilating the CTU prior to entry; and
- handling the cargo during packing and securing,

5.4.2.1 Packers should be aware of and mitigate the potential risks associated with:

- fumigating the cargo and marking the CTU once the CTU is closed (if required),
- incorrect or misleading packing documentation

5.4.2.2 Unpackers should:

- clean the CTU internally and externally and removing labels, marks and placards associated with the cargo.
- disposing of dunnage, securing materials and waste in a safe and environmentally friendly manner.

5.4.3 Shippers should be aware of and mitigate potential risks associated with incorrect or misleading packing documentation.

5.4.4 Road, and rail hauliers, intermodal operators and carriers should be aware of potential risks associated with indications that the cargo is leaking from the CTU or that the cargo has moved within the CTU making the CTU unstable.

5.5 Risk management and main risks and hazards

5.5.1 The management of risks and hazards enables undertakings to effectively identify the hazards and assess risks inherent in their CTU packing activities and the transport chain, and to develop prevention and mitigation strategies to eliminate, substitute, control, or reduce the risk so far as is reasonably practicable. Where there are extremely serious risks all practicable measures should be employed to eliminate or, where this is not possible, to minimize the risk. In accordance with the ILO Guidelines on Occupational Safety and Health Management Systems, 2001, the risk management system should be built upon the concept of continual improvement through a cycle of planning, implementing, reviewing and improving the processes and actions that an organization undertakes to meet its goals.

5.5.2 Employers should, in consultation with workers and their representatives in line with national law, conduct a risk assessment of all work activities carried out so as to provide and maintain workplaces, plant, equipment, tools and machinery, and so organize the work to eliminate, or if not possible, minimize or control as far as is reasonably practicable risk of accident or injury to the health of workers as well as other persons in the immediate vicinity of CTU packing, handling, transporting and unpacking activities. Cooperation between management, workers and their representatives within the undertaking is an essential element of all measures related to the prevention of hazards and risks inherent to the packing of CTUs. Workplace cooperation should cover all forms provided by paragraph 12 of Recommendation No. 164, as appropriate, and should cover all aspects identified in clause 5.3 of this chapter. While different risks may be present in CTU packing, transporting and unpacking activities, working at height, opening of CTUs and handling of cargoes and CTUs have been identified as the most prevalent risks.

5.5.3 Working at height

5.5.3.1 Working at height should create no hazards for anyone, yet it remains one of the most significant causes of fatalities and major injuries. Common cases include falls from roofs, ladders, and through fragile surfaces.

5.5.3.2 In accordance with national regulations specifying requirements for fall prevention or work at height, the employer should perform a risk assessment to identify and assess tasks that involve a risk of a person falling from height. Based on the risk assessment, a site-specific fall-prevention programme should be developed. The programme should at a minimum include:

- Written procedures for working at heights;

- Information, instruction and training for working safely at height;
- A process for preparing, testing and implementing emergency rescue procedures for fall scenarios; and
- The certification, provision, use, training, care, inspection, testing and maintenance of fall-prevention and fall-protection equipment.

5.5.3.3 More information on accessing CTU tops and access and safety equipment can be found in Chapter 9.

5.5.4 Opening CTUs

5.5.4.1 The exterior of the CTU should be checked for labels and placards. If there are concerns that there are labels or other indications of a dangerous atmosphere, a safety data sheet (SDS) should be requested from the consignor or from the shipper, as appropriate, and sampling the air inside the CTU before opening could be considered. For further information on the signs of dangerous atmospheres and measuring gases within the CTU cargo space see Chapter 9. Further advice for handling of dangerous goods can be found in Chapter 11.

5.5.4.2 The removal of high security seals can present workers with serous musculoskeletal disorders or injury if carried out incorrectly, especially when a number of CTUs are to be opened all at once. It is essential that workers adopt the correct stance and adjust their height relative to the seal to be cut to prevent injuries. Guidance to workers on their stance and relative height to the seal to be cut are provided in Chapter 14.

5.5.4.3 Doors on CTUs may not appear to present a risk to packers and unpackers, however, care should be taken when opening the doors. At no time should the doors be forced open, and persons should not stand where there is a risk of doors or door components falling on them.

5.5.4.4 Persons opening CTUs should be aware of the risk of cargo falling out. More information regarding procedures to prevent cargo from falling are provided in Chapter 14.

5.5.4.5 Once opened, doors should also be secured back to prevent them swinging and presenting a risk of injury to packers and unpackers.

5.5.4.6 No person should enter the CTU until it has been confirmed that it is safe. Hazards in addition to those of the cargo include:

- Toxic gases or emissions, including decomposition products, evolved and emitted by the cargo;
- Fumigant gases or fumigant residues that are still active;
- Lack of oxygen.

5.5.4.7 Fumigation creates a risk to those involved with packing and unpacking. Therefore, persons engaged in the handling of fumigated CTUs should be trained commensurate with their responsibilities. Guidance on the health and safety precautions related to fumigated CTUs can be found in Chapter 9, Chapter 10 and Chapter 14.

5.5.4.8 Ventilation should be performed prior entry of CTUs that have been closed for any extended period, or those that are known, or thought, to have carried a cargo:

- Which required fumigation;
- That releases toxic vapours or gases as a result of the manufacturing process: or
- That is regulated dangerous goods.

Further information on ventilation procedures can be found in Chapter 9 and Chapter 14.

5.5.5 Handling of cargoes and CTUs

5.5.5.1 Manual handling includes all forms of lifting, lowering, pulling and pushing of loads. Workers, including packers and unpackers, should not be required or permitted to manually handle loads that are likely to prejudice their health or safety owing to their weight, size or shape. For more information regarding manual handling, see Chapter 10.

5.5.5.2 The need to handle significant loads manually should be avoided by the use of mechanical handling equipment, whenever this is practicable. Manual handling should only be carried out by workers who have been trained or instructed in manual handling techniques.

5.5.5.3 Care should be taken to ensure that the CTU cannot move or tip during the packing or un-packing operation. More information on checking and positioning of CTUs can be found in Chapter 9.

5.5.5.4 Those involved with the handling of the CTU within the transport chain should also be trained to use the handling equipment. This will include proper speed and correct height control during transport.

5.5.5.5 All parties in the transport chain, especially those involved in road or railways transport, should be aware of any changes in the handling characteristics of the CTU, and report any such changes to the Shipper and to the next party in the transport chain.

5.6 Recording and notification

5.6.1 In the establishment, review and application of systems for the reporting, recording and notification of occupational accidents, occupational injuries, occupational diseases, ill health and dangerous occurrences, the competent authority should take account of the Employment Injury Benefits Convention, 1964 [Schedule I amended in 1980] (No. 121), the Occupational Safety and Health Convention, 1981 (No. 155), the Protocol of 2002 to the Occupational Safety and Health Convention, 1981, the List of Occupational Diseases Recommendation, 2002 (No. 194), the ILO List of Occupational Diseases (revised 2010), and the ILO code of practice on recording and notification of occupational accidents and diseases (1996).

5.6.2 In accordance with national laws or regulations, the employer should ensure that arrangements are made which are capable of satisfying the requirements to record and notify information in connection with:

- The national social insurance and/or compensation schemes in case of occupational injury and occupational disease; and
- The system for the recording and notification of occupational injuries, occupational diseases, ill health and dangerous occurrences.

5.6.3 A safe and healthy working environment should include zero tolerance of any form of workplace violence and harassment. In order to achieve this goal, management should develop a policy, in consultation with workers and their representatives, that aims to establish a system of education and prevention; a stress-free and confidential complaint mechanism; a fair and effective resolution process; and a system for recording incidents.

5.6.4 In accordance with national laws and regulations, taking into consideration the ILO Technical guidelines on biological hazards in the working environment (2023), the employer should notify the competent authority in case of any accident or incident involving biological agents. All cases of diseases or death identified in accordance with national laws and regulations to be the result of occupational exposure to biological agents should be notified to the competent authority and, where appropriate, relevant public health agencies.

5.7 Inspection and compliance with legal provisions

5.7.1 Taking into consideration the provisions of the Labour Inspection Convention, 1947 (No. 81), the Protocol of 1995 to the Labour Inspection Convention, 1947, and the Labour Inspection Recommendation, 1947 (No. 81), the competent authority should ensure adequate control and supervision, in particular by establishing the effective enforcement of national laws and regulations concerning the packing and securing of cargoes and CTUs through an appropriate system of labour inspection.

5.7.2 In a manner prescribed by the national laws and regulations, labour inspectors should be empowered with the faculties stated in Convention No. 81 and Convention No. 129. This includes having the right to enter freely and investigate occupational accidents and diseases, without any previous notice at any hour of the day or night, any workplace liable to inspection.

5.7.3 Sanitary conditions and pests may be a source of contamination if they are not properly addressed at the workplace. In accordance with the technical guidelines on biological hazards in the working environment (2023), the inspection and compliance with the pest and sanitary legal provisions should include tackling the consequences of these contaminations, that may also be a source of biological hazards not related to the nature of the activity but arising from non-hygienic conditions.

5.8 Training

5.8.1 Education and training are essential key factors for a successful work regarding safety and health. All functional roles detailed in the CTU Code should be given appropriate training in occupational safety and health commensurate with their responsibilities.

5.8.2 Training programmes should be provided at no cost and if possible, during working hours by the employer, the competent authority or other qualified institution. The outcomes of training should be assessed taking into account inputs from trained workers. The training programme should be reviewed periodically in consultation with workers' representatives and as the case may be, their representative organizations in the undertaking.

5.8.3 The ILO Guidelines on training in the port sector present a competency-based framework for training methods design to protect and promote health and safety. Training policies and programmes are to be developed in the context of specific time and place.

5.8.4 Training in packing of CTUs and topics for consideration in a training programme in detail are described in more detail Chapter 15.

5.9 Non-exhaustive list of ILO instruments and tools relevant to the CTU Code

5.9.1 General

- ILO Declaration on Fundamental Principles and Rights at Work and its Follow-up, 1998
- ILO Declaration on Social Justice for a Fair Globalization, 2008
- ILO Centenary Declaration for the Future of Work, 2019.

5.9.2 ILO fundamental instruments

- Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87)
- Right to Organise and Collective Bargaining Convention, 1949 (No. 98)
- Forced Labour Convention, 1930 (No. 29) and its 2014 Protocol
- Abolition of Forced Labour Convention, 1957 (No. 105)
- Minimum Age Convention, 1973 (No. 138)
- Worst Forms of Child Labour Convention, 1999 (No. 182)
- Equal Remuneration Convention, 1951 (No. 100)
- Discrimination (Employment and Occupation) Convention, 1958 (No. 111)
- Occupational Safety and Health Convention, 1981 (No. 155)
- Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187).

5.9.3 ILO OSH instruments

- Protocol of 2002 to the Occupational Safety and Health Convention, 1981
- Occupational Safety and Health Recommendation, 1981 (No. 164)
- Occupational Health Services Convention, 1985 (No. 161)
- Occupational Health Services Recommendation, 1985 (No. 171)
- Promotional Framework for Occupational Safety and Health Recommendation, 2006 (No. 197)
- Protection of Workers' Health Recommendation, 1953 (No. 97)
- Welfare Facilities Recommendation, 1956 (No. 102)
- List of Occupational Diseases Recommendation, 2002 (No. 194).

5.9.4 ILO OSH instruments (protection against specific risks) and equality of opportunity and treatment

- Radiation Protection Convention, 1960 (No. 115)
- Radiation Protection Recommendation, 1960 (No. 114)

- Occupational Cancer Convention, 1974 (No. 139)
- Occupational Cancer Recommendation, 1974 (No. 147)
- Working Environment (Air Pollution, Noise and Vibration) Convention, 1977 (No. 148)
- Working Environment (Air Pollution, Noise and Vibration) Recommendation, 1977 (No. 156)
- Asbestos Convention, 1986 (No. 162)
- Asbestos Recommendation, 1986 (No. 172)
- Chemicals Convention, 1990 (No. 170)
- Chemicals Recommendation, 1990 (No. 177)
- Prevention of Major Industrial Accidents Convention, 1993 (No. 174)
- Prevention of Major Industrial Accidents Recommendation, 1993 (No. 181)
- White Lead (Painting) Convention, 1921 (No. 13)
- Guarding of Machinery Convention, 1963 (No. 119)
- Guarding of Machinery Recommendation, 1963 (No. 118)
- Maximum Weight Convention, 1967 (No. 127)
- Maximum Weight Recommendation, 1967 (No. 128)
- Benzene Convention, 1971 (No. 136)
- Benzene Recommendation, 1971 (No. 144)
- Anthrax Prevention Recommendation, 1919 (No. 3)
- Lead Poisoning (Women and Children) Recommendation, 1919 (No. 4)
- White Phosphorus Recommendation, 1919 (No. 6)
- Violence and Harassment Convention, 2019 (No. 190)
- Violence and Harassment Recommendation, 2019 (No. 206).

5.9.5 Transport and maritime instruments

- Maritime Labour Convention, 2006 (MLC, 2006)
- Occupational Safety and Health (Dock Work) Convention, 1979 (No. 152)
- Occupational Safety and Health (Dock Work) Recommendation, 1979 (No. 160)
- Dock Work Convention, 1973 (No. 137)
- Dock Work Recommendation, 1973 (No. 145)
- Marking of Weight (Packages Transported by Vessels) Convention, 1929 (No. 27)
- Hours of Work and Rest Periods (Road Transport) Convention, 1979 (No. 153)
- Hours of Work and Rest Periods (Road Transport) Recommendation, 1979 (No. 161)
- Labour Inspection (Mining and Transport) Recommendation, 1947 (No. 82).

5.9.6 Codes of practice, guidelines and other materials

- Technical guidelines on biological hazards in the working environment (2023)
- Guidelines on the promotion of decent work and road safety in the transport sector (2019)
- Safety and health in ports, ILO code of practice (2016)
- Social Dialogue in the Railways Sector (2015)
- Safety and health in the use of machinery, ILO code of practice (2013)
- Guidelines on training in the port sector (2012)

- Social dialogue in the process of structural adjustment and private sector participation in ports. A practical guidance manual (2006)
- Security in ports, ILO/IMO code of practice (2004)
- Code of practice on workplace violence in services sectors and measures to combat this phenomenon (2003)
- An ILO code of practice on HIV/AIDS and the world of work
- Guidelines on occupational safety and health management systems, ILO–OSH 2001 (2001)
- Ambient factors in the workplace, ILO code of practice (2001)
- Technical and ethical guidelines for workers' health surveillance (1998)
- Protection of workers' personal data, ILO code of practice (1997)
- Accident prevention on board ship at sea and in port, ILO code of practice (second edition, 1996)
- Recording and notification of occupational accidents and diseases, ILO code of practice (1996)
- Safety in the use of chemicals at work, ILO code of practice (1993)
- Prevention of major industrial accidents, ILO code of practice (1991)
- Protection of workers against noise and vibration in the working environment, ILO code of practice (1977)
- Portworker Development Programme, (PDP1 and PDP2).

Chapter 6. General transport conditions

6.1 Within the supply transport chain, there are a number of different stresses acting on the cargo. These stresses may be grouped into mechanical and climatic stresses. Mechanical stresses are forces acting on the cargo under specific transport conditions. Climatic stresses are changes of climatic conditions including extremely low or high temperatures.

6.2 During transport various forces will act on the cargo. The force acting on the cargo is the mass of the cargo (m) which is measured in kg or tonne, multiplied by the acceleration (a) which is measured in m/s^2:

$$F = m \cdot a$$

Equation 1

Where:
F = force
m = mass
a = acceleration

Acceleration considered during transport are the gravitational acceleration ($a = g = 9.81\ m/s^2$) and acceleration caused by typical transport conditions such as by the braking or rapid change of traffic lanes by a road vehicle or by the motions of a ship in heavy sea. These accelerations are expressed as product of the gravitational acceleration (g) and a specific acceleration coefficient (c) e.g. a = 0.8 g.

6.3 The following tables provide the applicable acceleration coefficients for the different modes of transport and for the various securing directions. To prevent a cargo from movement, the cargo has to be secured in longitudinal and transverse direction according to the worst combination of horizontal and corresponding vertical accelerations. The securing arrangement has to be designed to withstand the forces due to accelerations in each horizontal direction (longitudinal and transverse) separately (see Chapter 10, Annex 10.2.2 and Annex 10.4.5).

Road transport				
Securing in	**Acceleration coefficients**			
	Longitudinally (cx)		Transversely (cy)	Minimum vertically down (cz)
	forward	rearward		
Longitudinal direction	0.8	0.5	-	1.0
Transverse direction	-	-	0.5	1.0

Rail transport (combined transport)				
Securing in	**Acceleration coefficients**			
	Longitudinally (cx)		Transversely (cy)	Minimum vertically down (cz)
	forward	rearward		
Longitudinal direction	0.5 (1.0/1.2)†	0.5 (1.0/1.2)†		1.0 (0.7)†
Transverse direction	-	-	0.5	1.0 (0.7)†

† The values in brackets apply to shock loads only with short impacts of 150 milliseconds or shorter, and may be used, for example, for the design of packaging. Shippers should contact their carriers for the applicable shock loads acceleration coefficient values.

Sea transport				
Significant wave height in sea area	**Securing in**	**Acceleration coefficients**		
		Longitudinally (c_x)	Transversely (c_y)	Minimum vertically down (c_z)
A $H_s \leq 8$ m	Longitudinal direction	0.3	-	0.5
	Transverse direction	-	0.5	1.0
B $8 \text{ m} < H_s \leq 12$ m	Longitudinal direction	0.3	-	0.3
	Transverse direction	-	0.7	1.0
C $H_s > 12$ m	Longitudinal direction	0.4	-	0.2
	Transverse direction	-	0.8	1.0

6.4 The effect of short-term impact or vibrations should always be considered. Therefore, whenever the cargo cannot be secured by blocking, lashing is required to prevent the cargo from being significantly displaced, taking into account the characteristics of the cargo and the mode of transport. The mass of the cargo alone, even when combined with a high friction coefficient (see Annex 10.4.5), does not sufficiently secure the cargo as the cargo can move due to vibrations.

6.5 The significant 20-years return wave height (H_s) is the average of the highest one-third of waves (measured from trough to crest) that is only exceeded once in 20 years. The allocation of geographic sea areas to the respective significant wave heights is shown in the following table:

A	B	C
$H_s \leq 8$ m	$8 \text{ m} < H_s \leq 12$ m	$H_s > 12$ m
Baltic Sea (incl. Kattegat) Mediterranean Sea Black Sea Red Sea Persian Gulf Coastal or inter-island voyages in following areas: Central Atlantic Ocean (between 30°N and 35°S) Central Indian Ocean (down to 35°S) Central Pacific Ocean (between 30°N and 35°S)	North Sea Skagerak English Channel Sea of Japan Sea of Okhotsk Coastal or inter-island voyages in following areas: South-Central Atlantic Ocean (between 35°S and 40°S) South-Central Indian Ocean (between 35°S and 40°S) South-Central Pacific Ocean (between 35°S and 45°S)	unrestricted

Sources:
The Royal Netherlands Meteorological Institute (KNMI):
The KNMI/ERA-40 Wave Atlas, derived from 45 years of ECMWF reanalysis data (ed. S.Caires, A.Stern, G.Komen and V.Swail), last updated 2011,
Hs 100-yr return values, 1958 – 2000

6.6 During longer voyages, climatic conditions (temperature, humidity) are likely to vary considerably. These may affect the internal conditions in a CTU which may give rise to condensation on cargo or internal surfaces (see Annex 3).

6.7 Whenever a specific cargo might be damaged when exposed to high or low temperatures during transport, the use of a CTU specially equipped for keeping the cargo temperature within acceptable limits should be considered (see Chapter 8).

Chapter 7. CTU types

Note: Definitions are given in Chapter 2.

7.1 General

7.1.1 When planning a consignment for transport the shipper should ensure that the CTU best suited for the cargo and the probable route is selected. If the shipper is uncertain about which CTU to select, further information can be obtained by contacting the CTU operator.

7.1.2 Packers should acquaint themselves with the characteristics of the CTU with particular reference to:

- Net mass capacity;
- Flooring strength;
- Anchor and securing points;
- Thermal capabilities;
- Sealing;
- Weatherproofness.

7.2 Freight containers

7.2.1 The external and internal dimensions of most containers are standardized by ISO.

7.2.2 Various types of containers are available, such as:

- Closed containers
- Open top containers
- Open side containers
- Platforms and platform-based containers
- Thermal containers
- Tank containers
- Bulk containers

For further information on different container types, see Annex 4.1.

7.2.3 The maximum gross mass and the permitted payload of a container depend on standardized design parameters. The International Convention for Safe Containers requires each container to carry a CSC safety approval plate, where the maximum permitted gross mass is specified (see clause 9.2.1 and Annex 5.1). Additionally, the tare mass and the payload are marked at least on the door or on the rear end of the container.

7.3 Regional and domestic containers

Regional and domestic containers are designed and manufactured to meet the needs of local transport operations. They may have the appearance of a freight container, but unless fitted with valid CSC safety approval plates they should not be used in international transport.

7.4 Swap bodies

7.4.1 A swap body is a regional transport containment of a permanent character designed for road and rail transport within Europe and complying with European standards.

7.4.2 Various types of swap bodies are available, such as:

- Box type swap body
- Curtain side swap body

- Thermal swap body
- Swap tank
- Bulk swap body

Swab bodies are also subdivided into length categories A, B and C. For further information on different swap body types and categories, see Annex 4.2.

7.5 Roll trailers

7.5.1 Roll trailers are exclusively used for the transport of goods in ro-ro ships and are loaded or unloaded and moved in port areas only. They present a rigid platform with strong securing points at the sides, and occasionally brackets for the attachment of cargo stanchions. The trailer rests on one or two sets of low solid rubber tyres at about one third of the length and on a solid socket at the other end. This end contains a recess for attaching a heavy adapter, the so-called gooseneck. This adapter has the king-pin for coupling the trailer to the fifth wheel of an articulated truck.

7.5.2 The packing of a roll trailer with cargo or cargo units should be planned and conducted under the conception that the cargo should be secured entirely by lashings. However, roll trailers are available equipped with standardized locking devices for the securing of containers including freight containers and swap bodies.

7.6 Road vehicles

7.6.1 Road vehicles are available in a number of different formats and designs.

7.6.2 Most vehicles have a strong front wall integrated into the closed superstructure. Closed superstructures of road vehicles may be provided with arrangements for applying approved seals.

7.6.3 Semi-trailers suitable for combined road/rail transport are generally equipped with standardized recesses for being lifted by suitable cranes, stackers or forklift trucks, to enable the lifting transfer from road to rail or vice versa.

7.6.4 For further information on road vehicle properties, see Annex 4.3

7.7 Railway wagons

In intermodal transport, railway wagons are used for two different purposes: First, they may be used as carrier unit to transport other CTUs such as containers, swap bodies or semi-trailers. Second, they may be used as a CTU themselves which is packed or loaded with cargo and run by rail or by sea on a railway ferry. For further information on railway wagon properties, see Annex 4.4.

Chapter 8. CTU suitability

8.1 Suitability in general

8.1.1 Containers and some other types of CTUs (e.g. swap bodies for rail transport in Europe) require type approval. In addition, depending on the type, the verification of a periodic or continuous examination scheme might be required as well. A CTU requiring approval (and examination) and not bearing a valid approval plate is not suitable for transport (see clause 9.2.1).

8.1.2 Containers and swap bodies showing serious defects in their structural components (e.g. top and bottom side rails, top and bottom end rails, door sills and header, floor cross members corner posts and corner fittings) may place persons into danger and are therefore not suitable for transport (see clause 9.2.2).

8.1.3 Road vehicles, semi-trailers and railway wagons showing deterioration in major structural components or other obvious defects impede the safe traffic on road or rail and are therefore not suitable for transport.

8.2 Suitability for the cargo

8.2.1 All cargo which is sensitive against weather conditions such as rain, snow, dust and sunlight, or against theft and other consequences of easy access should be carried in a closed or sheeted CTU. Containers closed or sheeted swap bodies, semi-trailers and other road vehicles are suitable for most cargoes.

8.2.2 Single packages such as:

- Cartons stacked by hand;
- Drums or similar packages stacked by forklift truck; or
- Any kind of palletized cargo

can be packed and preferably stowed from boundary to boundary. However, it depends on the type of CTU, whether such firm stowage alone provides sufficient cargo securing or whether additional securing is needed (see clause 10.4).

8.2.3 Certain cargoes such as cocoa or other agricultural produce are sensitive against climatic effects and may be damaged when the humidity within the CTU is condensed due to a decrease of temperature. This effect is specific for long distance sea transport and can be controlled by appropriate ventilation. Standard closed containers however allow only restricted air changes. Therefore, specially designed containers with increased ventilation may be preferred for such sensitive cargo.

8.2.4 Certain perishable cargoes such as foodstuffs and, in particular, deep-frozen products, require transport at low temperatures. Other products, e.g. certain chemicals, need to be protected from frost. Such commodities should be transported in insulated and temperature controlled CTUs which can be refrigerated or heated as appropriate.

8.2.5 Heavy items such as granite and marble blocks may also be packed into closed CTUs. However, this cargo cannot be simply stowed from wall to wall. Blocking against the frame of the CTU and/or lashing to the securing points is necessary (see Annex 10.4.5). As the lashing capacity of the securing points in general purpose containers is often limited, such standard containers might not be appropriate for certain large and heavy cargo items. Instead, platforms or flatracks could be used.

8.2.6 Cargo items of extreme dimensions may not fit inside a standard CTU as they exceed the inner width, length and perhaps also the height of the unit. Such cargo may be accommodated on a platform or on a flatrack. When the cargo is only “over-height” but not “over-width” an open top CTU may also be suitable.

8.2.7 For heavy cargo, open top, open side or platform CTUs should be used so that the cargo can be loaded from the top or from the side without a need to drive into the CTU with the forklift truck with the risk of the front axle load exceeding the maximum permissible concentrated load of the container floor. For information on container floor strength, see Annex 4.1.4.

8.2.8 Some cargoes such as scrap metal are usually handled by grabs or by conveyors. When this cargo is to be loaded into a CTU and a conveyor is not available, the only suitable CTU type is an open top CTU capable to be loaded with grabs. Placing the CTU vertically on its end and "pouring" the cargo in through the open doors is not permitted.

8.2.9 General purpose CTUs are not suitable for certain long, heavy and irregular cargo items such as timber logs, as the side walls are not designed to withstand the acceleration forces of such cargo and may suffer bulging damages. Stowage in shape of a pyramid and securing by lashing is extremely difficult in a closed container because the securing points are not accessible after this cargo is loaded, unless the lashings are arranged before loading. Therefore, such cargo should preferably be carried only on platform or flatrack CTUs.

8.2.10 Liquid and solid bulk cargoes should be preferably transported in tank CTUs or solid bulk CTUs. Under certain conditions, liquid bulk cargo may be carried in flexitanks which are stowed in CTUs. Similarly, solid bulk may be carried in general purpose CTUs which are equipped with a liner. However, CTUs used for such purposes should be suitably reinforced [15] and prepared, operational restrictions regarding the permissible payload should be observed (see Annex 10.5).

8.3 Suitability for the transport mode

8.3.1 Containers, including swap bodies and regional containers designed for stacking and approved under the CSC are basically suitable for all modes of transport. However, some designs of freight containers may be built with reduced stacking capacity see Annex 5.3 and require special stowage on board a ship, where the superimposed stacking mass will not exceed the permitted limits as marked on the plate. Furthermore, some containers and swap bodies may have a gross mass of 34 tonnes or higher for which some road chassis and railcars will not be capable of carrying such heavy units. Therefore, especially for heavy massed containers, it is of utmost importance to arrange for an appropriate chassis and tractor vehicle or railcar, as applicable.

8.3.2 As the maximum permissible payload of a railcar is not a fixed value for the distinguished wagon but depends in addition on the track category of the railway network (see Annex 5.5.1), the railway operator should be contacted, when necessary, in order to prevent overloading.

8.3.3 Swap bodies and semi-trailers are designed for an easy change of the means of transport. In most cases this might be an interchange between different carrier vehicles for swap bodies or different tractor vehicles for semi-trailers. When an intermodal change from road to rail is intended, it should be ensured that the swap body or the semi-trailer is capable of being lifted by grappler arms and approved for rail transport.

8.3.4 CTUs on ro-ro ships

8.3.4.1 Before dispatching a CTU for carriage on a ro-ro, the shipper needs to confirm with the CTU operator and/or the ro-ro ship operator whether specific requirements apply. Further, the shipper needs to ensure that the CTU to be used is fit for this kind of transport.

8.3.4.2 When road vehicles or semi-trailers are intended to be transported on a ro-ro ship, they should be equipped with securing points of a defined minimum strength in sufficient number (see Annex 4.3.4.2)

8.3.5 When railway wagons are intended to be transported on a railway ferry, they should be able to pass over the kink angle of the ferry ramp and to pass through the track curves on the ferry. In general, there are more restrictions for wagons equipped with bogies than for wagons equipped with two wheel sets only. The details should be clarified with the ferry line operator.

8.3.6 Railway wagons should be equipped with securing points on both sides in sufficient number when used in ferry traffic. To determine the required number and strength of securing points the ferry operator should be contacted. The maximum permitted axle loads and maximum permitted loads per linear metre depend on the properties of the ramp and of the characteristics of the ferry employed in the respective ferry service.

[15] False bulkheads may be fitted at the rear (door) end as required.

Chapter 9. Arrival, checking and positioning of CTUs

9.1 CTU Arrival

9.1.1 The type of CTU used for the transport will influence:

- The process of confirming that it is fit for use;
- The CTU's positioning to suit the packing operation and timing;
- The planning of the cargo packing.

9.1.2 The CTU operator will advise of the estimated time of arrival and departure. The type of CTU may influence these timings:

- Rigid road vehicles will come with a driver and it would be expected that the time to pack the vehicle will be dictated by any time restrictions that local regulations may impose.
- Detachable CTUs, such as trailers and rail wagons may be left at the packer's facility and the tractor unit/motor unit permitted to depart if the packing procedure is extended.
- Class C swap bodies (see Annex 4.2.1) fitted with legs can be unloaded onto their legs and the tractor unit/engine unit plus trailer (if present) may be driven away.
- Containers and class A and B swap bodies (see Annex 4.2.1) can remain on the trailer or be unloaded and placed on the ground.
- CTUs remaining on trailers may be left for a period of time.

9.1.3 If the consignment requires more than one CTU then it is important to plan what packages go within each unit and how each CTU is managed: multiple units might be delivered all at once and the packer can manage positioning of each unit to suit the facility available. Another option is to deliver the units sequentially so that the container operator delivers an empty unit and picks up a fully packed one.

9.1.4 In both cases planning what packages go into each unit will be important. Demand at the destination may require particular packages to be packed in each CTU. However, such demand can have an adverse effect on the load distribution, on possibility to secure the cargo properly, on the segregation of dangerous goods and also on volume utilisation. It is therefore important that a complete plan may be generated for all packages and CTUs prior to the start of packing the first CTU.

9.2 CTU checks

9.2.1 Approval plates

9.2.1.1 Containers and, under certain conditions, also swap bodies and road trailers may be required by applicable regulations to bear a safety approval plate. Details of the markings required on swap bodies and road trailers destined for transport by rail within the European railway network and data plates on containers transported internationally by sea and covered by the International Convention for Safe Containers (CSC) are shown in Annex 5.

9.2.1.2 If there is no CSC approval plate, the container should not be used or supplied for use in international traffic.

9.2.1.3 If there is no ACEP (Approved Continuous Examination Programme (see Annex 5.1.2.2)) mark and if the next examination date is already elapsed or is before the expected arrival time of the container at its destination, the container should not be used or supplied for use in intermodal or international traffic.

9.2.2 Exterior checks

9.2.2.1 The structural framework, the walls and roof of a CTU should be in good condition, and not significantly distorted, cracked or bent. The CTU operator is responsible for delivering a CTU that complies with international structural integrity requirements and international or national safety regulations. If the structural integrity is in doubt, advice should be sought from supervisory personnel or the CTU operator.

9.2.2.2 The doors of a CTU should work properly and be capable of being securely locked and sealed in the closed position, and properly secured in the open position. Door gaskets and weather strips should be in good condition.

9.2.2.3 A folding CTU with movable or removable main components should be correctly assembled. Care should be taken to ensure that removable parts not in use are packed and secured inside the unit.

9.2.2.4 Any component that can be adjusted or moved, or a pin that can be engaged and withdrawn, should be checked to see that it can be moved easily and retained correctly. This is of particular importance for folding flatracks where the end-walls are retained in the upright position by a pin or shoot bolt which should be engaged and retained from accidentally pulling out by a retaining flap.

9.2.2.5 Removable or swinging headers of open top CTUs should be inspected. The header is generally supported by removable pins. Checks should be made to ensure that the pins are of the correct length and freely removable at both ends. Checks should also be made for signs of cracks around the hinges.

9.2.2.6 Road vehicles that are likely to be carried on rail wagons or on ro-ro ships should be provided with points for securing them. There should be equal numbers of lashing points on both sides of the vehicle and each point should be intact and free from serious corrosion or damage.

9.2.2.7 For sheeted vehicles or containers the side, top or all round covers should be checked as being in satisfactory condition and capable of being secured. Loops or eyes in such canvas which take the fastening ropes, as well as the ropes themselves, should be in good condition. All lashing strap ratchet tighteners should be able to be engaged and operate correctly.

9.2.2.8 Labels, placards or marks regarding previous usages of the CTU should be removed. Permanently affixed signs and marks may never be removed.

9.2.2.9 When undertaking the exterior checks, the CTU should be checked for any signs of pest contamination particularly:

- Along bottom rails;
- Within forklift pockets;
- In and around the twist lock fittings;
- Underside and cross members;
- On tops where necessary.

9.2.3 Interior checks

9.2.3.1 Closed CTUs may have been subjected to atmosphere changing cargoes which could place a person at risk. Therefore, before opening and entering a CTU parties should be aware of clause 5.5.4 and Annex 6.4. Care should be taken to ensure that during this period, animals and insects should not enter the CTU.

9.2.3.2 The CTU should be free from major damage, with no broken flooring or protrusions such as nails, bolts, special fittings, etc. which could cause injury to persons or damage to the cargo.

9.2.3.3 The CTU should not show liquids or persisting stains on flooring and side walls. There are a number of different materials and surface treatments used for flooring in CTUs. Sealed surfaces generally can be cleaned with absorbent materials. Where a stain can be transferred by wiping a gloved hand over it, the CTU should not be used and a replacement CTU should be requested.

9.2.3.4 A CTU should be weatherproof unless clearly designed otherwise (e.g. flatrack). Patches or repairs to solid walls should be carefully checked for possible leakage by looking for rusty streaks below patches. Repairs to side and roof sheets should have a fully stitched patch covering all of the hole with a substantial overlap.

9.2.3.5 Potential points of leakage may be detected by observing whether any light enters a closed unit. Standard and approved procedures for identifying pin holes and other points of leakage should be adopted.

9.2.3.6 Cargo tie-down cleats or rings, where provided, should be in good condition and well anchored. If heavy items of cargo are to be secured in a CTU, the operator should be contacted for information about the cleat strength and appropriate action taken.

9.2.4 Cleanliness

9.2.4.1 All CTUs should be provided clean and free from pest contamination.

9.2.4.2 Closed CTUs should be clean, dry and free of residue and/or persistent odours from previous cargo.

9.2.4.3 Open CTUs should be free from debris and as dry as is possible.

9.2.4.4 Following receipt of the CTU the packer should ensure that measures are put in place to prevent pest contamination of the CTU and of the cargo packed in to or on it. This includes the area for the positioning of the CTU and the cargo.

9.3 Positioning CTUs for packing

9.3.1 Wheeled operation

9.3.1.1 Road vehicles and containers on chassis should be positioned so that safe access may be provided via a levelled ramp during loading operations, they cannot tip while forklift trucks are operated in them and so that access can be prevented before and after loading operations. Furthermore, brakes should be applied, and wheels should be chocked to prevent rolling.

9.3.1.2 For more information on positioning and securing wheeled CTUs, see Annex 6.2.1.

9.3.2 Grounded operation

9.3.2.1 CTUs may be unloaded from the delivery vehicle and be placed within secure areas for packing.

9.3.2.2 When landing CTUs it should be ensured that the area is clear of any debris or undulations in the ground that may damage the understructure of the CTU.

9.3.2.3 Grounded CTUs will deform to the ground on which they are placed, therefore it is important that the area should be firm, level and well drained. Failure may result in:

- The CTU racking if the ground is not level which may result in the doors being difficult to open and, more importantly, close;
- The CTU sinking into the soft area which may result in serious deformation;
- The CTU becoming flooded. Where there is a risk of flooding it should be placed on blocks to elevate it.

9.3.2.4 Packers should not position CTUs in such locations where there is a risk of recontamination. This means that, whenever possible, CTUs should be placed on a hard pavement clear of soil, vegetation, overhanging trees and away from flood lights.

9.3.2.5 When a swap body standing on its support legs is to be packed, particular care should be taken to ensure that the swap body does not tip when a lift truck is used for packing.

9.3.2.6 For more information on grounded operation of CTUs, see Annex 6.2.2.

9.3.3 Access to the CTU

9.3.3.1 After the CTU has been positioned for packing, a safe access should be provided via a levelled bridging unit that is prevented from dislocating.

9.3.3.2 Any movable parts of such roofs or covers that are opened during packing should be removed or suitably secured in order to avoid interference with the loading procedure.

9.3.3.3 Packing of CTUs in poor daylight conditions may require additional lighting. Electric lighting equipment should be used under the strict observance of relevant safety regulations, in order to eliminate the risk of electric shocks or incentive sparks from defective cables or heat accumulation from light bulbs.

9.3.3.4 For more information on access to CTU, see Annex 6.3, as well as Annex 7 concerning access to tank and bulk tops, working from height, and Annex 8 for accessing CTUs which have been fumigated.

Chapter 10. Packing cargo into CTUs

10.1 Planning of packing

10.1.1 Packers should ensure that:

- The packing process is planned in advance as far as practical;
- Incompatible cargoes are segregated;
- Special handling instructions for certain cargoes are observed. For manual handling see Annex 9;
- The maximum permitted payload is not exceeded;
- Restrictions for concentrated loads are complied with;
- Restrictions for eccentricity of the centre of gravity are complied with;
- The cargo and securing materials comply with the International Standards for Phytosanitary Measures[16] when applicable.

10.1.2 To carry out effective planning, packers should follow the provisions of Annex 10.1.

10.2 Packing and securing materials

10.2.1 Packers should ensure that securing materials are:

- Strong enough for the intended purpose;
- In good order and condition without tears, fractures or other damages;
- Appropriate to the CTU and goods to be carried;
- In compliance with the International Standards for Phytosanitary Measures No.15[11].

10.2.2 More information on packing and securing materials is provided in Annex 10.2 and in the appendices to Annex 10 as well as supplements.

10.3 Principles of packing

10.3.1 Packers should ensure that:

- The load is properly distributed in the CTU;
- Stowage and packing techniques are suitable to the nature of the cargo;
- Operational safety hazards are taken into account.

10.3.2 In order to comply with the obligations in 10.3.1 packers should follow the provisions of Annex 10.3 and the appendices to Annex 10 as well as supplements.

10.4 Securing cargo in CTUs

10.4.1 The packers should ensure that:

- Tightly arranged cargoes are so stowed in CTUs that boundaries of the CTU are not overstressed;
- In the case of CTUs with weak or without boundaries sufficient securing forces are produced by the cargo securing arrangement;
- Packages of greater size, mass or shape are individually secured to prevent sliding and, when necessary, tilting;
- The efficiency of the cargo securing arrangement is properly evaluated.

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[16] International Standards for Phytosanitary Measures, No. 15 Regulation of wood packaging material in international trade, 2009 (ISPM 15).

10.4.2 In order to comply with the obligations in clause 10.4.1 the packer should follow the provisions of Annex 10.4 and the appendices to Annex 10 as well as supplements.

10.4.3 Additional advice for the evaluation for certain cargo securing arrangements may be found in Appendix 10.4.

10.5 Packing bulk materials

10.5.1 Packers should ensure that:

- Applicable filling ratios for liquids are complied with;
- Tank fittings and valves are compatible with the goods to be carried;
- Specific requirements for foodstuffs are observed;
- Procedures for the safe transport of liquids in flexitanks are observed;
- CTUs are not overstressed by the carriage of solid bulk cargoes.

10.5.2 When working on the top of CTUs during the preparation, filling or emptying of CTUs packers should comply with the requirements of Annex 7.

10.5.3 In order to comply with the obligations in clause 10.5.1 the packer should follow the provisions of Annex 10.5.

10.6 Safety at work and security

10.6.1 Only activities authorized by the facility should be carried out in the vicinity where the CTU is packed.

10.6.2 When manual handling of cargoes is required during packing or unpacking of CTUs, the clauses in Annex 9 should be observed.

10.6.3 When fumigation is used, the clauses in Annex 8 should be observed.

Chapter 11. Additional advice on the packing of dangerous goods

11.1 General

11.1.1 The advice of this section applies to CTUs in which dangerous goods are packed. It should be followed in addition to the advice given elsewhere in this Code.

11.1.2 International (and often national) transport of dangerous goods may be subject to several dangerous goods transport regulations, depending on the origin, final destination and the modes of transport used.

11.1.3 For intermodal transport involving different modes, the rules and regulations applicable depend upon whether it is an international, national or regional move (e.g. transport within a political or economic union or trading zone).

11.1.4 Most national and international regulations are based on the United Nations Recommendations on the Transport of Dangerous Goods, Model Regulations (Orange Book). However, international (ADR, IMDG, ...) and national rules (CFR49, ...) may differ from the United Nations Recommendations on the Transport of Dangerous Goods.

11.1.5 Transport of dangerous goods by road, rail or inland waterways is subject to various regulations and agreements. Examples are:

- European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR);
- European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN);
- Regulations concerning the International Carriage of Dangerous Goods by Rail (RID); and
- Title 49 of the Code of Federal Regulations of the United States.

11.1.6 For international maritime transport, the provisions of the International Maritime Dangerous Goods (IMDG) Code apply. The IMDG Code provides detailed provisions on all aspects of the transport of packaged dangerous goods by sea.

11.1.7 Dangerous goods are classified into nine hazard classes. Some of these are subdivided into divisions. All details are set forth in the applicable dangerous goods regulations as mentioned above. The consignor is responsible for ensuring that packages containing dangerous goods are authorized and bear the appropriate labels and marks.

11.2 Before packing

11.2.1 The IMDG Code and other international and national regulations require that the consignor provides transport information on each dangerous substance, material or article. This information should include at least the following basic items:

- The UN number;
- The proper shipping name (including the technical name, as applicable);
- The class and/or division (and the compatibility group letter for goods of class 1);
- Subsidiary risks when assigned;
- The packing group when assigned;
- The total quantity of dangerous goods (by volume or mass, and for explosives the net explosive content); and
- The number and kind of packages.

Other items of information may be required, depending on the mode of transport and the classification of the goods (e.g., flashpoint for transport by sea). The various items of information required under

each regulation and applicable during intermodal transport operations should be provided so that appropriate documentation may be prepared for each shipment.

11.2.2 The consignor is also responsible for ensuring that dangerous goods are classified, packaged, packed and marked in accordance with the applicable regulations. A declaration by the consignor that this has been carried out is normally required. Such a declaration may be included with the required transport information.

11.2.3 The shipper is responsible for ensuring that the goods to be transported are authorized for transport for the applicable modes to be used for the transport operation. For example, self-reacting substances and organic peroxides requiring temperature control are not authorized for transport by rail under the RID regime. Certain types of dangerous goods are not authorized to be transported on board passenger ships and therefore the requirements of the IMDG Code should be carefully studied.

11.2.4 The carrier is responsible for ensuring that dangerous goods declared by the shipper are transported in accordance with applicable international and national regulations.

11.2.5 Current versions of all applicable regulations should be easily accessible and referred to during packing to ensure compliance.

11.2.6 Dangerous goods should only be handled, packed and secured by trained personnel. Supervision is required by a responsible person who is familiar with the legal provisions, the risks involved and the measures that should be taken in an emergency.

11.2.7 Suitable measures to prevent incidents such as fires should be taken, including the prohibition of smoking in the vicinity of dangerous goods.

11.2.8 Packages of dangerous goods need to be examined by the packer, and any found to be damaged, leaking or sifting should not be packed into the CTU. Packages showing evidence of staining, etc., should not be packed without first determining that it is safe and acceptable to do so. Water, snow, ice or other matter adhering to packages should be removed before packing. Substances that have accumulated on drumheads should initially be treated with caution in case they are the result of leakage or sifting of contents. If pallets have been contaminated by spilt dangerous goods, they should be destroyed by appropriate disposal methods to prevent use at a later date.

11.2.9 If dangerous goods are palletized or otherwise unitized, they should be packed so as to be regularly shaped, with approximately vertical sides and level at the top. They should be secured in a manner unlikely to damage the individual packages comprising the unit load. The materials used to bond a unit load together should be compatible with the substances unitized and retain their efficiency when exposed to moisture, extremes of temperature and sunlight.

11.2.10 The packing, labelling, marking and method of securing of dangerous goods in a CTU in compliance with applicable international and national regulations should be planned before packing is commenced.

11.3 Packing

11.3.1 Special care should be taken during handling to avoid damage to packages. However, if a package containing dangerous goods is damaged during handling so that the contents leak out, the immediate area should be evacuated, and personnel immediately moved to a safe place until the hazard potential can be assessed. The damaged package should not be shipped. It should be moved to a safe place in accordance with instructions given by a responsible person who is familiar with the risks involved and knows the measures that should be taken in an emergency in conformance with national regulations.

11.3.2 CTUs should be packed so that incompatible dangerous or other goods are segregated in accordance with the rules of all modes of transport. In some instances, even goods of the same class are incompatible with each other and should not be packed in the same unit, e.g., acids and alkalis of class 8. The requirements of the IMDG Code concerning the segregation of dangerous goods inside CTUs are usually more stringent than those for road and rail transport. Whenever an intermodal transport operation does not include international transport by sea, compliance with national relevant regulations and the respective inland transport regulations may be sufficient. However, if there is any possibility that a part of the transport operation will be international by sea, the segregation requirements of the IMDG Code generally apply.

11.3.3 Some dangerous goods should be segregated from foodstuffs by a certain distance within the CTU or are even prohibited in the same unit. More advice is to be found in the applicable dangerous goods regulations.

11.3.4 When dangerous goods are being handled, the consumption of food and drink should be prohibited

11.3.5 Packages should be handled and packed in accordance with their markings (if any). Further details regarding markings are provided in Appendix 10.1.

11.3.6 Drums containing dangerous goods should always be stowed in an upright position unless otherwise authorized by the competent authority.

11.3.7 Stacking heights, stacking load tests and stacking limitations are set forth in applicable dangerous goods regulations that should be strictly followed.

11.3.8 Dangerous goods consignments which form only part of the load of a CTU should, whenever possible, be packed adjacent to the doors with markings and labels visible. Particular attention is drawn to Annex 10.3.4.7 concerning the securing of cargo at the doors of a unit.

Chapter 12. Minimizing pest risks associated with the freight container pathway

12.1 General

12.1.1 The management of the pest risk associated with the container pathway currently represents a challenge for prevention of the introduction and spread of pests that may pose a serious risk to agriculture, forestry and natural resources. National plant protection organizations, other government organizations, and industry parties can play a role in reducing the risk of pest contamination of freight containers and their cargoes. The handling and storage of commodities before and during the packing of freight containers can result in pest contamination of the cargoes and freight containers. Packing is a stage when there is a high risk that internal pest contamination of freight containers may occur. Shippers and packers, acting on behalf of shippers, should implement measures to minimize pest contamination during packing. Others in the international container supply chains should also implement measures to reduce the risk of pest contamination while the freight container is in their control. Such measures, or best practices, should be in accordance with the parties' roles and responsibilities in the supply chains and should take into consideration all safety and operational constraints.

12.1.2 Minimizing pest contamination of freight containers and their cargoes is a shared responsibility and by applying best practices these parties can keep freight containers and their cargoes clean. This will help to prevent the introduction and spread of pests through international commerce. Freight containers are also likely to move through ports and reach their final destinations faster and with less expense if they are clean.

12.1.3 IPPC guidance clarifies that in order for a freight container to be deemed to be "clean" the empty freight container's exterior and interior and, for reefer containers, also the ventilation inlet grilles and floor drain holes, should have no visible presence of any of the following:

- Soil
- Plants/plant products/plant debris
- Seeds
- Moths, wasps, bees, beetles
- Snails, slugs, ants, spiders
- Mould and fungi
- Insect and bird droppings or waste
- Egg masses
- Animals, animal parts/ blood/excreta and reproductive components or parts thereof
- Other contamination that shows visible signs of harbouring pests

12.1.4 IPPC's guidance on reducing the risk of pest contamination in the container pathway also identifies several measures that a shipper or packer can take to ensure the cleanliness of a freight container and its cargo and prevent their contamination while in the staging and packing areas. Such measures may include:

- Ensure cargo packed into the freight container is clean and free of visible contaminants and stored in areas apart from contaminated containers and cargoes;
- Clear and clean the cargo staging and packing area to ensure that it is free from contaminants.
- Without compromising safe working conditions, do not keep containers under bright lights, which may attract flying insects, such as moths, to the cargo staging area and increase the likelihood of contamination. If containers must be kept under bright lights, check them regularly for signs of contamination by insects or egg masses and clean containers as needed to remove these contaminants.

- Where appropriate, use baits, traps, or barriers to keep pests out of the cargo staging and packing area. For example, a salt barrier may be used to prevent snail infestations.
- Ensure consignees completely unpack and clean freight containers before their next use or before vessel loading.

12.2 Freight container Custodians' responsibilities

12.2.1 All parties involved in the container supply chains, starting with container depots from where most empty freight containers are dispatched, should ensure that they exercise due diligence when executing their custodial responsibility to verify that freight containers are free of pest contamination before they are transferred into the custody of the next responsible party in the chain. Similarly, cargoes to be packed into freight containers should be free from pest contamination.

12.2.2 Parties with custodial responsibilities include but are not limited to container depots, consignors, shippers, packers, vessel operators, container operators, all carriers in all terrestrial modes (i.e. rail, truck), consignees and terminals.

12.2.3 The party receiving the freight container is encouraged to hold the previous party responsible if visible contamination is detected in or on the freight container and its cargoes.

12.3 Empty containers

Empty containers can also be contaminated by pests. A main contributor to such pest contamination is incomplete unpacking and cleaning. Consignees and container depots can play an important role in the cleanliness of empty freight containers, with container depots often acting as the start and end points for empty containers. Visual examination and, when necessary, cleaning of an empty container done at a container depot may cause the least interruption of container logistics.

12.4 Visual examination for contamination of freight containers and their cargoes

12.4.1 All relevant parties should visually examine, when accessible and safe to do so and in accordance with their custodial responsibilities, all interior and exterior surfaces of freight containers (e.g. the ceiling and roof, floor and undercarriage, side walls, end walls, doors) and their cargoes for potential pest contamination. Such examinations should be conducted not only in compliance with health and safety regulations but also in compliance with company-specific visual examination policies and procedures. Similarly, it is recommended that the exterior and interior of empty freight containers are also examined for pest contamination before dispatch, before packing and after unpacking, when accessible. In addition, it is recommended that the ventilation-inlet grilles and floor drain holes of refrigerated containers are visually examined.

12.4.2 More detailed information on the places where pest contamination is most often found, and guidance on how to undertake visual examination of freight containers (including examination of the undercarriage and roof) in a safe manner, is provided in the IPPC Guidelines for Sea Container Surveys for NPPOs (IPPC Secretariat, 2020b). This information has together with examples of pests and where they are commonly found been summarized in Annex 11.

12.5 Methods to remove contamination and manage pest contamination

12.5.1 Annex 11.5 describes methods for removal or management if pest contamination is found.

12.5.2 Recipients of freight containers that have moved internationally are encouraged to seek guidance on appropriate risk-management actions and disposal of pest contamination, including wash water, from their respective NPPO or other authorities if pest contamination is detected on or in containers and their cargoes. For that purpose, NPPOs are encouraged to provide such guidance.

12.6 IPPC guidance regarding minimizing pest risks in the freight container pathway

The IPPC on its website maintains and updates information and guidance regarding minimizing pest risks in the container pathway. All parties in the international containerized supply chains are encouraged to regularly consult the IPPC website and to follow the advice provided there.

Chapter 13. On completion of packing

13.1 Closing the CTU

13.1.1 After closing the CTU, the packer should ensure that all closures are properly engaged and secured. If the doors are locked, the means of locking should be such that, in case of emergency, they can be opened without delay. Where CTUs have hinged or detachable fittings, a check should be made that they are properly secured, with no loose equipment likely to cause a hazard during transport.

13.1.2 When required, the shipper should ensure that CTUs in international transport be sealed immediately upon completion of the packing with a seal bearing a unique identification number. Countries may require that such seals meet the standard of ISO 17712. Further details of the positioning, selection and fitting of seals can be found in Annex 12.

13.1.3 Where security devices, beacons or other tracking or monitoring equipment are used, they should be securely installed to the CTU and, when equipped with a source of energy, they should be of a certified safe type as defined by applicable dangerous goods regulations. It should be noted that, where applicable, the International Convention for the Safety of Life at Sea (SOLAS) specifies that during sea transport no sources of ignition be present in enclosed cargo spaces where highly flammable dangerous goods are stowed.

13.2 Marking and placarding

13.2.1 The applicable dangerous goods regulations may require that placards (enlarged labels), marks and other labels be affixed to the surfaces of a CTU. The specifications of these labels, marks and placards and the locations where they should be affixed are described in detail in the applicable dangerous goods regulations and Chapter 11 of this Code.

13.2.2 The applicable dangerous goods regulations may require other labels warning of specific risks, e.g. a label warning of the possibility of an asphyxiating atmosphere when solid carbon dioxide (CO_2 – dry ice) or other expendable refrigerant has been used for cooling purposes or a label warning of a potentially explosive atmosphere when vehicles or lighters have been packed into the CTU.

13.2.3 The applicable dangerous goods regulations may require specific marks for CTUs under fumigation even though the cargo is not classified as dangerous. The details of marking and further instructions for the handling of such CTUs are set forth in the applicable dangerous goods regulations (see Annex 8).

13.3 Documentation

13.3.1 In conformance with clause 4.2.5, the shipper is responsible for ensuring that all documents required by applicable international and national regulations are received from the consignor and the packer, that the documents are accurate, and, where required, are provided to the carrier before the transport commences respectively as early as required by the carrier.

13.3.2 When the CTU is a container and sea transport is involved, applicable international and national regulations requires that the gross mass of the container is verified either by:

13.3.2.1 weighing the packed container using calibrated and certified equipment; or

13.3.2.2 weighing all packages and cargo items, including the mass of pallets, dunnage and other securing material to be packed in the container and adding the tare mass of the container to the sum of the single masses, using a certified method approved by the competent authority of the State in which packing of the container was completed.

Certain types of cargoes (liquid and solid bulk cargoes) do not lend themselves to individual weighing of the cargo to be packed in the container. In such cases, the method described in clause 13.3.2.1 above should be used instead.

13.3.3 The packer of the CTU should inform the shipper of the identification number of the CTU (container number or vehicle number as appropriate), the verified gross mass of the unit and the identification number of the seal (if applicable), thus to ensure that the verified gross mass and

the identification numbers are included in all transport documents, such as bills of lading, way bills, consignment notes or cargo manifests, and are communicated to the carrier as early as required by the carrier.

13.3.4 Whenever the cargo projects beyond the overall dimensions of the CTU the information described in clause 13.3.3 should state the exact maximum over-height, over-width or over-length, as appropriate.

13.3.5 If a freight container having an allowable stacking mass of less than 192,000 kg marked on the safety approval plate (see clause 9.2.1) is intended to be carried by ship, the carrier should be informed of the reduced stacking capability of that freight container.

13.3.6 In addition, whenever dangerous goods are packed into a CTU for transport by sea or where a maritime leg is included in the transport route, the IMDG Code and other transport regulations may require that those responsible for the packing of the CTU provide a "container/vehicle packing certificate" specifying the identification number of the container or the vehicle and certifying that the packing operation was carried out in accordance with the requirements of the applicable dangerous goods regulations. For all details of documentation, the relevant dangerous goods regulations should be referred to.

Chapter 14. Advice on receipt and unpacking of CTUs

Note: For further information see Annex 6.

14.1 General precautions

14.1.1 The unpacker of the CTU should:

14.1.1.1 Visually examine the CTU on arrival to ensure that it is pest free and continue to check the there are no signs of pest contamination.

14.1.1.2 Check whether the unit is externally in good condition, and not significantly distorted, cracked or bent. If such damage is found, the receiver should document and notify it to the CTU operator. Specific attention should be paid to damage that may have influenced the condition of the cargo within the unit.

14.1.2 Where a seal number is stated on the transport documentation, the seal should be checked. If the reference number on the seal differs from the documentation or if the seal appears to be damaged or is missing, this could indicate that the CTU has been opened during transport. In such case the CTU operator should be contacted.

14.1.3 If a CTU shows signs of abnormally high temperatures it should be moved to a safe place and the fire services notified. Care should be taken to ensure that the fire-fighting methods used are suitable for the cargo in the unit.

14.1.4 Persons opening a CTU should be aware of the risk of cargo falling out (for details see Annex 6.5).

14.1.5 CTUs with substances used for cooling or conditioning purposes present a particular risk of a toxic or asphyxiant atmosphere (see clauses 13.2.2 and 13.2.3). Before opening the doors, it should be ascertained by measurement that no harmful atmosphere is present in the CTU.

14.1.6 Some cargoes may emit harmful fumes. Especially after long sea voyages, it has been repeatedly realized that apparently non-hazardous goods such as shoes, textile products, furniture or the like emit harmful substances to an extent making the atmosphere in the CTU dangerous. Care should be taken not to come into contact with the internal atmosphere when opening the doors. Therefore, any CTU should be ventilated before allowing personnel to enter, preferably by mechanically forced ventilation. If this is not available, the doors should be opened for a period of time – enough to allow the internal atmosphere to regularize with the ambient.

14.1.7 CTUs that are fumigated should be properly labelled. On occasion, the labels may become obliterated or lost during transport. As CTUs may then not be appropriately labelled, the doors and vents should be checked. Tape applied to door gaskets or to the vents may indicate the risk of fumigant presence (see Annex 8).

14.1.8 If there is a particular reason to suspect damage to packages with dangerous goods, expert advice should be sought before unpacking of the unit starts. When possible, a safety data sheet (SDS) should be required from the consignor, to determine appropriate measures and necessary personal protection equipment.

14.2 Unpacking a CTU

14.2.1 For the positioning of a CTU, clause 9.3 applies. Where access to the roof of the CTU is required, e.g. to remove the canvas of an open top unit, mobile steps or a gantry platform should be provided. Access to the doors of a CTU should be made by using ramps or platforms if required (see clause 9.3.3).

14.2.2 Persons engaged in the removal of seals should be aware that their stance and the selection of the correct cutting equipment is essential to prevent injury. Further information is found in Annex 12.

14.2.3 Persons opening CTUs should be aware of the risk of cargo falling out. To reduce the risk of personal injury from shifted cargo coming out when doors are opened, the use of a safety strap is encouraged. The strap should be secured around the inner locking rods of a CTU to minimize the free movement of the door which is first opened. Movement of the cargo within sheeted CTUs may also present a risk to those opening the side curtains of open sided units.

14.2.4 Suitable unpacking equipment and techniques should be used (see Annex 10.3.5), so that persons involved are not placed at risk.

14.2.5 When removing lashing or blocking devices or other cargo securing material, care should be taken to ensure that cargo items do not move when released. The valves of inflatable dunnage bags should be opened, and the air released.

14.2.6 It should be considered that items with low friction such as piles of steel plates may suddenly shift and that unstable items may topple when retaining straps are removed.

14.2.7 When any damage to the cargo is detected during the unloading of the CTU, this should be documented and notified to the carrier and/or CTU operator and shipper, as appropriate. If a package containing dangerous goods is found to be so damaged that the contents leak out, the immediate area should be evacuated until the hazard potential has been assessed. When possible, a safety data sheet (SDS) should be requested from the consignor, to determine appropriate measures and necessary personal protection equipment.

14.3 Returning the unpacked CTU

14.3.1 Upon unpacking the CTU, it may in agreement with the CTU operator either be returned to the CTU operators' facility or transported to a new consignor/packer/shipper. Under either scenario, unless otherwise agreed, the consignee is responsible for ensuring that the CTU is completely empty, clean and free of cargo residues, noxious materials and pest contamination.

14.3.2 When disposing of cargo residues and cargo associated waste, the applicable environmental regulations should be considered. Wherever practicable, dunnage bags and other securing materials should be recycled. When wood quarantine requirements apply, timber bracings and packing/securing material of natural wood, not bearing the appropriate IPPC marking (Annex 10.1.14), should be disposed of as required by national or local plant protection regulations.

14.3.3 After a CTU with dangerous goods has been unpacked, particular care should be taken to ensure that no hazard remains. This may require special cleaning, particularly if spillage of a toxic or corrosive substance has occurred or is suspected. In case of doubt with regard to appropriate cleaning measures, the CTU operator should be contacted.

14.3.4 All placards and other markings referring to the last shipment, including, where applicable, markings referring to dangerous goods, should be removed, masked or otherwise obliterated.

Chapter 15. Training in packing of CTUs

15.1 Introduction

15.1.1 The successful application of this Code concerning the packing of CTUs and the achievement of its objectives are greatly dependent on the appreciation by all persons concerned of the risks involved and on a detailed understanding of the Code. This can only be achieved by properly planned and maintained initial and retraining programmes for all persons concerned with the packing of CTUs.

15.1.2 Training of persons employed by the parties mentioned in Chapter 4 can be undertaken in-house through the use of designated personnel alternatively external or distance (e-learning) training providers may be used. However, when parties use external training providers, they should ensure that such providers can provide training to meet the requirements of this Code. Persons responsible for planning and supervision of packing should be fully knowledgeable about all technical, legal and commercial requirements of this task and on all risks and dangers involved. They should know the customary terminology in order to communicate effectively with consignors, forwarders and the persons who do the actual packing.

15.1.3 Personnel engaged in the actual packing should be trained and skilled in doing this work and understand the relevant terminology in order to comply with the instructions of the planner. They should be aware of the risks and dangers involved including safe manual handling.

15.1.4 Persons responsible for planning and supervision of packing as well as personnel responsible for the actual packing should receive appropriate education and training for their tasks before they do the work with immediate responsibility.

15.1.5 The management of a facility where CTUs are packed is responsible to ensure that all personnel involved in the packing of cargo in CTUs or in the supervision thereof are adequately trained and appropriately qualified, commensurate with their responsibilities within their organization.

15.2 Regulatory authorities

The regulatory authority should work with stakeholders to establish minimum requirements for training and, where appropriate, qualifications for each person involved, directly or indirectly, in the packing of cargo in CTUs, particularly in relation to dangerous goods.

15.3 Training

15.3.1 Personnel engaged in the packing of CTUs should be trained in the contents of this Code according to their respective level of responsibilities. Employees should be trained before assuming responsibilities and should only perform functions for which training has not been provided under the direct supervision of a trained person. If appropriate, such training should be supplemented by a period spent assisting knowledgeable planners and packers so that practical experience can be gained.

15.3.2 The training should be designed to provide an appreciation of the consequences of badly packed and secured cargo in CTUs, the legal requirements, the magnitude of forces which may act on cargo during road, rail and sea transport, as well as basic principles of packing and securing of cargoes in CTUs. Topics for consideration, to be included in the training as appropriate, are given in Annex 13.

15.3.3 Persons responsible for planning and supervision of packing as well as personnel responsible for the actual packing should receive appropriate education and training about risks of illegal goods smuggling, including wildlife, and the latest trends in the concealment methods and trafficking routes used by criminals. Topics for training, as appropriate, are given in Annex 13 point 16.

15.4 Records

Records of training should be kept and maintained to document employee training in accordance with local regulatory practice.

Annex 1. Information flow

1.1 To ensure that the cargo is transported from sender to destination safely and securely, it is essential that those involved in CTU movements fully comply with the proper flow of information.

1.2 This includes the responsibility of the packer to identify all packages packed into a CTU and to include them in all appropriate documentation.

1.3 Additionally, it will include a responsibility of the packer to determine the actual gross mass of the CTU and to declare any hazards that may be present for all or part of the journey.

1.4 Parties involved with transport are responsible for ensuring that documentation and information is provided in adequate time and using terms that are internationally accepted.

1.5 The functions of the supply chain are discussed in Chapter 4 of this Code and can be summarized in the graphical representation shown in Figure 1-1.

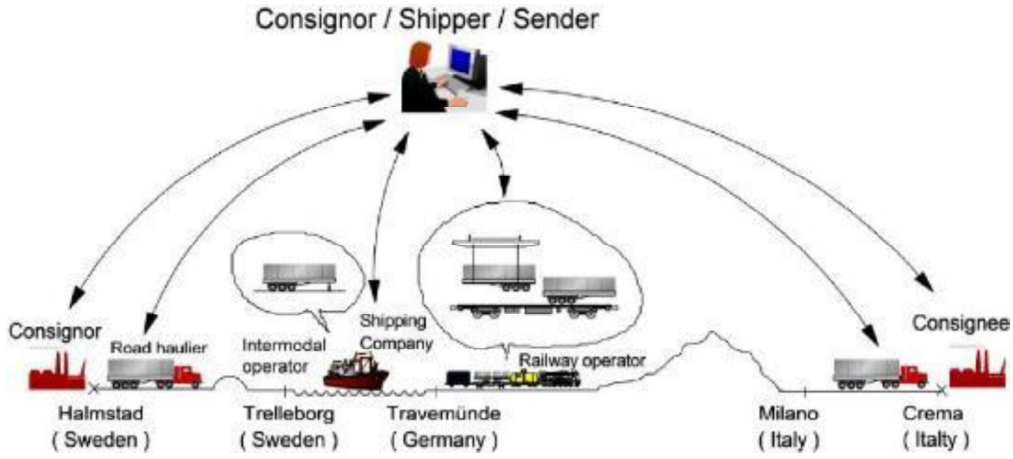


Figure 1-1 Typical flow of information

1.6 Within the terms of this Code the principal contracts are between the shipper and the carrier. Others parties such as the terminal or haulier, though actively involved, are responsible to one of these parties.

1.7 The shipper will arrange the transport of the goods and may arrange the cargo insurance cover. In some contracts there is an agreed location, terminal or destination where the responsibility of the shipper ends. Thereafter responsibility is transferred to the consignee or another party who may undertake the function of a shipper.

1.8 Figure 1-2 shows a typical INCOTERM published by the International Chamber of Commerce. Under this contract the shipper is responsible for all aspects of transport up until the CTU is unloaded at the port of import.

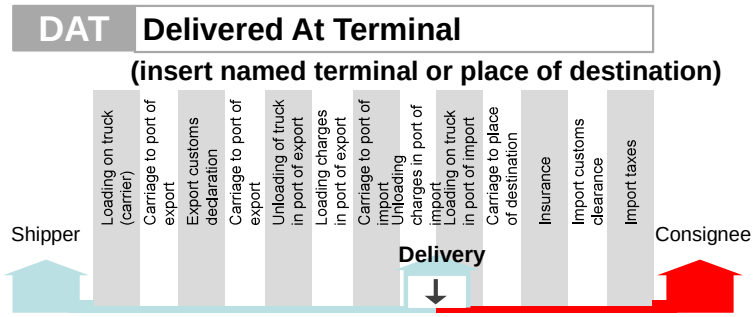


Figure 1-2 Typical contract term

1.9 Thereafter the consignee, or their agent who will undertake the function of a shipper, will arrange onward transport of the CTU and continue the chain of information for the shipment.

Annex 2. Safe handling of CTUs

1 General

1.1 CTUs are designed for intermodal transport. They are capable to be transferred from one mode of transport to another by rolling or lifting. A swap body can be carried on a road vehicle or on a railway wagon. A container can be carried on a road vehicle, on a railway wagon, on an inland barge or on a seagoing ship. A road vehicle can be carried on a railway wagon, on an inland barge or on a seagoing / ro-ro ship. A railway wagon can be carried on a seagoing ship (railway ferry).

1.2 When CTUs are handled, it should be ensured that all handling devices such as lifting appliances and internal movement equipment are in good condition and suitable for the intended purpose.

1.3 On completion of handling, CTUs should be secured to the means of transport as appropriate for the specific transport mode.

1.4 A CTU which is leaking cargo or obviously unsafe for further transport should not be loaded onto a means of transport.

2 Transfer by rolling

2.1 Swap bodies are carried by road on special swap carrier vehicles. The carrier vehicle is capable to be lowered on its wheels and to roll under the swap body standing on its supports. By lifting the vehicle to its normal operating position, the swap body is taken onto the chassis of the carrier vehicle. Then the support legs are retracted.

2.2 Road vehicles may be rolled onto a ship driven by their own engine. Semi-trailers are normally carried on board ships without tractor unit. They are loaded to and unloaded from the ships by specific port internal movement vehicles. These vehicles should be conspicuously painted or marked and fitted with a flashing or rotating yellow beacon. The drivers' cab should provide good all round visibility, with minimal obstruction of the driver's view. Only authorized persons should be allowed on the ramp or any vehicle deck while vehicle movements are taking place. The movement of persons on foot on the ramp should be strictly controlled and minimized.

2.3 The cargo decks of railway ferries are equipped with several rail tracks which can be accessed by a movable ramp which is fitted with rails, capable to be connected to the rail tracks on board. The maximum permissible kink angle between the ramp and the level of the rail deck in the ship is restricted and depends on the type of wagons shunted into the ship. In specific cases this angle may be as low as 1.5°.

3 Transfer by lifting

3.1 Before lifting a CTU, the handling staff should ensure that the lifting equipment is safely attached to the CTU and that all securing, fixing and lashing devices have been released.

3.2 Swap bodies for combined road/rail transport and also purpose-built semi-trailers for combined road/rail transport are equipped with standardized recesses for being lifted at four points by grappler arms attached to the spreader of a crane or reach stacker. Thus, they can be transferred from road to rail and vice versa.

3.3 Lifting of freight containers[17] (refer to ISO 3874)

3.3.1 The most appropriate method to lift a freight container is the use of a top lift spreader. The spreader is locked by twistlocks to the top corner fittings of the freight container. This method can be used for all freight container sizes fitted with top corner fittings, in an empty or packed state. When the spreader cannot be attached directly to the corner fittings, e.g. in case of over-height cargo, slings or chains can be used and connected to the spreader so that the lifting force remains vertical.

3.3.2 The side-lift frame is designed to lift a freight container by the two top corner fittings of one side and to take the reaction forces on the bottom corner fittings of the same side or on

[17] Other types of container may be lifted using these methods.

suitable corner post areas above those corner fittings. This method can be used on all sizes of empty freight containers. In the case of packed freight containers, this method is suitable for 20 ft and 10 ft freight containers only.

3.3.3 The end-lift frame is suitable only for the handling of 20 ft and 10 ft empty freight containers. The frame is designed to lift a freight container by the two top corner fittings of one end and to take reaction forces on the bottom corner fittings of the same end or on suitable corner post areas above those corner fittings.

3.3.4 A top lift sling can be used for empty freight containers of all sizes. The freight container is lifted by all four top corner castings with forces applied other than vertically. Lifting devices need to be properly engaged, hooks always be placed in an inward to outward direction. In the packed state, this method is suitable only for 10 ft freight containers, provided that the lifting forces are applied at an angle not less than 60° to the horizontal.

3.3.5 Bottom slings are used in connection with a cross beam spreader bar. The freight container may be lifted from the side apertures of four bottom corner fittings by means of lifting devices bearing on the bottom corner fittings only. Hooks are not suitable for this connection. This method can be used for all freight container sizes in an empty or packed state. For packed freight containers the angle between the sling and the horizontal should not be less than 30° for 40 ft freight containers, 45° for 20 ft freight containers and 60° for 10 ft freight containers.

3.3.6 When a freight container is provided with fork pockets, it can be lifted by means of forks under certain conditions. The forks should, ideally, extend the whole width of the freight container, but under no circumstances should they extend less than 1,825 mm into the fork pockets. This method can be used on 20 ft and 10 ft freight containers in an empty or packed state with the exception of tanks and pressurized bulk containers which should not be lifted by forklift trucks at all. Where there are no fork pockets, the freight container should not be lifted by forks in any state.

3.4 Railway wagons may be lifted and may change bogies when the railway ferry operates between countries where the gauge of the track is different. In such cases, the railway wagons should be suitable for an easy exchange of bogies. The involved ferry ports provide specific equipment for this operation.

4 Safety and security checks prior to entry

4.1 It is important for the terminal to ensure that CTUs accepted into the terminal are safe for operations and do not present a threat to the safety and security of the terminal, or ships and personnel within its environs. It is particularly important to ensure that "paperless" systems do not result in any dilution of the need to verify documentation.

4.2 The terminal should undertake the following actions at the first entry gate of the export yard, or while the CTU is in the terminal and before it goes onto a ship:

- Match the carrier's documentation against that of the haulier in order to prevent fraudulent shipments;
- Check the integrity of the CTU and its seal in order to preclude stowaways and the smuggling of contraband or threats to security. Whenever a broken or missing seal is found, it should be reported to the shipper and the authorities and replaced with a new seal. The new seal number should be recorded;
- Check the CTU number against documentation;
- Check the presence of placards and markings on CTUs containing dangerous goods and verify them against documentation;
- Verify the gross mass against documentation by use of a weighbridge or mass gauge/load indicator on yard equipment or, alternatively, verify that accurate gross mass determination has occurred before entry and that such determination was compliant with international requirements, where applicable, or accepted best practice;
- Ensure, during the lifting of the CTU by any terminal equipment, that an evaluation is made by the operator to check that the mass of the cargo is reasonably evenly distributed. If it is

determined to exceed the "60% within half the length rule", the terminal should take steps to rectify the problem;

- Sideline any CTU that appears to be structurally unsound and/or unsafe for a more detailed examination;
- Check the lashing of non-enclosed CTUs;
- Confirm the dimensions of out of gauge cargo and update booking data accordingly;
- Notify the CTU operator if out of gauge cargo is found to be improperly or inadequately secured to the CTU;
- Check reefer temperatures against setting and, in cases where the allowable variance is exceeded, follow up with the CTU operator. A reasonable temperature variance should be set to trigger follow up action with CTU operators, and this should vary depending on the cargo type, i.e. chilled or frozen. If this is not possible at the gate due to a low battery, then the check should be made when the CTU is plugged into the terminal's power supply;
- Check reefer plugs and wires for defects prior to plugging into the terminal's reefer system.

5 Stacking on ground and terminal operation with containers[18]

5.1 The ground should be a firm, flat and drained surface. On the ground, the container should be supported by the four bottom container fittings only. When stacking containers, the bottom surfaces of the lower corner fittings of the upper container should have complete contact with upper surfaces of top container fittings of the lower container. A shift of up to 25 mm laterally and 38 mm longitudinally may be tolerated.

5.2 A container stack may be subject to forces by heavy wind. This might lead to sliding and toppling of the containers. Stacks of empty containers will be more subject to such dangers than stacks of packed containers. The critical wind speed is higher for multiple rows than for a single row. Wind effect can be reduced by limiting the stacking height, by block stowage or by a combination of both. A recommended combination is shown in Table 2-1 below:

Number of tiers	20 ft standard	40 ft standard	40 ft high cube
2	2 rows	2 rows	3 rows
3	2 rows	3 rows	3 rows
4	2 rows	3 rows	3 rows
5	3 rows	3 rows	4 rows
6	4 rows	4 rows	5 rows

Table 2-1

5.3 Above recommendation is applicable for a wind speed up to 20 m/s (Force 8 Beaufort scale). In case of higher wind speeds, additional measures should be considered, such as changing the block to a stepped pyramid or securing containers with lashings to the ground.

5.4 Containers should be moved within a terminal area only by use of suitable equipment, such as van carriers, reach stackers or trailers. Trailers should be so constructed that the containers are supported by their corner fittings. For operation within the designated terminal area, tie down devices are not required, provided that the container is correctly loaded on the trailer and prevented from moving horizontally. Therefore, trailers which are not equipped with twistlocks should be fitted with substantial corner plates or other restraints of sufficient height to retain the container in position.

6 Securing of CTUs

6.1 Swap bodies are carried by road on dedicated carrier vehicles. The corner fittings of the swap

[18] Applies to container that are designed to stack.

body fit onto cones of locking devices (twistlocks) which, by turning the cones, provide a form closure between the swap body and the vehicle structure (see Figure 2-1).

Figure 2-1 Twistlock on a road vehicle

6.2 Containers should be carried by road on purpose-built container chassis, where the container is supported by the four corner fittings. The corner fittings of the container fit onto the twistlocks cones of the chassis, similar to the securing devices described in clause 6.1.

6.3 When carried by rail, swap bodies and containers are loaded on open wagons which are specifically fitted with stacking or locking devices. Semi-trailers may be carried on wagons equipped with dedicated bedding devices for accommodating road vehicles.

6.4 Container ships are specifically constructed for the carriage of freight containers. Cargo spaces under deck or cargo spaces on hatchless container ships are equipped with cell guides, where the freight containers are stacked, obtaining sufficient hold and securing. 20 ft freight containers may be stowed in 40 ft cell guides, provided that suitable stacking cones are inserted into the corner fittings of the freight containers. Freight containers carried on deck are affixed to the ships structure by means of twistlocks. Twistlocks are used also to interconnect freight containers stowed one on top of another. In addition, container stacks on deck are secured to the ships structure by means of lashing rods and tensioning devices (bottle screws) (see Figure 2-2). Details of the securing arrangement are described in the Cargo Securing Manual of the individual ship.

Figure 2-2 Cell guides and lashing rods on a container ship

6.5 When carried on general cargo ships which are not specifically constructed for the carriage of containers, the containers are secured to the ships structure by means of lashing chains or wire

ropes and tensioning devices (see IMO Code of Safe Practice for Cargo Stowage and Securing, Annex 1). Further details are described in the Cargo Securing Manual of the individual ship.

6.6 When vehicles are loaded in a vehicle deck of a ro-ro ship, the parking brakes should be applied and locked, engines should be in gear. Uncoupled semi-trailers should not be supported on their landing legs but preferably supported by a trestle or similar device. Lashings which are attached to the securing points of the vehicle should be connected with hooks or other devices so designed that they cannot disengage from the aperture of the securing point if the lashing slackens during the voyage. Only one lashing should be attached to any one aperture of the securing point on the vehicle. Further details are described in the Cargo Securing Manual of the individual ship.

6.7 The wheels of railcars shunted into the rail deck of a railway ferry should be chocked on the rail with appropriate steel chocks. The wagons should be secured to the ships structure with chains and tensioning devices (bottle screws). In case of severe weather conditions, the spring system of the wagons should be released by use of specific trestles. Further details are described in the Cargo Securing Manual of the individual ship.

Annex 3. Prevention of condensation damages

1 Introduction

Condensation damage is a collective term for damage to cargo in a CTU from internal humidity especially in containers on long voyages. This damage may materialize in form of corrosion, mildew, rot, fermentation, breakdown of cardboard packaging, leakage, staining, chemical reaction including self-heating, gassing and auto-ignition. The source of this humidity is generally the cargo itself and to some extent timber bracings, pallets, porous packaging and moisture introduced by packing the CTU during rain or snow or packing in an atmospheric condition of high humidity and high temperature. It is therefore of utmost importance to control the moisture content of cargo to be packed and of any dunnage used, taking into consideration the foreseeable climatic impacts of the intended transport.

2 Definitions

For the assessment of the proper state of "container-fitness" of the cargo to be packed and for the understanding of typical processes of condensation damage the most relevant technical terms and definitions are given below:

Absolute humidity of air	Actual amount of water vapour in the air, measured in g/m^3 or g/kg.
Condensation	Conversion of water vapour into a liquid state. Condensation usually starts when air is cooled down to its dew point in contact with cold surfaces.
Corrosion threshold	A relative humidity of 40% or more will lead to an increasing risk of corrosion of ferrous metals.
Crypto climate in the container	State of relative humidity of the air in a closed container, which depends on the water content of the cargo or materials in the container and on the ambient temperature.
Daily temperature variation in the container	Rise and fall of temperature in accordance with the times of day and often exaggerated by radiation or other weather influences.
Dew point of air:	Temperature below the actual temperature at which a given relative humidity would reach 100%. Example: The dew point of air at a temperature of 30°C and 57% relative humidity (=17.3 g/m^3 absolute humidity) would be 20°C, because at this temperature the 17.3 g/m^3 represent the saturation humidity or 100% relative humidity.
Hygroscopicity of cargo	Property of certain cargoes or materials to absorb water vapour (adsorption) or emit water vapour (desorption) depending on the relative humidity of the ambient air.
Mould growth threshold	A relative humidity of 75% or more will lead to an increasing risk of mould growth on substances of organic origin like foodstuff, textiles, leather, wood, ore substances of non-organic origin such as pottery.
Relative humidity of air	Actual absolute humidity expressed as percentage of the saturation humidity at a given temperature. Example: An absolute humidity of 17.3 g/m^3 in an air of 30°C represents a relative humidity of 100 · 17.3 / 30.3 = 57%.

Saturation humidity of air	Maximum possible humidity content in the air depending on the air temperature (2.4 g/m^3 at -10°C; 4.8 g/m^3 at 0°C; 9.4 g/m^3 at 10°C; 17.3 g/m^3 at 20°C; 30.3 g/m^3 at 30°C; see Figure 3-1 below).
Sorption equilibrium	State of equilibrium of adsorption and desorption at a given relative humidity of the ambient air and the associated water content of the cargo or material.
Sorption isotherm	An empirical graph showing the relation of water content of a cargo or material to the relative humidity of the ambient air. Usually, the adsorption process is used to characterize the above relation. Sorption isotherms are specific for the various cargoes or materials (see Figure 3-2 below).
Water content of cargo	Latent water and water vapour in a hygroscopic cargo or associated material, usually stated as percentage of the wet mass of cargo (e.g. 20 tonne cocoa beans with 8% water content will contain 1.6 tonne water).

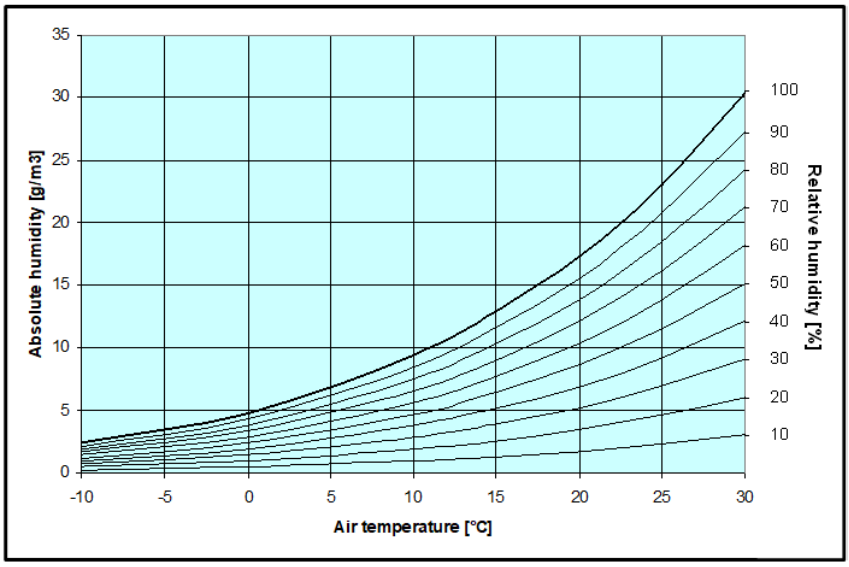


Figure 3-1 Absolute and relative humidity

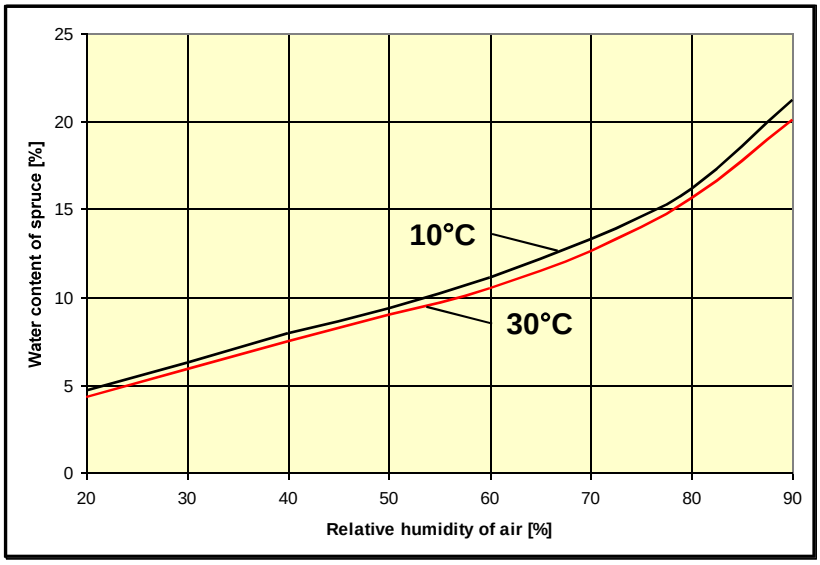


Figure 3-2 Sorption isotherms of Sitka spruce

3 Mechanisms of condensation

3.1 Closed CTUs, in particular closed containers, packed with a cargo that contains water vapour, will quickly develop an internal crypto climate with a distinguished relative humidity in the air surrounding the cargo. The level of this relative humidity is a function of the water content of the cargo and the associated materials of packaging and dunnage, following the specific sorption isotherms of the cargo and associated materials. A relative humidity of less than 100% will prevent condensation, less than 75% will prevent mould growth and less than 40% will prevent corrosion. However, this protective illusion is only valid as long as the CTU is not subjected to changing temperatures.

3.2 Daily temperature variations to CTUs are common in longer transport routes, in particular in sea transport, where they also depend largely on the stowage position of the CTU in the ship. Stowage on top of the deck stow may cause daily temperature variations of more than 25°C, while positions in the cargo hold may show marginal variations only.

3.3 Rising temperatures in a CTU in the morning hours will cause the established relative humidity of the air to drop below the sorption equilibrium. This in turn initiates the process of desorption of water vapour from the cargo and associated materials, thus raising the absolute humidity in the internal air, in particular in the upper regions of the CTU with the highest temperature. There is no risk of condensation during this phase.

3.4 In the late afternoon the temperature in the CTU begins to decline with a pronounced drop in the upper regions. In the boundary layer of the roof, the air reaches quickly the dew point at 100% relative humidity with immediate onset of condensation, forming big hanging drops of water. This is the formidable container sweat which will fall down onto the cargo and cause local wetting with all possible consequences of damage. Similarly, condensate on the container walls will run down and may wet the cargo or dunnage from below.

3.5 The condensed water retards the overall increase of the relative humidity in the air and thereby decelerates the absorption of water vapour back into the cargo and associated materials. If this temperature variation process is repeated a number of times, the amount of liquid water set free by desorption may be considerable, although some of it will evaporate during the hot phases of the process.

3.6 A quite similar mechanism of condensation may take place if a container with a warm and hygroscopic cargo, e.g. coffee in bags, is unloaded from the ship but left unopened for some days in a cold climate. The cargo will be soaked by condensation from the inner roof of the container.

3.7 Notwithstanding the above described risk of container sweat due to the daily temperature variation, an entirely different type of condensation may take place if cargo is transported in a closed CTU from a cold into a warm climate. If the CTU is unpacked in a humid atmosphere immediately after unloading from the ship, the still cold cargo may prompt condensation of water vapour from the ambient air. This is the so-called cargo sweat, which is particularly fatal on metal products and machinery, because corrosion starts immediately.

4 Loss prevention measures

4.1 Corrosion damage: Ferrous metal products, including machinery, technical instruments and tinned food should be protected from corrosion either by a suitable coating or by measures which keep the relative humidity of the ambient air in the CTU reliably below the corrosion threshold of 40%.

4.2 The moisture content of dry dunnage, pallets and packing material can be estimated as 12% to 15%. The sorption isotherms for those materials show that with this moisture content the relative humidity of the air inside the CTU will inevitably establish itself at about 60% to 75% after closing the doors. Therefore, additional measures like active drying of the dunnage and packing material or the use of desiccants (drying agents in pouches and other passive methods for moisture capture) should be taken, in combination with a sealed plastic wrapping.

4.3 Fibreboard packaging and dunnage when used in association with dangerous goods should undergo water resistance test using the Cobb method as specified in ISO 535[19].

4.4 Mould, rot and staining: Cargoes of organic origin, including raw foodstuff, textiles, leather, wood and

[19] EN 20535:1994, ISO 535:1991 Paper and board - Determination of water absorptiveness - Cobb method

wood products, or substances of non-organic origin such as pottery, should be packed into a CTU in "container-dry" condition. Although the mould growth threshold has been established at 75% relative humidity, the condition "container-dry" defines a moisture content of a specific cargo that maintains a sorption equilibrium with about 60% relative humidity of the air in the CTU. This provides a safety margin against daily temperature variations and the associated variations of relative humidity. Additionally, very sensitive cargo should be covered by unwoven fabric (fleece) which protects the cargo top against falling drops of sweat water. The introduction of desiccants into a CTU containing hygroscopic cargo, that is not "container-dry", will generally fail due to the lack of sufficient absorption capacity of the drying agent.

4.5 Collapse of packing: This is a side effect of moisture adsorption of usual cardboard that is not waterproof. With increasing humidity from 40% to 95% the cardboard loses up to 75% of its stableness. The consequences are the collapse of stacked cartons, destruction and spill of contents. Measures to be taken are in principle identical to those for avoiding mould and rot, or the use of "wet strength" cardboard packaging.

4.6 Unpacking

4.6.1 Goods packed in a cold climate on arrival in a warm climate with higher absolute humidity should be delayed until the goods have warmed up sufficiently for avoiding cargo sweat. This may take a waiting time of one or more days unless the goods are protected by vapour tight plastic sheeting and a sufficient stock of desiccants. The sheeting should be left in place until the cargo has completely acclimatized.

4.6.2 Hygroscopic goods packed in a warm climate on arrival in a cold climate with low absolute humidity should be unpacked immediately after unloading from the ship, in order to avoid cargo damage from container sweat. There may be a risk of internal cargo sweat when the cargo is cooled down too quickly in contact with the open air, but experience has shown that the process of drying outruns the growth of mould, if the packages are sufficiently ventilated after unpacking.

Annex 4. CTU properties

1 Freight containers

1.1 General

1.1.1 Within the CTU Code one of the CTU types is the container which covers freight containers, regional and domestic containers. This clause concentrates on freight containers but may apply to other types of containers. Supplement 1 describes all types of freight container. However, the shorter term “container” is used in this code and general operations to refer freight container and may be interchangeable. Both terms are defined in Chapter 2. This clause of the annex briefly describes the differences between, and use of containers.

1.1.2 With the exception of platforms (a container deck without walls), packed freight containers are capable of being stacked. This feature is mainly used in land-based storage areas and on ships during a sea passage. The permissible stacking mass is displayed on the approval plate. Freight containers with a stacking mass equal to or greater than 192,000 kg may be transported without restriction. However, freight containers with a stacking mass value less than 192,000 kg do also exist. They shall be marked in accordance with the latest edition of ISO 6346 and require special attention when used for intermodal transport, in particular for the stowage in stacks on seagoing ships (see Annex 5.3).

1.1.3 General purpose containers are available as closed containers, ventilated containers and open top containers. The side walls are capable of withstanding a uniform load equal to 60% of the permitted payload. The front wall and the door end are capable of withstanding 40% of the permitted payload. These limitations are applicable for a homogenous load on the relevant wall area and do not exclude the capability of absorbing higher forces by the framework of the freight container. The container floor is primarily designed to sustain the total payload homogeneously distributed over the bottom structure. This results in limitations for concentrated loads (see Annex 10.3.1).

1.1.4 Most general-purpose containers have a limited number of lashing rings or bars. When lashing rings are fitted, the anchor points at the bottom have a maximum securing load (MSL) of at least 10 kN in any direction. The lashing points at the top side rails have a MSL of at least 5 kN[20].

1.1.5 Closed containers generally have labyrinth protected openings for venting (pressure compensation), but these openings do not measurably support air exchange with the ambient atmosphere. Special type "ventilated containers" have weatherproof ventilation grills built into the top and bottom side rails and the front top rail and bottom sill, through which the natural convection inside the container is intensified and a limited exchange of air and humidity with the ambient atmosphere is established.

1.1.6 General-purpose containers are not designed or tested for packing or filling other than in the horizontal position and under no circumstances should they be stood on their end wall, see Annex 10.5.3.1.5 and Annex 10.5.3.5.

1.1.7 An open top container is similar to a closed container in all respects except that it has no permanent rigid roof. It may have a flexible and movable or removable cover, e.g. of canvas, plastic or reinforced plastic material. The cover is normally supported by movable or removable roof bows. In some cases, the removable roof is a compact steel construction suitable to be lifted off in one piece. The header (transverse top rail above the doors) is generally movable or removable (known as swinging headers). The headers are part of the container strength and should be fitted to have full strength of the container.

1.1.8 Open side containers have a curtain or canvas on one or both sides, a rigid roof and rear doors. While the strength of the end walls is similar to that of closed containers, the side curtain provides limited or no restraint capability. Open side containers are not covered by

[20] See ISO 1496-1:2013 Freight containers – Specification and testing – Part 1: General cargo containers for general purposes, Annex C.

ISO standards.

1.1.9 Platforms and platform-based containers are characterized by having no side superstructure except either fixed or collapsible end walls (flatracks) or are designed without any superstructure (platforms). The benefit of collapsible end walls is that the flatrack may be efficiently stacked when transported in empty condition for repositioning.

1.1.10 Flatracks and platforms have a bottom structure consisting of at least two strong longitudinal H-beam girders, connected by transverse stiffeners and lined by solid wooden boards. For securing of cargo units, strong anchor points are welded to the outer sides of the longitudinal bottom girders with a MSL of at least 30 kN according to the standard. In many cases the anchor points have a MSL of 50 kN. Cargo may also be secured in longitudinal direction by blocking against the end walls of flatracks. These end walls may be additionally equipped with lashing points of at least 10 kN MSL.

1.1.11 Thermal containers, commonly referred to as reefer containers, are designed for the transport of cargo under temperature control. Such cargo is generally homogeneously packed and tightly stowed from wall to wall. Therefore, the side and end wall strength are similar to that of general purpose containers. However, thermal containers are generally not equipped with anchor and lashing points. When a cargo needs to be secured by lashings, specific fittings may be affixed to the "T" section gratings, thus providing the required anchor points.

1.1.12 A tank container comprises two basic elements, the tank shell (or shells in case of a multiple-compartment tank container) and the framework. The framework is equipped with corner fittings and renders the tank suitable for intermodal transport. The frame should comply with the requirements of the CSC. If dangerous goods are intended to be carried in the tank, the shell and all fittings such as valves and pressure relief devices should comply with the applicable dangerous goods regulations.

1.1.13 A non-pressurized dry bulk container is a container especially designed for the transport of dry solids, capable of withstanding the loads resulting from filling, transport motions and discharging of non-packaged dry bulk solids, having filling and discharging apertures and fittings. There are containers for tipping discharge, having filling and discharge openings and also a door. A variant is the hopper type for horizontal discharge, having filling and discharge openings but no doors. The front and rear end walls of solid bulk containers are reinforced and so constructed to bear a load equal to 60% of the payload. The strength of the side walls is similar to that of general-purpose containers.

1.1.14 More detailed properties of various container variations are given in Supplement 1.

1.2 Exterior dimensions of containers

1.2.1 ISO container dimensions:

ISO Freight container sizes												
Freight container description		Freight container designation	ISO Size Code	Actual								
				Length, L			Width, W			Height, H		
Length	Height			mm	ft	in	mm	ft	in	mm	ft	in
45 ft	9 ft 6 in	1EEE	55	13,716	45		2,438	8		2,896	9	6
	8 ft 6 in	1EEE	52							2,591	8	6
40 ft	9 ft 6 in	1AAA	45	12,192	40		2,438	8		2,896	9	6
	8 ft 6 in	1AA	42							2,591	8	6
	8 ft	1A	40							2,438	8	
	Half height	1AX	48							1,295	4	3
30 ft	9 ft 6 in	1BBB	35	9,125	29	11¼	2,438	8		2,896	9	6
	8 ft 6 in	1BB	32							2,591	8	6
	8 ft	1B	30							2,438	8	
	Half height	1BX	38							1,295	4	3
20 ft	9 ft 6 in	1CCC	25	6,058	19	10½	2,438	8		2,896	9	6
	8 ft 6 in	1CC	22							2,591	8	6
	8 ft	1C	20							2,438	8	
	Half height	1CX	28							1,295	4	3
10 ft	8 ft	1D	10	2,991	9	9¾	2,438	8		2,438	8	
	Half height	1DX	18							<2438	<8	

Table 4-1 ISO container sizes

1.2.2 In addition to the standard lengths there are regional / domestic variations, which include 48 ft, 53 ft and longer.

1.2.3 The standard width is 8 ft (2,438 mm), with regional variations of 8 ft 6 in (United States) and 2.5 m (Europe).

1.2.4 The ISO standard heights are half height (4 ft 3 in / 1,295 mm), 8 ft (2,438 mm), 8 ft 6 in (2,591 mm) and 9 ft 6 in (2,896 mm).

.1 There are very few 8 ft high containers left in circulation.

.2 Practically all 20 ft containers are 8 ft 6 in high.

.3 Practically all 45 ft containers are 9 ft 6 in high.

1.2.5 Regional heights of 9 ft, 10 ft and 3 m can be found for specific cargoes.

1.3 Carrying capacity of containers

1.3.1 The maximum gross mass of a container is specified on the CSC safety approval plate (see Annex 5). It is additionally, along with the tare mass and the payload, marked in painted letters on the door or on the rear end of the container.

1.3.2 When considering the carrying capacity of containers in terms of mass, three values should be considered:

.1 Rating (*R*) or maximum gross mass (MGM). These values refer to the maximum permissible gross mass of the container for which it is designed;

.2 Tare mass (*T*) refers to the mass of the container in an empty condition; and

.3 Maximum payload (*P*) can be calculated by subtracting the tare from the rating / maximum gross mass ($P = R - T$) and refers to the maximum permissible mass of the cargo carried in the container including the mass of all securing materials and dunnage.

1.3.3 Under ISO standards[21] all container types and lengths except 10 ft have a maximum rating of 30,480 kg. However, 20 ft, 40 ft and 45 ft box type containers may be rated at 32,500 kg or 34,000 kg. Platform based containers, including flatracks may be rated up to 55,500 kg. Special containers or those manufactured to previous versions of the standard may have a lesser rating.

1.3.4 When planning, the packer may know only the mass of all packages and cargo items. An estimate of the mass of securing materials and dunnage should be made. These values should be added to the tare of the container, which varies from 2,200 kg for a 20 ft general purpose container to 5,300 kg for a 40 ft folding flatrack. The sum of these three elements produces an estimated gross mass for the container. If this value exceeds 30,480 kg then the packer should contact the CTU operator to see if there are containers with higher ratings available. This estimated gross mass should not be used when providing the verified gross mass of the CTU after packing. For more information concerning verification of the gross mass of containers in international transport, including sea voyage see the *Guidelines regarding the verified gross mass of a container carrying cargo* (MSC.1/Circ.1475).

1.3.5 Consideration should be given to local or national road and rail regulations which may limit the permissible gross mass of the packed container.

1.4 Floor strengths

1.4.1 Heavy cargo items lifted by a forklift truck may result in a front axle load exceeding the maximum permissible concentrated load inside a CTU. For example, modern freight containers are designed to withstand a force of 0.5 kN/cm^2 which may limit package masses to approximately 3 to 3.5 tonnes depending on the type of forklift truck used.

1.4.2 Floors on containers covered by the CSC are only required to withstand an axle load of 5,460 kg or 2,730 kg per wheel[22] although they may be built to withstand a greater axle load. This value depends on the diameter and width of the wheel and the length of the axle. To achieve this value the wheels are arranged so that all points of contact between each wheel and a flat continuous surface lie within a rectangular envelope measuring 185 mm (in a direction parallel to the axle of the wheel) by 100 mm and that each wheel makes physical contact over an area within this envelope of not more than 142 cm^2. The wheel width should be nominally 180 mm and the wheel centres should be nominally 760 mm. Using a counterbalance forklift truck with a front axle in line with these dimensions will permit the movement of 2,000 to 2,500 kg packages.

1.4.3 Axle loads may be increased if the wheel diameter or width is increased, and the contact area is greater than 142 cm^2. Conversely, fork trucks with smaller diameter wheels will not be able to move similar mass packages. The CTU operator may be able to provide more precise information.

1.5 Forklift pockets:

1.5.1 may be provided on 10 ft and 20 ft containers, but are not generally fitted on 30 ft and longer containers;

1.5.2 20 ft containers are generally fitted with forklift pockets with centres of 2,050 mm ±50 mm, which may be used for lifting full containers. Some 20 ft containers may have a second set at 900 mm centres, which should only be used for lifting containers when they are empty. However, this design feature is now almost extinct;

1.5.3 according to the ISO standard forklift pockets may not be fitted on tank containers; and

1.5.4 when fitted on 30 ft and longer containers, forklift pockets should only be used for the lifting of empty containers.

2 Swap bodies

2.1 General

[21] Standard ISO 668:2013 Series 1 freight containers – Classification, dimensions and ratings.

[22] International Convention for Safe Containers, 1972, Annex II

2.1.1 An item of transport equipment having a mechanical strength designed only for rail and road vehicle transport by land or by ferry within Europe and, therefore, not needing to fulfil the same requirements as containers built to ISO standards; having a width and/or a length exceeding those of containers of equivalent basic size, for better utilisation of the dimensions specified for road traffic.

2.1.2 Swap bodies are generally 2.5 m or 2.55 m wide, although thermal swap bodies can be up to 2.6 m wide, and are subdivided into three length categories:

- Class A: 12.2 to 13.6 m, 13.712 m (45 ft) (maximum gross mass 34 tonnes);
- Class B: 9.125 (30 ft).
- Class C: 7.15, 7.45 or 7.82 m (maximum gross mass 16 tonnes). The most commonly used length in this class is 7.45 m.

2.1.3 Swap bodies are fixed and secured to the vehicles with the same devices as those of containers: for this reason, such devices are fixed as specified in ISO 668 and ISO 1161 but owing to the size difference are not always located at the swap body corners.

2.1.4 The standard box type swap body has a roof, side walls and end walls, and a floor and has at least one of its end walls or side walls equipped with doors.

2.1.5 The curtain-sided swap body is designed similarly to a standard curtain side semi-trailer. It has an enclosed structure with rigid or removable roof and end walls and a floor. The sides consist of removable canvas or plastic material. The side boundary may be enforced by removable stanchions.

2.1.6 A thermal swap body is a swap body that has insulating walls, doors, floor and roof. Thermal swap bodies may be insulated, but not necessarily equipped with mechanical device for cooling. A variant is the mechanically refrigerated swap reefer.

2.1.7 A swap tank is a swap body that consists of two basic elements, the tank or tanks, and the framework. The tank shell of a swap tank is not always fully enclosed by the framework.

2.1.8 A swap bulker is a swap body that consists of the containment for dry solids in bulk without packaging. It may be fitted with one or more round or rectangular loading hatches in the roof and "cat flap" or "letter box" discharge hatches in the rear and/or front ends.

2.1.9 More detailed information on various swap body types is given in Supplement 2.

2.2 Handling and stacking

2.2.1 Most swap bodies were originally designed for road and rail transport without the need for stacking and lifting achieved using grapple arms or lowering the swap body onto their own legs (Class C). Class A and B outwardly have the appearance of the container and all sizes are now produced with the ability to top lift and to have limited stacking capability.

2.2.2 Stackable swap bodies have top fittings enabling the handling with standard container handling equipment. Alternatively, the swap body may be handled using grappler arms, inserted into the four recesses in the bottom structure. Swap bodies not suitable for stacking can only be handled with grappler arms. Class C swap bodies can be transferred from the road vehicle to their supporting legs and returned to the vehicle by lowering or raising the carrier vehicle on its wheels.

2.3 Dimensions and rating

2.3.1 Swap bodies of Class A (EN 452 and CEN / TS 14993)

Designation	Length [mm]	Length [ft]	Height [mm]	Width [mm]	Rating [kg]
A 1219	12,192	40	2,670[1]	2,500[2]	34,000
A 1250	12,500	41			
A 1360	13,600	44ft 7in			
A 1371[3]	13,716	45	2,900[4]	2,550	32,000 to 34,000

[1] The body height of 2,670 mm assures transport without hindrance on the main railway lines of Europe.

[2] A maximum width of 2,600 mm is permitted for certain thermal bodies according to Council Directive 88/218/EEC. The body width of 2,500 mm assures transport without hindrance throughout Europe.

[3] Swap bodies for combined transport – stackable swap bodies type A 1371 Technical specification

[4] Maximum height

Table 4-2 Swap bodies - Class A rating

2.3.2 Swap bodies – non stackable swap bodies of Class C

Designation	Length [mm]	Length [ft]	Height [mm]	Width [mm]	Rating [kg]
C 745	7,450	24ft 5in	2750	2,500[2]	16,000
C 782	7,820	25ft 8in			

Table 4-3 Swap body Class C rating

2.4 Cargo securing devices

2.4.1 Cargo securing devices may be provided in swap bodies as optional features; however, for curtain sider swap bodies, cargo securing devices are mandatory. Where fitted, cargo securing devices should meet the requirements of EN 12640 (Securing of cargo on road vehicles – Lashing points on commercial vehicles for goods transportation – minimum requirements and testing)

2.4.2 Lashing points should be designed so that they transmit the forces they receive into the structural elements of the vehicle. They should be fixed in the loading platform and in the vertical front-end wall. In their position of rest, they should not project above the horizontal level of the loading platform nor beyond the vertical surface of the front end wall into the loading space.

NOTE: The recesses in the loading platform required to accommodate the lashing points should be as small as possible.

3 Road Vehicles

3.1 General

3.1.1 Vehicles with closed superstructures are the primary choice for cargo that is sensitive to rain, snow, dust, sunlight, theft and other consequences of easy access. Such closed superstructure may consist of a solid van body or a canvas covered framework of roof stanchions and longitudinal battens, occasionally reinforced by side and stern boards of moderate height. In nearly all cases these vehicles have a strong front wall integrated into the closed superstructure. Closed superstructures of road vehicles may be provided with arrangements for applying approved seals.

3.1.2 More detailed information on various road vehicle types and dimensions are given in Supplement 3

3.2 Capacity

3.2.1 Road vehicles are allocated a specific maximum payload. For road trucks and full trailers, the maximum payload is a constant value for a given vehicle and should be documented in the registration papers. However, the maximum allowed gross mass of a semi-trailer may vary to some extent with the carrying capacity of the employed articulated truck as well as in which country it is operating. The total gross combination mass, documented with

the articulated truck, should never be exceeded.

3.2.2 The actual permissible payload of any road vehicle depends distinctly on the longitudinal position of the centre of gravity of the cargo carried. In general, the actual payload should be reduced if the centre of gravity of the cargo is conspicuously off the centre of the loading area. The reduction should be determined from the vehicle specific load distribution diagram (see Annex 10.3.3.5 Applicable national regulations on this matter should be observed. In particular closed containers transported on semi-trailers with the doors at the rear of the vehicle quite often tend to have their centre of gravity forward of the central position. This may lead to an overloading of the articulated truck if the container is packed toward its full payload.

3.3 Strength

3.3.1 The boundaries of the loading platform of road vehicles may be designed and made available in a strength that would be sufficient – together with adequate friction – to retain the cargo under the specified external loads of the intended mode of transport. Such advanced boundaries may be specified by national or regional industry standards. However, a large number of road vehicles are equipped with boundaries of less resistivity in longitudinal and transverse direction, so that any loaded cargo should be additionally secured by lashings and/or friction increasing material. The rating of the confinement capacity of such weak boundaries may be improved if the resistance capacity is marked and certified for the distinguished boundary elements of the vehicle.

3.3.2 In Europe, European standard EN 12642 would apply. According to this, there are two levels of requirements of vehicle sides and ends: Code L and Code XL. The strength requirements of the side walls for the Code L vehicles is similar to the requirements for sides of swap bodies according to the standard EN 283 (see paragraph 6.4.4). The side walls of Code XL vehicles are designed to withstand a force equal to 40% of the permitted payload uniformly distributed over the side up to 75% of the height of the side, independently of the type of vehicle. The front wall of Code L vehicles is designed to take up a force equal to 40% of the permitted payload, the maximum however is 50 kN. For Code XL vehicles the front wall is designed to withstand a force equivalent to 50% of the payload without any further limit. The rear wall of Code L vehicles is designed to withstand a force equal to 30% of the permitted payload, the maximum however is 31 kN. For Code XL vehicles the rear wall is designed to withstand a force equivalent to 40% of the payload without any further limit.

3.4 Securing points

3.4.1 Road vehicles are generally equipped with securing points along both sides of the loading platform. These points may consist of flush arranged clamps, securing rails or insertable brackets and should be designed for attaching the hooks of web lashings and chains. The lashing capacity of securing points varies with the maximum gross mass of the vehicle. The majority of vehicles is fitted with points of a lashing capacity (LC) or maximum securing load (MSL) of 20 kN. Another type of variable securing devices are pluck-in posts, which may be inserted into pockets at certain locations for providing intermediate barriers to the cargo. The rating of the lashing capacity of the securing points may be improved if their capacity is marked and certified. Modern vehicles are often equipped with continuous connecting points for lashing bars on each side, thus, to enable the affixing of the lashing bars exactly in the required positions to block the cargo against movement towards the rear side.

3.4.2 When road vehicles or semi-trailers are intended to be transported on a ro-ro ship, they should be equipped with securing points of a defined minimum strength in sufficient number according to Table 4-4[23]:

Gross vehicle mass (GVM (tonnes))	Minimum number of securing points on each side of the vehicle	Minimum strength of each securing point (kN)
$3.5 \leq \text{GVM} \leq 20$	2	$\frac{GVM\ x\ 10\ x\ 1.2}{n}$
$20 < \text{GVM} \leq 30$	3	

[23] See IMO Resolution A.581(14).

$30 < GVM \leq 40$	4	
$40 < GVM \leq 50$	5	
$50 < GVM \leq 60$	6	

where n is the total number of securing points on each side of the vehicle

Table 4-4 Minimum strength in sufficient number of securing points

3.4.3 Road trains, comprising two or more trailers, require each trailer to be considered in isolation and be fitted with, and secured by, the minimum number of securing points for the GVM of that trailer component. Semi-trailer tractor or towing vehicles are excluded from the table and should be provided with two securing points or a towing coupling at the front of the vehicle.

4 Railway wagons

4.1 General

4.1.1 In intermodal transport, railway wagons are used for two different purposes: First, they may be used as carrier units to transport other CTUs such as containers, swap bodies or semi-trailers. Second, they may be used as CTUs themselves which are packed or loaded with cargo and run by rail or by sea on railway ferries.

4.1.2 The first mentioned purpose is exclusively served by open wagons, which are specifically fitted with devices for securing containers, inland containers and swap bodies or have dedicated bedding devices for accommodating road vehicles, in particular semi-trailers. The second mentioned purpose is served by multifunctional closed or open wagons, or wagons which have special equipment for certain cargoes, e.g. coil hutches, pipe stakes or strong lashing points.

4.1.3 On board ferries the shunting twin hooks are normally used for securing the wagon to the ship's deck. These twin hooks have a limited strength and therefore some wagons are equipped with additional stronger ferry eyes. These external lashing points should never be used for securing cargo to the wagon.

4.1.4 The maximum payload is generally not a fixed value for the distinguished wagon, but allocated case by case by means of the intended track category and the speed category. More details on payload and concentrated loading are provided in Annex 5.5.1.5.

4.1.5 In case of concentrated loads a reduction of the payload is required, which depends on the loaded length and the way of bedding the concentrated load. The applicable load figures are marked on each wagon. Also, any longitudinal or transverse eccentricity of concentrated loads is limited by the individual axle load capacity or the wheel load capacity. More details are provided in Annex 5.5.1.6.

4.1.6 Closed railway wagons are designed for the compact stowage of cargo. The securing of cargo should be accomplished by tight packing or blocking to the boundaries of the wagon. However, wagons equipped with sliding doors should be packed in a way that doors remain operable.

4.1.7 When a railway ferry is operating between railway systems of different gauges, wagons which are capable for changing their wheel sets over from standard gauge to broad gauge or vice versa are employed. Such wagons are identified by the first two figures of the wagon number code.

4.1.8 More detailed information on railway wagons are given in Supplement 4.

5 Roll trailers

5.1 General

5.1.1 Roll trailers are exclusively used for the transport of goods in RO/RO ships and are loaded or unloaded and moved in port areas only. They present a rigid platform with strong securing points at the sides, and occasionally brackets for the attachment of cargo

stanchions. The trailer rests on one or two sets of low solid rubber tyres at about one third of the length and on a solid socket at the other end. This end contains a recess for attaching a heavy adapter, the so–called gooseneck. This adapter has the kingpin for coupling the trailer to the fifth wheel of an articulated truck.

5.1.2 The packing of a roll trailer with cargo or cargo units must be planned and conducted under the conception that the cargo must be secured entirely by lashings (see Annex 10.4.4.2). However, roll trailers are available equipped with standardized locking devices for the securing of containers and swap bodies.

Annex 5. Approval plates

1 Safety plates

1.1 Containers used in international transport and, under certain conditions, also swap bodies and road trailers are required by applicable regulations to bear safety approval plates.

1.2 Under the International Convention for Safe Containers (CSC), each container is required to bear a safety approval plate permanently affixed to the rear of the container, usually the left-hand door. On this plate, the most important information for the packer is:

- The date manufactured;
- The maximum gross mass which should not be exceeded; and
- The allowable stacking mass which should not be exceeded,

as shown in Figure 5-1**Error! Reference source not found.**

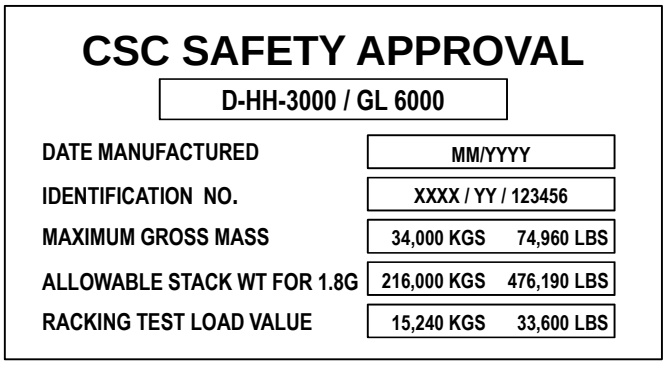


Figure 5-1 Diagram of CSC safety approval plate

1.2.1 The CSC requires containers to be thoroughly examined 5 years after manufacture and subsequently at least every 30 months. The date of the next periodic examination is stamped on the approval plate or affixed to it in form of a decal (see Figure 5-2).

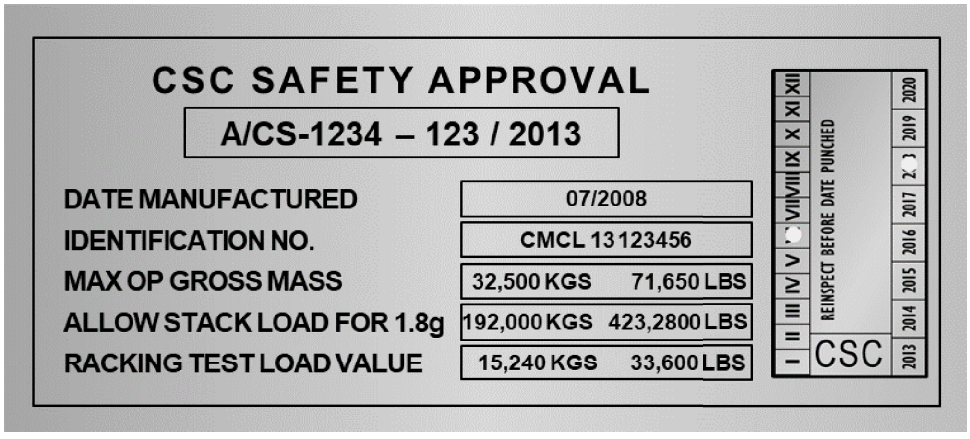


Figure 5-2 CSC safety approval plate with next examination date

1.2.2 As an alternative to such periodic inspections, the owner or operator of the container may execute an approved continuous examination programme where the container is frequently inspected at major interchanges. Containers operated under such programme should be

marked on or near to the safety approval plate with a mark starting "ACEP" followed by numerals and letters indicating the approval number of this continuous examination programme (see Figure 5-3).

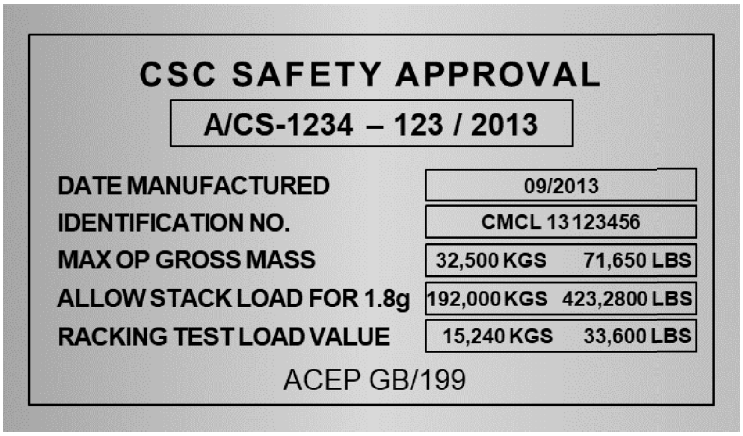


Figure 5-3 Safety approval plate with ACEP mark

1.2.3 If there is no ACEP mark and if the next examination date is already elapsed or is before the expected arrival time of the container at its destination, the container should not be used in intermodal or international transport.

1.3 Swap bodies and road trailers destined for transport by rail within the European railway network require a marking as per EN 13044[24]. This operational marking provides information for codification and for approval of the swap body or semi-trailer for rail transport.

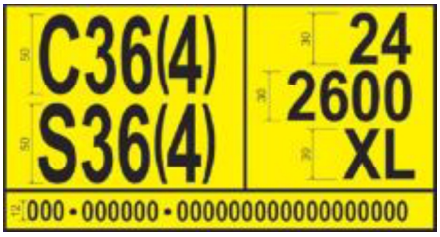


Figure 5-4 Yellow operational mark for swap bodies

Figure 5-5 Yellow operational mark for trailers

1.3.1 The data on the plates shown in Figure 5-4 and Figure 5-5 relate to dimensions of CTU and how they can fit onto rail wagons. The significant information relates to the characters "XL" shown on both plates. This indicates the strength of the swap bodies' body, standard or reinforced, with the marking referring to EN 12642 (see also Table 5-1 Static test conditions).

Component	Standard structure Code L	Reinforced structure Code XL
Front wall	0.4P and maximum limit[a]	0.5P without maximum limit
Rear wall	0.25P and maximum limit[b]	0.3P without maximum limit
Side wall	Up to 0.3P	0.4P[c]
[a] 5,000 daN [b] 3,100 daN [c] Except for double-decker		

[24] EN 13044-2:2011 Intermodal loading units – Marking Part 2: markings of swap bodies related to rail operation

Table 5-1 Static test conditions

1.3.2 The XL test requirements specifically apply to the following types of body structures:

- box type;
- drop side with side and tail boards without cover;
- drop side with side and tail boards with tarpaulin cover;
- curtain-siders.

2 Maximum gross mass

2.1 Containers, like all CTUs, have a maximum gross operating mass or rating which is shown both on the CSC safety approval plate (see Figure 5-1, Figure 5-2 and Figure 5-3) and on the rear end of the container (see Figure 5-6).

Figure 5-6 Rear of container

2.2 The two values shown on a container should be the same, however if they are different the value shown on the CSC safety approval plate should be used.

2.3 The tare mass shown in the figure relates to the empty mass of the container and should always be shown on the rear end of the container. This value will include any permanently attached equipment such as an integral refrigeration unit, but will not include items that are attached, such as a nose mounted generator (clip on unit).

2.4 The maximum payload (or net mass) may be shown on the rear of the container, however the correct method for calculating the maximum mass of cargo that the container can carry is:

$$P = R - \left(T_c + T_g + T_s\right)$$

Equation 2

Where:

P	=	Maximum payload (or net mass) of cargo
R	=	Maximum gross mass of freight container
T_c	=	Tare mass of the freight container
T_g	=	Mass of additional attached items
T_s	=	Mass of the cargo securing materials

3 Allowable stacking mass

3.1 The allowable stacking mass represents the maximum superimposed load that any container can be subjected to and is often referred to as the stacking capability or stack height (when converted to a number of containers).

3.2 Containers built to the provisions of ISO 1496 are required to withstand a minimum superimposed

load of 213,360kg. This value is the equivalent of seven superimposed containers with an average mass of 30,480kg.

3.3 Containers having an allowable stacking mass of less than 213,360 kg are not unrestrictedly suitable for sea transport. This includes:

- Containers built to a previous edition of ISO 1496 standard;
- Swap bodies;
- Containers designed to be used with one door removed/open.

3.4 Swap containers and tanks have a different design and therefore a different stacking capability. The wider designed width of the swap bodies means that there is a step between the corner posts and the top corner fittings which are shown clearly on the swap tank as shown in Figure 5-7 and Figure 5-8.

Figure 5-7 Step back at the top fitting

Figure 5-8 Step back with secondary side lift aperture

3.5 Containers with a step of this nature will generally have a lower stacking capability. The container may be marked with a warning decal that indicates that there is a reduced stacking capability.

Figure 5-9 CSC safety approval plate for one door off operation

3.6 Containers with one door off / open will have reduced allowable stacking mass and racking as shown in Figure 5-9.

3.7 The practice of transporting cargo in one door open or one door removed containers is inherently dangerous and therefore is strongly discouraged. The practice is illegal unless it is marked on the CSC plate (see Figure 5-9). Additionally, there may be negative consequences to using this practice in the supply chain (e.g. terminals refusing to handle open door containers).

3.8 Where there is reduced allowable stacking mass, due to design or operation, the total gross mass of containers and swap bodies placed above should not exceed this value.

3.9 Containers which are designed with an allowable stacking mass less than 192,000 kg should be marked in accordance with ISO 6346. This means that the fourth character of the ISO size type code will be a letter.

4 Tank data plates

4.1 All tank containers and swap tanks require essential manufacturing and test data to be recorded on a data plate. This will be generally found on the rear of the tank but may be found attached to the side of one of the rear corner posts.

4.2 The plate shown in Figure 5-10 is a typical tank data plate with the sections identified.

Figure 5-10 Typical tank data plate

Owner's name and address

Manufacturers name, address and manufacturing serial number

Tank design details

Operation details

Pressures

Materials

Connections

Inspecting authority

Hydraulic test data

Timber content

CSC Safety approval plate

Customs plate

4.3 The important sections are the CSC safety approval plate and the hydraulic test data. Every tank should be subjected to a pressure test every 30 months and a full hydraulic test every 5 years and the date of the test marked on the data plate.

5 European rail wagon marks

5.1 Static axle load and linear load

5.1.1 The axle load and axle spacing of the vehicles defines the vertical quasi-static load input to the track.

5.1.2 The load limits for wagons take into account their geometrical characteristics, weights per axle and weights per linear metre.

5.1.3 They should be in accordance with the classification of lines or sections of lines, categories A, B1, B2, C2, C3, C4, D2, D3, D4 as defined in Table 5-2.

Classification	**Mass per axle (P)**						
	A	B	C	D	E	F	G
Mass per unit length (*p*)	16.0 tonne	18.0 tonne	20.0 tonne	22.5 tonne	25.0 tonne	27.5 tonne	30.0 tonne
5.0 tonne / m	A	B1					
6.4 tonne / m		B2	C2	D2			
7.2 tonne / m			C3	D3			
8.0 tonne / m			C4	D4	E4		
8.8 tonne / m					E5		
10.0 tonne / m							

p =	Mass per unit length, i.e. the wagon mass plus the mass of the load, divided by the wagon length in metres, measured over the buffers when uncompressed.
P =	Mass per axle

Table 5-2 Rail wagon classification

5.1.4 Classification according to the maximum mass per axle P is expressed in capital letters (A, B, C, D, E, F, G); classification according to the maximum mass per unit length *p* is expressed in Arabic numerals (1, 2, 3, 4, 5, 6), except for Category A.

5.1.5 Rail vehicle load table

Shown on each side to the left.

The maximum payload is generally not a fixed value for the distinguished wagon, but allocated case by case by means of the intended track category (categories A, B, C, D) and the speed category (S: ≤ 100 km/h; SS: ≥ 120 km/h). These payload figures imply a homogeneous load distribution over the entire loading area (see Figure 5-11).

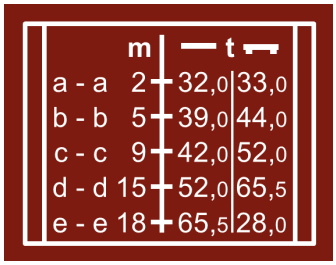
	A	B	C	D
S	68,0	80,0	95,0	107,0
SS	68,0	80,0	92,0	

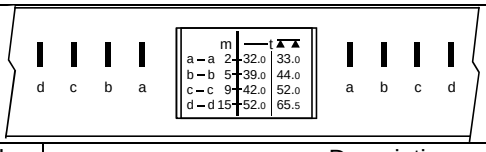
Figure 5-11 Allocation of payload to a rail car

5.1.6 Concentrated loads

5.1.6.1 Shown in the centre of each solebar[25]

5.1.6.2 In case of concentrated loads, a reduction of the payload is required, which depends on the loaded length and the way of bedding the concentrated load. The applicable load figures are marked in each wagon. Also any longitudinal or transverse eccentricity of concentrated loads is limited by the individual axle load capacity or the wheel load capacity (see **Error! Reference source not found.**).





Column	Symbol	Description
1		Signs showing the length of the supporting surfaces of concentrated loads, or the distance between supports
2	m	Distance in metre between the signs showing the length
3	———	Maximum tonnage of concentrated loads

[25] Main side beam of a rail wagon

4		Maximum tonnage of loads resting on two supports

Figure 5-12 Reduction in payload due to concentrated load and bedding distance

Annex 6. Receiving CTUs

1 Introduction

1.1 This annex covers a number of actions and activities and provides safety advice for persons involved in the reception and unpacking of CTUs.

1.2 When receiving a CTU, the unpacker should:

1.2.1 Confirm that the unit is as specified on the transport documentation, checking the CTU identification reference as shown Figure 6-1. If the identification reference shown on the documentation is not the same as that on the CTU, it should not be accepted until clarification is received from the shipper.

Figure 6-1 Three examples of CTU identification references

1.2.2 Inspect the seal, if fitted. Inspecting a seal requires visual check for signs of tampering, comparison of the seal's identification number with the cargo documentation and noting the inspection in the appropriate documentation. If the seal is missing, or shows signs of tampering, or shows a different identification number than the cargo documentation, then a number of actions are necessary:

1.3 The unpacker should bring the discrepancy to the attention of the consignee who in turn should notify the CTU operator or, where different, the carrier and the shipper. The consignee should also note the discrepancy on the cargo documentation and notify Customs or law enforcement agencies, in accordance with national legislation. Where no such notification requirements exist, the consignee should refuse custody of the CTU pending communication with the carrier until such discrepancies can be resolved.

2 Positioning CTUs

2.1 Wheeled operation

2.1.1 Road trailers and containers on chassis can be left at the packer's premises for a period of time without a tractor unit. When this happens, the correct positioning of the CTU is particularly important as a safe shifting of the CTU at a later stage might be difficult. After positioning, brakes should be applied and wheels should be chocked.

2.1.2 Trailers with end door openings and general purpose containers on chassis can be backed up to an enclosed loading bay or can be positioned elsewhere in the premises. For this type of operation a safe access to the CTU by means of suitable ramps is required.

2.1.3 When a semi-trailer or a container on a chassis is to be packed, care should be taken to ensure that the trailer or chassis cannot tip while a lift truck is being used inside the CTU (see Figure 6-2).

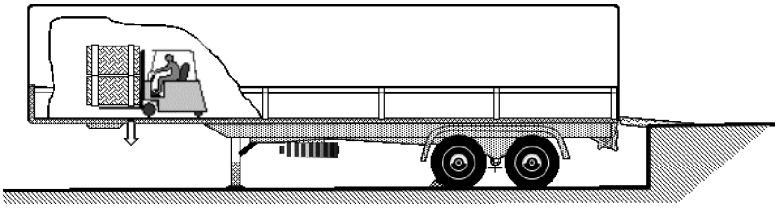


Figure 6-2 Inadequate support of a trailer

2.1.4 If there is a risk for forward tipping the semi-trailer or chassis should be sufficiently supported by fixed or adjustable supports (see Figure 6-3 and Figure 6-4).

Figure 6-3 Fixed support

Figure 6-4 Adjustable support

2.2 Grounded operation

2.2.1 Containers may be unloaded from the delivery vehicle and be placed within secure areas for packing. The area should be level and have a firm ground. Proper lifting equipment is required.

2.2.2 When landing containers it should be ensured that the area is clear of any debris or undulations in the ground that may damage the understructure (cross members or rails) of the container.

2.2.3 As container doors may not operate correctly when the ground is not level, the door end of the container should be examined. When one corner is raised off the ground, when the doors are out of line (see Figure 6-5) or when the anti-racking plate is hard against one of the stops, the container doors should be levelled out by placing shims under one or other corner fitting, as appropriate.

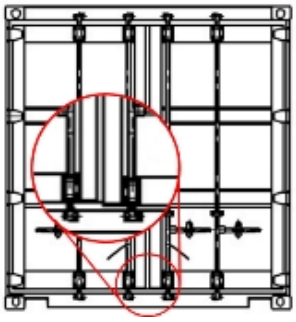


Figure 6-5 Racked container

2.2.4 When a swap body standing on its support legs is to be packed, particular care should be taken to ensure that the swap body does not tip when a lift truck is used for packing. It should be checked that the support legs of the swap body rest firmly on the ground and cannot shift, slump or move when forces are exerted to the swap body during packing (see Figure 6-6).

Figure 6-6 Swap body landed on support legs

3 Access to the CTU

3.1 After the CTU has been positioned for packing, a safe access should be provided. For loading a CTU by means of forklift trucks driven into the CTU, a bridging unit between the working ground or loading ramp and the CTU floor should be used. The bridging unit should have lateral boundaries and be safely connected to the CTU for avoiding dislocation of the bridging unit during driving operations.

3.2 If the CTU floor is at a height level different to that of the loading ramp, a hump may appear between the loading ramp and the bridging unit or between the bridging unit and the CTU floor. Care should be taken that the forklift truck used keeps sufficient ground clearance over this hump. Lining the level differences with suitable timber material under the bridging unit should be considered (see Figure 6-7 and Figure 6-8).

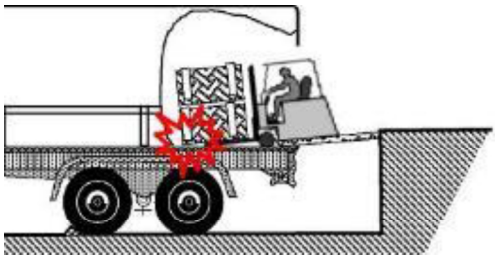


Figure 6-7 Grounding on down slope

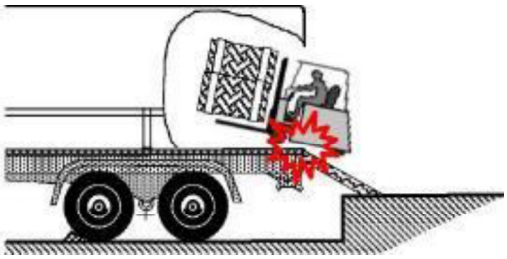


Figure 6-8 Grounding on up slope

3.3 If forklift trucks are employed for packing, any roofs or covers of the CTU should be opened if necessary. Any movable parts of such roofs or covers should be removed or suitably secured in order to avoid interference with the loading procedure.

3.4 Packing of CTUs in poor daylight conditions may require additional lighting. Electric lighting equipment should be used under the strict observance of relevant safety regulations, in order to eliminate the risk of electric shocks or incentive sparks from defective cables or heat accumulation from light bulbs.

4 Preparing to open the doors

4.1 External checks

4.1.1 Once the seal has been removed the CTU doors may be opened, however before doing so, a few more checks should be made.

4.1.1.1 Check the exterior for placards, marks and labels that may indicate that the cargo may put those involved in unpacking the CTU at risk.

Figure 6-9 Flexitank label

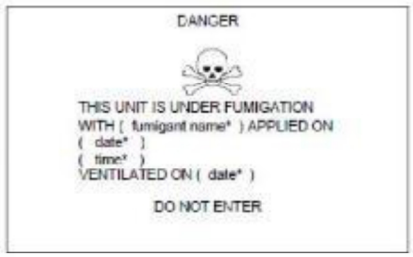


Figure 6-10 Fumigation label

Figure 6-11 Dangerous atmosphere label

4.1.1.2 The labels shown above indicate that opening the doors should follow a particular process. Only the right-hand door on a CTU carrying a flexitank should be opened (see Figure 6-9). CTUs that have been fumigated (see Figure 6-10) or where there is a coolant or conditioner (see Figure 6-11 should be opened and ventilated before entering the CTU.

4.1.2 Removing seals

Where seals have been fitted, they need to be removed safely and their details recorded. See Annex 12.

4.2 Dangerous atmospheres

4.2.1 CTUs carrying dangerous goods also should be opened with care as there is a risk that the carrying packages have been damaged and the goods spilled.

4.2.2 Fumigants are highly toxic. Cargoes most likely to have been fumigated include foodstuffs, leather goods, handicrafts, textiles, timber or cane furniture, luxury vehicles and cargo in timber cases or on timber pallets.

4.2.3 CTUs transported under fumigation are required to be marked and declared in accordance with the applicable dangerous goods regulations. However, absence of marking cannot be taken to mean fumigants are not present. CTUs marked as having been ventilated after fumigation may also contain fumigant that was absorbed by the cargo and released during transit (see Annex 8).

4.2.4 CTUs that are fumigated should be properly labelled. On occasion, the labels may become obliterated or lost during transport. As CTUs may then not be appropriately labelled, the doors and vents should be checked. Tape applied to door gaskets or to the vents may indicate the risk of fumigant presence (see Figure 6-12).

Figure 6-12 Vent tapped over

4.2.5 In addition to the presence of fumigants, toxic gases associated with the cargo's manufacturing process have been found in dangerous levels, for example shoes may have high levels of toluene, benzene and 1,2-dichloroethane

4.2.6 In the short term, vapours irritate the eyes, the skin and respiratory tract. Inhalation of vapours can cause pulmonary oedema. The substance can have an effect on the central nervous system, the kidneys and the liver, causing functional deficiency.

4.2.7 If there are concerns that there are labels or other indications of a dangerous atmosphere, a safety data sheet (SDS) should be requested from the consignor or from the shipper, as appropriate and sampling the air inside the CTU before opening could be considered.

4.3 Measuring gases

4.3.1 A number of surveys have revealed undeclared gases carried in CTUs. Many of the gases are dangerous and would constitute a severe risk to those involved in unpacking.

4.3.2 The person who controls the opening and entry of CTUs should always check the chemical properties and the threshold limit value (TLV) of the relevant chemical, referring to their own national standards and guidelines where they exist.

4.3.3 Unfortunately, one cannot rely on one's sense of smell as most of these gases will be well above their TLV by the time they can be detected. The only practical way is to take air samples. In the open this is very difficult. Initially, a device that identifies the gas is required before the concentration of the gas can be measured.

4.3.4 The simplest and easiest way to measure the internal atmosphere is to use a readily available detector tube device. Do not open the CTU but gas can be sampled by forcing a solid tube in through the door gaskets (see Figure 6-13).

Figure 6-13 Sampling gas

4.3.5 There is no device available that can detect all hazardous gases; therefore one measurement will not provide sufficient information about the internal atmosphere and multiple tests will be required.

4.3.6 The risk of hazardous gases in CTUs is relevant to all parties in the supply chain. The causes of these gases can be attributed to internal business processes in manufacturing or by actions performed on behalf of third parties (service providers and logistics companies).

4.3.7 Action plans for testing and reacting to hazardous gases in CTUs may be drawn up by companies to protect their employees from the effects of these gases when opening and unpacking them. The companies producing the actions plans may not be the ultimate consignees of the goods, but may be authorized to open the CTU earlier in the supply chain or responsible for unpacking. An example of a possible action plan for checking for hazardous gases is shown in Supplement 5

4.3.8 It should be remembered that hazardous gases may be introduced into the CTU by:

- Deliberately adding gases to prevent deterioration of the goods by pests;
- Emissions of substances used in the manufacture of products or dunnage;
- Chemical or other processes in the cargo.

4.3.9 In addition, incidents may occur that permit the release of gases from declared or undeclared dangerous goods being carried.

5 Opening the doors

5.1 Unstable or poorly packed cargoes may be pressing against the doors which may be forced open when the door gear is released, or the cargo may fall out once the doors are opened.

5.2 The first action for steel doors is to "ring" them which is to tap the flat surface of both doors. If the sound is dull and there is no resonance then it is likely that the cargo will be resting against the door. Extra care should be taken when opening the door.

5.3 If there is a risk that the cargo is resting against the doors or the CTU contains bulk materials, a safety chain can be fitted across the doors, from top to bottom corner fitting (see Figure 6-14). This technique can be also used on CTUs without corner fittings by applying a chain from an anchor point on each side or using a shorter chain attached to the locking bars. The length of the chain should be long enough to permit the doors to open but short enough so that the doors cannot open more than 150 mm (6 in).

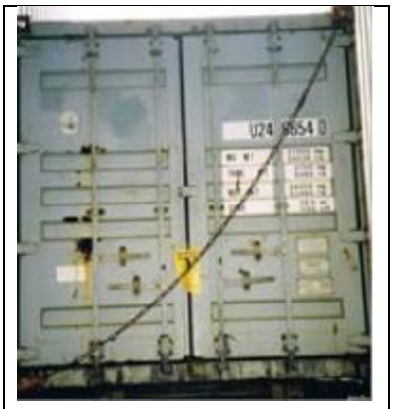


Figure 6-14 Safety Chain

5.4 If a diagonal chain cannot be fitted, then a loose strap across the inner lock rods may be used. If there is no facility for attaching the strap, or strap available the person opening the doors should always open the doors with caution.

5.5 Handles for CTUs vary, some will have one locking bar, others two and the handle design may be a bar or a formed handle, as shown in Figure 6-15 to Figure 6-17.

Figure 6-15 Container doors

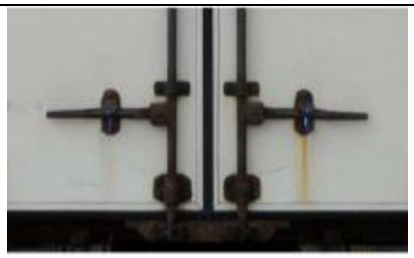


Figure 6-16 Trailer doors

Figure 6-17 Trailer doors

5.6 They may be in the format where the handle is on the same side of the locking rod (see Figure 6-18) or between the rods (see Figure 6-19).

Figure 6-18 Handles on same side

Figure 6-19 Handles between bars

5.7 Most CTU doors open easily by rotating the handles approximately 90° and then pulling on the handles of locking bars. The action of rotating the bars will mean that the cams push against their

keepers and force the door open.

5.8 Figure 6-20 shows the operation of the cams on many containers. Rotating the lock rod (A) will cause the breaker surface of the cam to press against the keeper (B), thus forcing the door open (C).

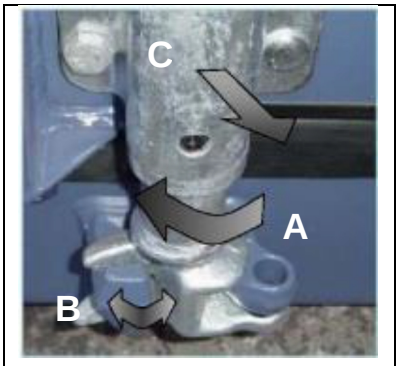


Figure 6-20 Door cam operation

5.9 Once the lock rods have been fully rotated, adopt an upright stance and grasp the lock rods or the door at about shoulder height or just below and pull backwards using the whole body.

5.10 If the doors do not open easily:

- Check that the cams are clear of the keepers;
- Check that the CTU is level and the doors are not binding on the frame;
- Gain assistance to pull the doors open.

5.11 If one door will not open, and the other door may be opened (i.e. the CTU is not carrying a dry bulk tank), then both doors could be opened at the same time which may make opening the doors easier.

5.12 As the door opens be prepared to step back quickly if:

- The contents of the CTU start to fall out; or
- The door appears to be pushing you, not you pulling the door.

5.13 If you need to step out of the way move away from the hinged side of the door.

5.14 Doors in the various types of CTU may open with different degrees of difficulty. The following contribute to this difficulty:

- Corrosion to the door component and hinge pins;
- Damage to the door component, including door gear, or corner post resulting in the misalignment of the hinges;
- Condition of the gaskets, which may not seat properly on the door;
- Racking of the CTU. Many CTUs rely on the doors to hold the rear end of the CTU square. If the CTU is placed on uneven ground the CTU may rack and the doors become misaligned (see Figure 6-21).

5.15 Once the doors are free to swing and there is no risk on injury caused by the cargo falling out, walk the doors through 270° and attach the retaining strap to the hook to prevent the door from swinging (see Figure 6-22).

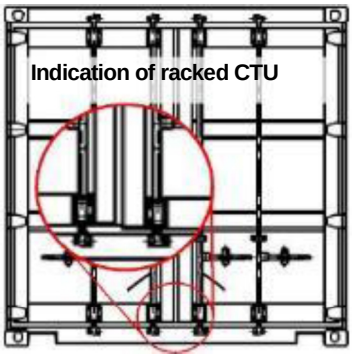


Figure 6-21 Racked CTU


Figure 6-22 Door retaining strap

5.16 DO NOT ENTER THE CTU YET

6 Ventilation

6.1 Introduction

6.1.1 Closed CTUs are enclosed spaces and care should be taken before entering. Even without toxic gases and other asphyxiates oxygen supply may be depleted which could make normal breathing difficult. Ventilating a CTU will allow fresh air to circulate into the CTU and around any cargo carried and remove any harmful or toxic gases or fumes. The most effective method is to use forced ventilation.

6.1.2 It is a risky activity and it is important that CTUs are ventilated responsibly. The person who opens and closes the doors should be aware of the possible risks involved and, if required, wear personal protective equipment (PPE). The selection of the appropriate PPE will depend on measurements taken to determine the concentration and toxicity of the gases within the CTU and may require a combination of breathing apparatus and skin protection.

6.2 Planning

6.2.1 When ventilating CTUs a number of factors will determine the action required:

6.2.1.1 The concentration of the gas. The greater the concentration the longer the CTU will require for ventilation.

6.2.1.2 The nature of the gas. Some gases are very light and volatile and will evaporate quickly. Others are less volatile and/or adhere to the cargo, such as methyl bromide and 1,2-dichloroethane. The time for ventilation will need to be decided upon accordingly. It may not be possible to completely remove traces of gases that adhere to the cargo and the CTU may only be declared clean and safe to enter after the cargo has been removed and the CTU washed.

6.2.1.3 Ambient temperature. Higher temperatures will generally permit faster evaporation thus reducing the time to declare the CTU safe to enter. At lower temperatures, some fumigants stop working and remain inert until the temperature again rises. This can mean that the correct volume of a fumigant for the journey initially applied in a hot packing location which then passes into a colder area may arrive at the destination with high levels of fumigant still remaining in the CTU.

6.2.1.4 The size of the CTU. A 12 m CTU has approximately twice the internal volume of a 6 m unit, and if the doors are only at one end, the circulation of gas has to travel considerably further.

6.2.1.5 The packing method. A CTU that has been tightly packed and is especially full will be more difficult to ventilate than one with many gaps and “open air” around the packages.

6.2.1.6 The nature of the cargo. Cargo that absorbs gases, such as mattresses and clothes, requires more time for ventilation than hard surfaced products. Absorbent materials hermetically sealed within a plastic or similar cover will not require the same time to ventilate as an uncovered item.

6.2.1.7 Packing material used. Absorbent packing materials will require extra time for any gases to leach out. Such materials may require special disposal to meet local environmental regulations.

6.2.1.8 The time which elapsed after the CTU has been closed.

6.3 Ventilation of CTUs can happen in two ways, natural or forced ventilation.

6.3.1 Natural ventilation

6.3.1.1 This can be done by simply opening the doors.

6.3.1.2 In some countries local regulations require an environmental permit for opening CTUs with high concentrations of dangerous gases. Once the application is received the Competent Authority determines under what conditions the company may ventilate on site. The granting of an environmental permit may take up to 6 months.

6.3.1.3 Estimate the necessary ventilation time in advance. CO, CO_2 or O_2 degas quickly. At encountering these substances start with a minimum of 2 hours ventilation. For other substances this will be insufficient and it is suggested that the CTU is ventilated for at least 24 hours. Record start and end time.

6.3.2 Forced ventilation

6.3.2.1 To carry out forced ventilation or degassing there are several possibilities. A few examples:

- Powerful fans, one or more fans directing air into and/or out of the CTU will stimulate the circulation of gases within the CTU.
- A “degassing door” (Ventilation & Gas Recapture System). This door will completely seal off the CTU and is fitted with two sealable openings. When for example air is blown through the top opening and is extracted at the bottom the unwanted gas disappears with the air from the CTU. At the end of the hose where the air from the CTU comes out, a suitable filter can be placed so the gases don’t end up in the environment.

6.3.3 The advantage of forced ventilation is that it reduces the time necessary to remove high concentration of residual gas, partly because the climatic conditions can be optimized.

6.4 General safety

6.4.1 Do not enter the CTU during ventilation.

6.4.2 Make sure that during ventilation warning signs or otherwise clearly indicate that the CTU should not be approached or entered. For methyl bromide, phosphine and sulfuryl fluoride, for example, a minimum distance of 20 m all around the CTU should be set.

6.4.3 Toxic gas concentrations in the cargo space and the cargo itself should be measured and once they fall below the limit(s) the CTU may be released for entry. Carry out additional measurements if the doors are closed without the cargo being unpacked and the interior cleaned for a period of 12 or more hours.

6.4.4 The climatic conditions should also be monitored and action taken if:

- The outside temperature falls below 10°C. It is unlikely that ventilation will occur as gases will not evaporate at this temperature;
- There is no wind. Gases expelled from the CTU will not be diluted into the atmosphere and may linger at the CTU’s doors.

6.4.5 A specialist gas removal contractor should be used if:

- The concentration exceeds 6 times the limit;
- If phosphine is detected. When opening a CTU or when unpacking or transferring cargo, highly toxic gas may be released as a result of residues of tablets not yet exhausted. In this case, the limit of the substance concerned may be exceeded.

6.4.6 Specialist gas removal contractors may move the CTU off site into closed and regulated area. The premises are inaccessible to unauthorized persons and the company guarantees that the cargo is monitored.

6.4.7 If in doubt, or for questions always contact a local company who specializes in the ventilation and degassing of CTUs.

6.5 Environment

6.5.1 Remember that toxic gases within the CTU will dissipate into the atmosphere. It should be remembered that the higher the gas concentration the greater the harm to the environment.

6.5.2 Consider the waste (residue) as hazardous waste. In practice this means that the waste should be offered to a certified collector to be processed or destroyed.

6.6 Ventilation first, then measure. This means that if the quantity and concentration of a toxic gas is known, then the CTU may be ventilated in accordance with the calculated time without the need for measuring the atmosphere until the ventilation time has expired. As always, a test should be carried out before entering the CTU.

7 Returning the CTU

7.1 General

7.1.1 The internal and external cleanliness, including the absence of pest contamination, of CTUs

is very important if unnecessary restrictions to their use and movement are to be avoided.

7.1.2 Unless otherwise agreed, the consignee is responsible for ensuring that the CTU is returned to the CTU operator completely empty and clean.

This means that the CTU should be:

- Completely empty and clean. A clean CTU should be free of all cargo residues, pest contamination, packing, lashing and securing materials, labels, marks and placards associated with packing the CTU or the cargo, and any other debris removed. This includes fumigant materials or other noxious substances (see definitions in Chapter 2 of this Code). Personal protective equipment should be provided for such work;
- Returned in a timely manner as agreed with the CTU operator. CTUs in the supply chain and associated road vehicles, if separate, are often scheduled for immediate reuse or positioning. CTU operators may charge demurrage if the CTU is not returned as soon as practically possible after unpacking.

7.2 Cleanliness

7.2.1 If additional cleaning beyond a thorough sweep of the CTU is required the unpacker and/or consignees should consider the following techniques:

- Washing – wash the interior of the CTU using a low pressure hose and a scrubbing brush (if required). To remove contamination a suitable additive or detergent can be used;
- Power washing – internal faces using a medium pressure washing device;
- Scraping – areas of contamination can be removed by light scrapping. Care should be taken not to damage the paint work, or flooring.

7.2.2 After a CTU with dangerous cargoes, including fumigated cargoes, has been unpacked, particular care should be taken to ensure that no hazard remains. This may require special cleaning, particularly if spillage of a toxic substance has occurred or is suspected. When the CTU offers no further hazard, labels, marks and placards regarding the cargoes should be removed. A CTU that retains any label, mark or placard related to a dangerous goods should continue to be handled as though it still carried the indicated dangerous goods.

7.2.3 Contamination of the CTU can be found in many different guises including:

- Damage to the interior paint work where the surface finish becomes cracked, flaky or softened by contact with a substance;
- Stains and wet patches to any part of the CTU, especially the flooring, which can be transferred to a cloth by light wiping. Small dry stains that do not transfer to the cloth are considered as non-transferrable and may not be considered as contamination;

7.2.4 Examples of pest contamination are provided in Annex 11.

7.2.5 Dunnage, blocks, bags, braces, lashing materials, nails into the floor and tape used to cover vents and gaskets should all be removed.

7.3 Disposal

7.3.1 Local environmental regulations and legislation should be considered when disposing of waste removed from the CTU.

7.3.2 Cargo residues should be removed and disposed of in line with the unpackers' and/or consignee's procedures and any applicable local or national requirements.

7.3.3 Wherever possible or practicable, dunnage bags and other materials should be recycled[26].

7.3.4 Timber dunnage, blocks and braces should be checked for the appropriate IPPC mark (see Annex 10.1.14). Other timber should be disposed of by incineration.

7.3.5 Liner bags and flexitanks are often removed by the supplier; however all will be contaminated and should be disposed of at an appropriate facility.

7.3.6 Pest contamination should be disposed of as described in Annex 11.

[26] Do not reuse inflatable dunnage bags if they cannot be safely reinflated

7.4 Damages

7.4.1 The various types of CTU suffer differing degrees of damage en route. Rail wagons probably do not suffer much handling damage and are only likely to be damaged by poorly secured cargoes. Road vehicles, especially articulated trailers, do suffer from turning and reversing damage as the vehicle is manoeuvred. Containers and swap bodies will suffer from the same manoeuvring damage, but may also suffer from impact damage between other containers and swap bodies and handling equipment.

7.4.2 Drivers of road vehicles will generally report any manoeuvring damage but if the trailer or container has been collected from a terminal, will only be able to report on damages incurred in the delivery phase. Damages incurred earlier in the supply chain may go unreported unless marked on an interchange document.

7.4.3 The consignee will generally be held responsible for any damage incurred, other than those that have been verifiably observed and endorsed by the CTU operator. For unaccompanied CTUs this endorsement should be shown on the interchange document. It is therefore important that any signs of damage, including recent damage, should be identified and reported on arrival.

Annex 7. Access to tank and bulk tops, working at height

1 General

1.1 Clause 5.5.3 of this Code identifies the principal safety and health aspects of working at height, while this annex provides more technical information on accessing the tops of bulk and tank CTU and practices that should be adopted when undertaking any tack while on the CTU top.

1.2 Access to the top pf CTUs is often required in preparation for packing/filling cargoes into specialist bulk CTUs. A safe means of access, such as steps, a portable ladder, a mobile elevating work platform or an access cage, should be provided whenever access is required.

1.3 Workers who have to work on top of containers should be prevented from falling off them. Whenever possible, the work should be carried out from a mobile elevating work platform or an access cage. If this equipment is not available, fall arrest equipment should be worn.

1.4 A risk assessment should be carried out before accessing tank and bulk CTU tops and unsafe practices, such as climbing up the door fittings of a container, should be prohibited.

1.5 Incident preparedness

As is the case for all activities where there is a risk of injury, there should be procedures in place to mitigate the immediate and future effects of the incident such first aid for falls and near miss and incident reporting.

2 CTU ladders

2.1 CTUs used for bulk transport will often require access to their tops, in order to gain access to the interiors, to open and close the loading hatches or to sample the cargo. These units usually have some built-in means of access, e.g. ladders or toe-holds, but these are generally for emergency purposes rather than regular use. As such, they may be restrictive with irregularly spaced steps and/or large gaps between ladder rungs.

2.2 Tank containers, swap tanks and road tankers will usually have ladders built into their rear frames, some of which may be readily apparent as ladders (see Figure 7-3), while others appear to be climbing frames (see Figure 7-1 and Figure 7-2).

Figure 7-1 Full frame ladder

Figure 7-2 Partial frame ladder

Figure 7-3 Road tanker

2.3 Ideally, inbuilt ladders should be constructed with two styles and should have steps that are at least 300 mm wide with high friction surface and the steps uniformly spaced about 300 mm apart. The pictures above show good and less satisfactory versions.

2.4 The designs of tank containers, swap tanks and road tankers generally facilitate placement of feet while accessing their tops. Access to the tops of bulk CTUs is generally far less satisfactory, often only provided by a number of shaped bars attached to the doors (see Figure 7-4). The example shows five shaped bars, the bottom and top steps quite narrow and the spacing varies from 480 mm to 640 mm. Operators attempting to climb onto and from the roof may find these steps difficult.

Figure 7-4 Bulk container rungs

2.5 Where routine access to the top of a CTU is necessary, the CTU will bear a warning decal adjacent to the means of access. The decal provides warning of overhead hazards in general and power cables in particular (see Figure 7-5). Operators, when deciding whether to access the top of the CTU, should make themselves aware of all potential hazards directly overhead and immediately adjacent to the CTU. This warning is particularly important for operations in rail transfer depots but may affect other handling operations.

Figure 7-5 Overhead warning label

2.6 As the process of climbing onto the top of a CTU entails risks of slipping and falling, a built-in ladder should only be used for emergency access. Operational access to tank container tops should be made using suitable mobile steps or from a gantry.

2.7 When a tank or dry bulk CTU is loaded onto a chassis, the bottom of the ladder can be as much as 1,600 mm, and the top of the CTU as much as 4.3 m off the ground. Furthermore, on some designs of chassis, the CTU will be slightly inclined with the front end elevated which would mean that the ladder would be inclined backwards towards to the operator.

2.8 The steps/rungs are generally manufactured from steel or aluminium and can be slippery in the cold and wet. Operators can easily miss their step when climbing these ladders.

2.9 When transitioning from the ladder to the walkway on the CTU top, there are limited hand holds available for the operator to grip (see Figure 7-6) making the manoeuvre hazardous. An operator climbing onto the top of the tank container shown in Figure 7-7 will be presented with either the walkway securing bracket or the miss-stacking plate, neither of which are ideal handholds. Climbing off the top of the CTU can be more hazardous as the operator is attempting to locate rungs/steps which are not visible and in an awkward position.

Figure 7-6 Freight container handhold

Figure 7-7 Transitioning

3 Access and safety equipment

3.1 Where regular access to the top of CTUs is required, alternative access solutions should be considered. Some operators have provided more substantial access ladders attached to trailers as shown in Figure 7-8. This type of ladder satisfies the step dimension recommendation and can be adjusted so that the lowest step is just off the ground. However, there are no guard rails on the ladder or on the work platform so the operator may still be at risk of a fall. As an alternative, mobile steps similar to those shown in Figure 7-9 can be used which can be positioned beside the CTU and from which the operator can safely step.

Figure 7-8 Trailer mounted access ladder

Figure 7-9 Mobile access ladder

3.2 At facilities where regular access is required the CTU should be positioned next to a fixed access gantry (see Figure 7-10). Once the CTU is positioned next to the gantry the operator can lower the counterbalanced handrail/barrier to provide additional safety while working on the CTU top.

Figure 7-10 Access gantry

3.3 If the CTU is mounted on a chassis, the operator should not attempt to access the top of the CTU unless the tractor unit has been disconnected or immobilized to prevent accidental movement of the CTU.

3.4 A fall arrest system may be the best item of personnel safety equipment that can be employed. Operators should wear an approved harness and attach themselves to the overhead cables. In Figure 7-11 a number of "T" shaped stanchions are positioned about the area where an operator will work on the top of the container. The connecting overhead cables have counterbalanced arrest drums supported from them to which the operator will attach a harness.

Figure 7-11 Fall arrest stanchions

3.5 The top of the CTU should not be overcrowded. The walkways are limited in size and strength. Furthermore, with too many people on the top of the CTU moving about can be hazardous.

Annex 8. Fumigation

1 General

1.1 Fumigation is utilized for control of pests in buildings (structural fumigation), soil, grain, and produce, and is also used during processing of goods to be imported or exported to prevent transfer of exotic organisms. This method also affects the structure itself, affecting pests that inhabit the physical structure, such as woodborers and drywood termites.

1.2 Timber products used for dunnage can be treated by fumigation under the requirements of the International Standards for Phytosanitary Measures, No. 15 (ISPM 15)[27]. Some shippers believe, incorrectly, that they can achieve this by throwing in a fumigation bomb just before the CTU doors are closed. This, however, is not permitted under ISPM 15 and does not achieve the required level of treatment.

1.3 Cargoes such as foodstuffs, leather goods, handicrafts, textiles, timber or cane furniture, luxury vehicles and cargo in timber cases or on timber pallets may be subject to fumigation.

1.4 Fumigated CTUs containing no other dangerous goods are subject to a number of provisions of dangerous goods regulations, such as those included in this annex[28].

1.5 When the fumigated CTU is packed with dangerous goods in addition to fumigant, any provision of the dangerous goods regulations (including placarding, marking and documentation) applies in addition to the provisions of this annex.

1.6 Only CTUs that can be closed in such a way that the escape of gas is reduced to a minimum should be used for the transport of cargo under fumigation.

2 Training

Persons engaged in the handling of fumigated CTUs should be trained commensurate with their responsibilities.

3 Marking and placarding

3.1 A fumigated CTU should be marked with a warning mark (see Figure 8-1) affixed at each access point in a location where it will be easily seen by persons opening or entering the CTU. This mark should remain on the CTU until the following provisions have been met:

- The fumigated CTU has been ventilated to remove harmful concentrations of fumigant gas; and
- The fumigated goods or materials have been unpacked.

3.2 The fumigation warning mark should comply with the relevant dangerous goods regulations. Below is the fumigation warning mark as shown in the 18th revised edition of the United Nations Recommendations on the Transport of Dangerous Goods, Model Regulations.

[27] Secretariat of the International Plant Protection Convention, Food and Agriculture Organization of the United Nations: Regulation of wood packaging material in international trade.

[28] See also the latest edition of the UN Recommendations on the Transport of Dangerous Goods, Model Regulations at www.unece.org/trans/danger/publi/unrec/rev13/13nature_e.html, or modal transport regulations such as the IMDG Code

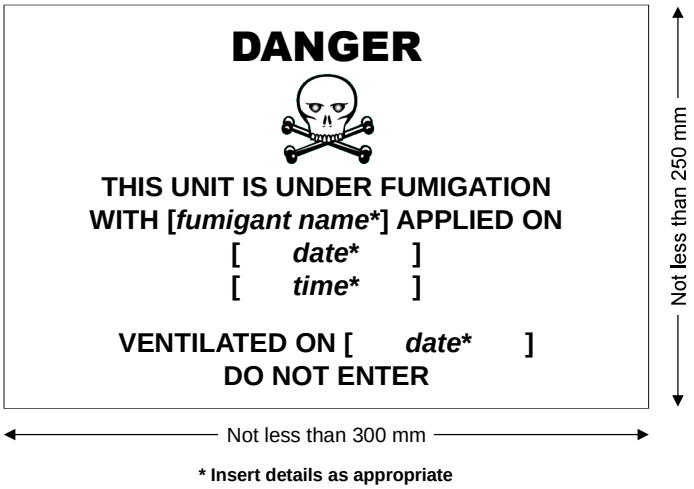


Figure 8-1 Fumigation warning mark

4 Ventilation (see Annex 6.6)

4.1 After the fumigant has performed its function, it can be ventilated before it is transported if required. When the fumigated CTU has been completely ventilated either by opening the doors of the CTU or by mechanical ventilation after fumigation, the date of ventilation should be marked on the fumigation warning mark.

4.2 Care should be taken even after a CTU has been declared as ventilated. Gas can be held in packages of cargo, then desorbed over a long period of time, even over many days, raising the level of gas inside the cargo transport unit to above the safe exposure level. Bagged cereals and cartons with large air spaces are likely to produce this effect. Alternatively, gas and the fumigant sachets or tablets can become 'trapped' at the far end of a CTU by tightly packed cargo.

4.3 In reality any CTU that has carried dangerous or fumigated goods should not be considered as safe until it has been properly cleaned and all cargo residues, gaseous and solid, have been removed. The consignee for such goods should have the facilities to carry out this cleaning process safely.

4.4 When the fumigated CTU has been ventilated and unpacked, the fumigation warning mark should be removed.

Annex 9. Manual Handling

1 Introduction

1.1 Manual handling relates to the moving of items either by lifting, lowering, carrying, pushing or pulling. But it's not just a case of 'pulling something' due to the weight of the item, although this can be a cause of injury. Injuries can be caused because of the amount of times a packer has to pick up or carry an item, the distance the packer carries it, the height the packer has to pick it up from or putting it down at (picking it up from the floor, putting it on a shelf above shoulder level) and any twisting, bending stretching or other awkward posture you may get in whilst doing a task.

1.2 Manual handling is one of the most common causes of injury at work and causes over a third of all workplace injuries which include work related Musculoskeletal Disorders such as upper and lower limb pain/disorders, joint and repetitive strain injuries of various.

1.3 Manual handling injuries can occur almost anywhere in the workplace and heavy manual labour, awkward postures and previous or existing injury can increase the risk. Work related manual handling injuries can have serious implications for both the employer and the person who has been injured. Employers may have to bear substantial costs, through lost production, sickness absence costs of retraining, wages/overtime to cover for the absent person and potentially compensation payments. The injured person may find that their ability to do their job is affected and there may be an impact on their lifestyle, leisure activities, ability to sleep and future job prospects.

1.4 It is essential that the risk to packers is properly managed. If possible all manual handling should be eliminated, however this is not always possible and where such handling is necessary, the risk of injury to the packer reduced by using mechanical handling devices (MHD).

2 Reduce the risk of injury

2.1 Measures to control risk will vary depending on the task. Reduce the risk of injury from hazardous manual handling operations you can't avoid. Where possible, provide mechanical help, for example a sack trolley or hoist. Where this is not reasonably practicable, explore changes to the task, the load and the working environment.

2.2 If manual lifting is the only option then there are things you can do to reduce the risk, including:

- make the load smaller or lighter and easier to grasp;
- break up large consignments into smaller loads;
- modify the workplace to reduce carrying distances, twisting movements, or the need to lift things from floor level or above shoulder height;
- change the work routine to avoid excessive work rates and tight deadlines;
- improve the environment – more space, better flooring, extra lighting or changing the air temperature can make manual handling easier and safer;
- make sure the person doing the lifting has been trained to lift as safely as possible.

2.3 Avoid hazardous manual handling

2.3.1 Eliminate handling the load

Wherever possible Packers should try to eliminate hazardous manual handling by not moving loads, for example, by looking at whether the work could be done in a different way. When manual handling is required, practices shown in Supplement 6 should be followed.

2.3.2 Lifting and lowering guidelines

2.3.2.1 When lifting or lowering forms part of the manual handling practices, understanding the capabilities of workers undertaking the operation should be identified. Manual handling regulations may not set specific limits to the weight of packages handled, so the values set out in Figure 9-1 are not safe limits. They use broad assumptions or generalisations where, if met, the risk of injury is considered to be low. But working outside the limits is likely to increase the risk of injury, which can lead to ill health. The guidelines are

derived from lifting capacity data which show differences between men and women in the population (rather than individuals).

2.3.2.2 Figure 9-1 assumes that the load is easily grasped with both hands and is handled in reasonable working conditions, with the worker in a stable body position.

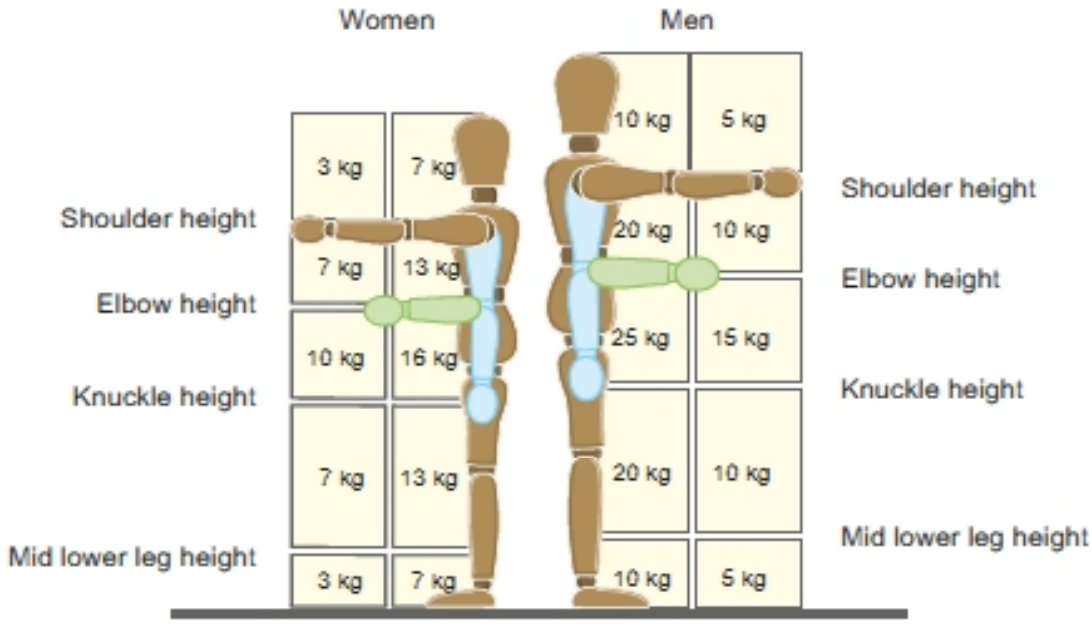


Figure 9-1 Lifting and lowering risk

2.3.2.3 Each box in Figure 9-1 contains a value for lifting and lowering in that zone. The values in the boxes are reduced if handling is done with arms extended, or at high or low levels, as that is where injuries are most likely to happen.

2.3.2.4 The work activity involving lifting and lowering should be observed and compared to Figure 9-1:

- The zone or zones the worker's hands pass through when moving the load should be identified. The smallest and the maximum mass being handled should be assessed. If it is less than the value given in the matching box, it is within the guidelines.
- If the worker's hands enter more than one zone during the operation, the smallest mass should be used or an in-between mass when hands are close to a boundary between zones.

2.3.3 Automation or mechanisation

2.3.3.1 If handling the load cannot be avoided, consider whether the operations can be automated or mechanised to eliminate the manual part of the handling (see Supplement 7).

2.3.3.2 It should be ensured that new risks are avoided when automation or mechanisation is introduced (for example, when maintaining equipment or when things break down).

2.3.3.3 It should be ensured that workers are trained to use any introduced equipment, such as lift trucks.

3 Packaging information for manual handling

3.1 Consideration should be given to taking appropriate steps to provide general indications and, where it is reasonably practicable to do so, precise information on the mass of each package, and the heaviest side of any package whose centre of gravity is not positioned centrally.

3.1.1 Consignors should label a load if there is a risk of injury and it is reasonably practicable to do so.

3.1.2 Consignors do not have to provide this information if the effort involved in doing so would be much greater than any health and safety benefits that might result.

3.2 It is much better to reduce risky manual handling operations by providing lifting aids, splitting loads and telling people not to carry several items at once.

3.3 What information should be included

3.3.1 If it is reasonably practicable to give precise information the consignor should do so

3.3.2 Giving information that will help to prevent injury does not necessary require consignors to quote masses to anything more than the nearest kilogram or two.

3.3.3 More detailed information would not help packers avoid risks. This also applies to indications of the heaviest side, unless the load is sufficiently out of balance to take handlers by surprise.

3.3.4 The purpose of providing information about mass is to quickly and reliably warn handlers when a load is heavy. This information should, therefore, be easy to understand and placed where it can best be seen.

4 Manual handling training

4.1 Providing information and training alone will not ensure safe manual handling. The first objective should always be to design the handling operations to be as safe as reasonably practicable. Manual handling training is important to further manage the risk of injury if the task cannot be avoided and you have already taken action to reduce the risk. However, on its own, it can't overcome:

- a lack of mechanical aids;
- badly designed tasks;
- unsuitable loads;
- an unsuitable working environment.

4.2 The information covered by manual handling training should be specific to the job and should include:

- manual handling risk factors and how injuries can happen;
- appropriate systems of work for the individual's tasks and environment;
- use of mechanical aids;
- how to carry out safe manual handling, including good handling techniques;
- practical work relevant to the job to allow the trainer to identify and put right anything the trainee is not doing safely;
- how to report symptoms and injuries.

Annex 10. Packing and securing cargo into CTUs

1 Planning of packing

1.1 When applicable, planning of packing should be conducted as early as possible and before packing actually commences. Foremost, the fitness of the envisaged CTU should be verified (see Chapter 8). Deficiencies should be rectified before packing starts.

1.2 Planning should aim at producing either a tight stow, where all cargo packages are placed tightly within the boundaries of the side and front walls of the CTU, or a secured stow, where packages do not fill the entire space and will therefore be secured within the boundaries of the CTU by blocking and/or lashing.

1.3 The compatibility of all items of cargo and the nature, i.e. type and strength, of any packages or packaging involved should be taken into account. The possibility of cross-contamination by odour or dust, as well as physical or chemical compatibility, should be considered. Incompatible cargoes should be segregated.

1.4 In order to avoid cargo damage from moisture in closed CTUs during long voyages, care should be taken that other wet cargoes, moisture inherent cargoes or cargoes liable to leak are not packed together with cargoes susceptible to damage by moisture. Wet timber planks and bracings, pallets or packagings should not be used. In certain cases, damage to equipment and cargo by condensed water dripping from above may be prevented by the use of protective material such as polythene sheeting. However, such sheeting or wrapping may promote mildew and other water damage, if the overall moisture content within the CTU is too high. If drying agents are to be used, the necessary absorption capacity should be calculated. More information may be found in Annex 3.

1.5 Any special instructions on packages, or otherwise available, should be followed, e.g.:

- Cargoes marked "this way up" should be packed accordingly;
- Maximum stacking height marked should not be exceeded.

Note: See Appendix 10.1 to this annex for further details on packaging marks.

1.6 Where packing results in stacks of packages, the strength of the individual packages should be capable of supporting those placed above them. Care should be taken that the stacking strength of packages is appropriate for the stack design.

1.7 Consideration should be given to potential problems, which may be created for those persons who unpack the CTU at its destination. The possibility of cargo falling out when the CTU is opened should definitely be avoided.

1.8 The mass of the planned cargo should not exceed the maximum payload of the CTU. In the case of containers, this ensures that the permitted maximum gross mass of the container, marked on the CSC safety approval plate, will not be exceeded. For CTUs not marked with their maximum permissible gross mass or payload, these values should be identified before packing starts.

1.9 Notwithstanding the foregoing, any limitation of height or mass along the projected route that may be dictated by regulations or other circumstances, such as lifting, handling equipment, clearances and surface conditions, should be complied with. Such mass limits may be considerably lower than the permitted gross mass referred to above.

1.10 When a heavy package with a small "footprint" will be shipped in a CTU, the concentrated load should be transferred to the structural transverse and longitudinal bottom girders of the CTU (see clause 3.1 of this annex for details).

1.11 In longitudinal direction the centre of gravity of the packed cargo should be within allowed limits. In transverse direction the centre of gravity should be close to the half width of the CTU. In vertical direction the centre of gravity should be below half the height of the cargo space of the unit. If these conditions cannot be met, suitable measures should be taken to ensure the safe handling and transporting of the CTU, e.g. by external marking of the centre of gravity and/or by instructing forwarders/carriers. In case of CTUs, which will be lifted by cranes or container bridges, the longitudinal centre of gravity should be close to a position at half the length of the CTU (see Appendix

10.4).

1.12 If the planned cargo of an open-topped or open-sided CTU will project beyond the overall dimensions of the unit, suitable arrangements should be made with the carriers or forwarders for accommodating compliance with road or rail traffic regulations or advising on special stowage locations on a ship.

1.13 When deciding on packaging and cargo-securing material, it should be borne in mind that some countries enforce a garbage and litter avoidance policy. This may limit the use of certain materials and imply fees for the recovery of packaging at the reception point. In such cases, reusable packaging and securing material should be used. Increasingly, countries require timber dunnage, bracings and packaging materials to be free of bark.

1.14 If a CTU is destined for a country with wood treatment quarantine regulations, care should be taken that all wood in the unit, packaging and cargo complies with the International Standards for Phytosanitary Measures, No. 15 (ISPM 15)[29].This standard covers packaging material made of natural wood such as pallets, dunnage, crating, packing blocks, drums, cases, load boards and skids. Approved measures of wood treatment are specified in Annex I of ISPM 15. Wood packaging material subjected to these approved measures should display the following specified mark:

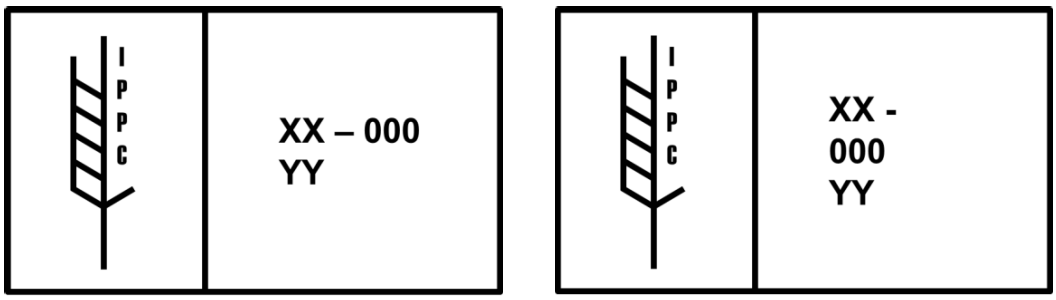


Figure 10-1 Phytosanitary mark

The marks indicating that wood packaging and dunnage material has been subjected to approved phytosanitary treatment in accordance with the symbols shown in Figure 10-1 will have the following components:

1.14.1 Country code

The country code should be the International Organization for Standardization (ISO) two letter code (shown in the figure as “XX”).

1.14.2 Producer/treatment provider code

The producer/treatment provider code is a unique code assigned by the national plant protection organization to the producer of the wood packaging material, who is responsible for ensuring that appropriate wood is used (shown in the figure as “000”).

1.14.3 Treatment code

The treatment code (shown as “YY” in the figure) shows the abbreviation for the approved measure used (HT for heat treatment, MB for fumigation with methyl bromide). In Europe the letters “DB” can be added where debarking has been done.

Note: Treatment should be carried out before the packaging and dunnage material is packed into the CTU. In situ treatment is not permitted.

1.15 Damaged packages should not be packed into a CTU, unless precautions have been taken against harm from spillage or leakage (see also Chapter 11 of this Code on dangerous goods). The overall capability to resist handling and transport stresses should be ensured.

1.16 The result of planning the packing of a CTU may be presented to the packers by means of an oral or written instruction or by a sketch or even scale drawing, depending on the complexity of the case. Appropriate supervision and/or inspection should ensure that the planned concept is properly

[29] Secretariat of the International Plant Protection Convention, Food and Agriculture Organization of the United Nations: Regulation of wood packaging material in international trade

implemented.

2 Packing and securing materials

2.1 Dunnaging and separating material

2.1.1 Dunnaging materials should be used as appropriate for the protection of the cargo against water from condensed humidity, in particular by:

- Timber planks against water collecting at the bottom of the CTU;
- Gunny cloth, paperboard or natural fibre mats against water dropping from the ceiling; and
- Timber planks or plywood against sweat water running down the sides of the CTU.

2.1.2 Timber planks or battens may also be used for creating gaps between parcels of cargo in order to facilitate natural ventilation, particularly in ventilated containers. Moreover, the use of such dunnaging is indispensable, when packing reefer containers.

2.1.3 Timber planks, plywood sheets or pallets may be used to equalize loads within stacks of cargo parcels and to stabilize these stacks against dislocation or collapse. The same material may be used for separating packages, which may damage each other or even for installing a temporary floor in a CTU for eliminating inappropriate stack loads to the cargo (see Figure 10-2).

Figure 10-2 Timber temporary floor

2.1.4 Cardboard or plastic sheathing may be used for protecting sensitive cargo from dirt, dust or moisture, in particular while packing is still in progress.

2.1.5 Dunnaging material, in particular sheets of plastic or paper and fibre nets may be used for separating unpackaged cargo items, which are designated for different consignees.

2.1.6 The restrictions on the use of dunnaging materials with regard to quarantine regulations, in particular wood or timber, should be kept in mind (see clauses 1.13 and 1.14 of this annex).

2.2 Friction and friction increasing material

2.2.1 For handling and packing of cartons and pushing heavy units a low friction surface may be desirable. However, for minimizing additional securing effort, a high friction between the cargo and the stowage ground of the CTU is of great advantage. Additionally, good friction between parcels or within the goods themselves, e.g. powder or granulate material in bags, will support a stable stow.

2.2.2 The magnitude of the vertical friction forces between a cargo item and the stowage ground depends on the mass of the item, the vertical acceleration coefficient and a specific friction factor μ, which may be obtained from Appendix 10.2.

2.2.2.1 The factors presented in Appendix 10.2 are applicable for static friction between different surface materials. These figures may be used for cargoes secured by blocking or by friction lashings.

Friction force:

$$F_F = \mu \cdot c_z \cdot m \cdot g \text{ [kN]},$$

Equation 3

Where:
m = mass of cargo [t] and
g = acceleration 9.81 [m/s^2]

2.2.2.2 For cargoes secured by direct securing, a dynamic friction factor should be used with 75% of the applicable static friction factor, because the necessary elongation of the lashings for attaining the desired restraint forces will go along with a little movement of the cargo.

2.2.2.3 The friction values given in Appendix 10.2 to this annex are valid for swept clean dry or wet surfaces free from frost, ice, snow, oil and grease. When a combination of contact surfaces is missing in the table in Appendix 10.2or if the friction factor cannot be verified in another way, the maximum friction factor to be used in calculations is 0.3. If the surface contact is not swept clean, the maximum friction factor to be used is 0.3 or the value in the table, when this is lower. If the surface contacts are not free from frost, ice and snow a friction factor μ = 0.2 should be used unless the table shows a lower value. For oily and greasy surfaces or when slip sheets have been used a friction factor μ = 0.1 should be used. The friction factor for a material contact can be verified by static inclination or dragging tests. A number of tests should be performed to establish the friction for a material contact (see Appendix 10.3).

2.2.3 Friction increasing materials like rubber mats, sheets of structured plastics or special cardboard may provide considerably higher friction factors, which are declared and certified by the manufacturers. However, care should be taken in the practical use of these materials. Their certified friction factor may be limited to perfect cleanliness and evenness of the contact areas and to specified ambient conditions of temperature and humidity. The desired friction increasing effect will be obtained only if the weight of the cargo is fully transferred via the friction increasing material, this means only if there is no direct contact between the cargo and the stowage ground. Manufacturer's instructions on the use of the material should be observed.

2.3 Blocking material and arrangements

2.3.1 Blocking is a securing method, where either the cargo is stowed directly against strong structural elements of the CTU or additional materials e.g. timber beams and frames, empty pallets or dunnage bags are used to fill gaps between cargo and solid boundaries of the CTU or into gaps between different packages (see Figure 10-3). Forces are transferred in this method by compression with minimal deformation. In CTUs with strong sides, and where possible, packages should be stowed tightly to the boundaries of the CTU on both sides, leaving the remaining gap in the middle. This reduces the forces to the blocking arrangement, because lateral g-forces from only one side will need to be transferred at a time.

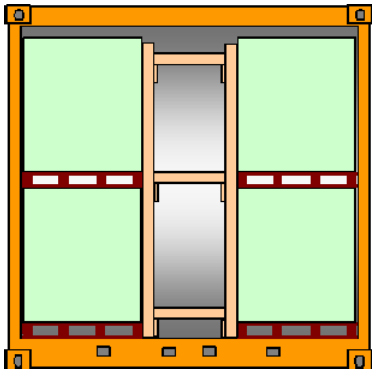


Figure 10-3 Centre gap with transverse bracing

2.3.2 The restrictions on the use of blocking materials with regard to quarantine regulations, in particular for wood or timber, should be kept in mind (see clauses 1.13 and 1.14 of this annex).

2.3.3 Temporary wooden structures used for blocking also referred to as bracing or shoring should be so designed that they primarily transfer the forces from the cargo to the boundaries of the CTU by means of compressions of the timber and not rely on their bending strength or the strength of the joints of the different components. Those forces need to be dispersed at the points of contact by suitable spreader beam unless a point of contact represents a strong structural member of the cargo or the CTU. Softwood timber spreader beams should be given sufficient overlaps at the shoring beam contact points. For the assessment of bedding and blocking arrangements, the nominal strength of timber should be taken from the following Table 10-1:

	Compressive strength normal to the grain	**Compressive strength parallel to the grain**	**Bending strength**
Low quality	0.3 kN/cm^2	2.0 kN/cm^2	2.4 kN/cm^2
Medium quality	0.5 kN/cm^2	2.0 kN/cm^2	3.0 kN/cm^2

Table 10-1 Strength of timber

2.3.4 A temporary wooden structure should be designed and completed in such a way that it remains intact and in place, also if compression is temporarily lost. This requires suitable supports or benches supporting the actual blocking elements, a proper joining of the elements by nails or clamps and the stabilizing of the arrangement by diagonal braces as appropriate (see Figure 10-4). Inclined blocking arrangements bear the risk of bursting open under load and should therefore be properly designed.

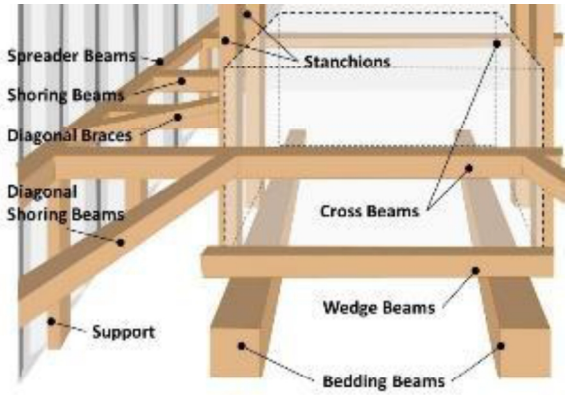


Figure 10-4 Components of a temporary wooden blocking arrangement

2.3.5 Blocking that is secured using mechanical fastenings on bedding or spreader beams should be used for minor securing demands only. The different types of fixing will provide a range of shear strength, depending on the type, configuration and size of the nails used. For example, nailed on wedges may be favourable for blocking round shapes like pipes. Care should be taken that wedges are cut in a way that the direction of grain supports the shear strength of the wedge. Any such timber battens or wedges should only be nailed to dunnage or timbers placed under the cargo (see Figure 10-5). Wooden floors of closed CTUs are generally not suitable for nailing. Nailing to the softwood flooring of flatracks or platforms and open CTUs may be acceptable with the consent of the CTU operator.

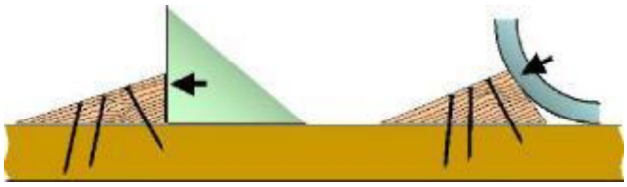


Figure 10-5 Properly cut and nailed wedges

2.3.6 Joints in blocking arrangements fail when the lateral load exceeds the strength of the mechanical fastener, often resulting in the blocking beam or wedge rotating and levering the fastening out. To prevent this, the correct type of mechanical fastenings must be selected and correctly inserted. The most common fastening used in fabrication packing framework is the nail due to its ease of availability and use. Nailed joints rely on three basic elements:

- The size and shape of the nail
- The penetration of the nail
- The timber used for blocking.

2.3.6.1 The size of the nail is measured by its diameter and length. The most commonly used nail has a smooth shank and round in cross section. Other shapes and designs are available and may improve the effectiveness of the joint. When deciding on the size of the nail and its effectiveness the loads that the joint is subjected to and the effectiveness of the two timber elements need to be considered:

.1 Nails in use are subjected either to withdrawal loads or lateral loads (as shown in Figure 10-6 and Figure 10-7), or a combination of the two. Both withdrawal load and lateral load are affected by the wood, the nail, and the condition of use.

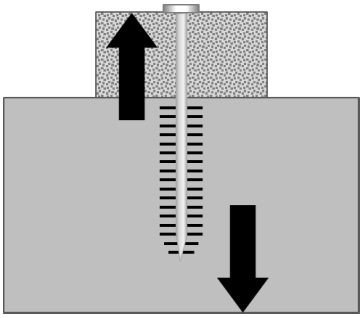


Figure 10-6 Withdrawal loads

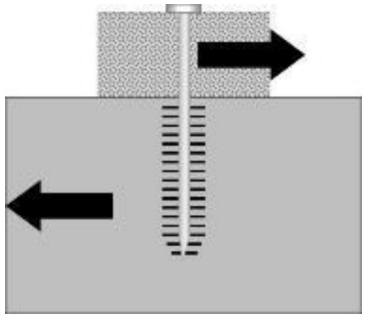


Figure 10-7 Lateral loads

.2 Any lateral load on a blocking element that is affixed using nails will result in the hole formed in the timber as the nail was driven in will distort and the blocking element rotates, thus levering out the nail (see Figure 10-8). As shown in Figure 10-9, the force required to extract the nail diminishes significant already at relatively small displacements, but the effect is less prominent for ringed or spiral nails.

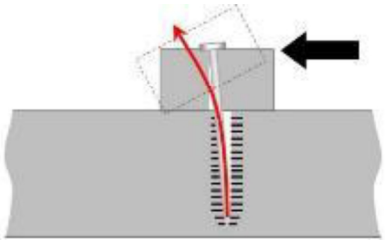


Figure 10-8 Lateral displacement and effect on nail

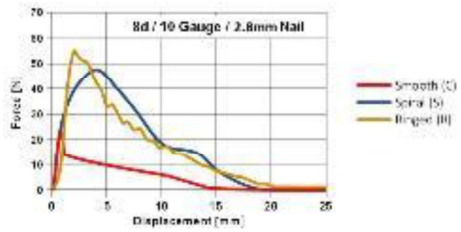


Figure 10-9 Extraction force vs displacement

.3 Blocking arrangements that rely on nailed joints should primarily be used for taking up lateral loads on the nails and be sufficiently strong to not allow any significant displacement of the wooden components. Table 10-2 gives the approximate blocking capacity for nails of various sizes with sufficient penetration.

Nail diameter [mm]	Approximate blocking capacity per nail [daN]
3	90
4	120
5	150

Table 10-2 Approximate lateral blocking capacity of nails with various diameters and sufficient penetration

2.3.6.2 Depth of penetration

.1 The lateral nail load is also related to the depth of penetration of the nail in the foundation member or member receiving the point. There are two general rules for the depth of penetration:

(a) The depth of penetration generally recommended for plain-shank nails to develop full load varies but is about 14 times the nail diameter for the softer woods[30]

[30] The most common used timbers for blocking arrangements are softwoods such as Douglas Fir, Larch, Scots Pine and Spruce.

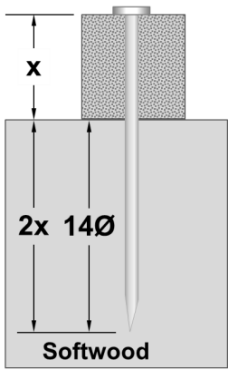


Figure 10-10 Depth of penetration

(b) The depth of penetration can also be calculated so that the shank penetrates to a depth of twice the thickness of the affixed member. Thus, the length of the nail should, if possible, be three times the thickness of the blocking element to be attached and that the nail is fully driven in.

2.3.6.3 Finally, the effectiveness of the nail will depend on the timber used and it should be properly seasoned:

- It should be clean, dry, and free from dry rot, knotholes, infestation, and splits which will affect its strength or interfere with proper nailing.
- Dry timber (at approximate moisture content 15 to 25 percent) is an excellent securing material. It is much lighter than wet or green timber. This is very important when weight limitations are to be considered.
- The use of green or wet timber should always be avoided.
  - Such timber quickly loses most of its strength and can contain 30 to 50 percent moisture depending upon the species.
  - Green and wet timber will emit a heavy concentration of moisture which may cause water or sweat damage, moulding, or cargo staining
  - Shrinkage of green timber in drying loosens the nails, and the movement of the container during transportation often causes nails to work out. This results in a reduction of cargo security in the container and eventual breakdown of the holding system.

2.3.6.4 As it has been shown the use of nails to provide resistance to lateral forces within a blocking arrangement is very limited and it is therefore recommended that nails are used to secure blocking elements in place, but where they are required to provide the lateral resistance the largest diameter of nail available should be used.

2.3.7 When cargo units are blocked against each other, void spaces should be filled and may be favourably stuffed by empty pallets inserted vertically and tightened by additional timber battens as necessary. Material which may deform or shrink permanently, like rags of gunny cloth or solid foam of limited strength, should not be used for this purpose. Small gaps between unit loads and similar cargo items, which cannot be avoided, and which are necessary for the smooth packing and unpacking of the goods, are acceptable and need not to be filled. The sum of void spaces in any horizontal direction should not exceed 15 cm. However, between dense and rigid cargo items, such as steel, concrete or stone, void spaces should be further minimized, as far as possible.

2.3.8 Gaps between cargo that is stowed on and firmly secured to pallets (by lashings or by shrink foil), need not to be filled, if the pallets are stowed tightly into a CTU and are not liable to tipping (see Figure 10-11). Securing of cargo to pallets by lashing, shrink foil or winding foil wrapping is only sufficient if the transport stability of such unit loads has been determined by a practical test which should be documented by marking the unit with its corresponding Transport Stability Level (TSL) as provided in clause 4.2 of this Annex.

Figure 10-11 Cargo firmly secured to pallets by textile lashings

2.3.9 If dunnage bags are used for filling gaps[31], the manufacturer's instructions on filling pressure and the maximum gap should be accurately observed. Dunnage bags should not be used as a means of filling the space at the doorway, unless precautions are taken to ensure that they cannot cause the door to open violently when the doors are opened. If the surfaces in the gap are uneven with the risk of damage to the dunnage bags by chafing or piercing, suitable measures should be taken for smoothing the surfaces appropriately (see Figure 10-12 and Figure 10-13). The blocking capacity of dunnage bags should be estimated by multiplying the nominal burst pressure with the contact area to one side of the blocking arrangement and with a safety factor of 0.75 for single use dunnage bags and 0.5 for reusable dunnage bags (see Appendix 10.4.4).

Figure 10-12 Gap filled with a central dunnage bag

Figure 10-13 Irregular shaped packages blocked with dunnage bags

2.4 Road vehicles may be prepared to accept different types of demountable blocking devices, such as stanchions or blocking cross beams. Such devices may be marked with their Blocking Capacity (BC), indicating the maximum ability to take loading distributed over the device's full height and width during sustained use. Stanchions are exerted to a bending moment which depends on the height of the load. Blocking beams are typically restricted by the strength of the fittings on each side the CTU (see Figure 10-14 to Figure 10-16)

[31] Dunnage bags (inflated by air) should not be used for dangerous goods on US railways.

Figure 10-14 Floor mounted stanchions

Figure 10-15 Blocking cross beams with limited strength due to physical connection

Figure 10-16 Blocking cross beams with greater strength due to physical connection

2.5 Lashing materials and arrangements

2.5.1 Lashings transfer tensile forces. The strength of a lashing may be declared by its breaking strength or breaking load (BL). The maximum securing load (MSL) is a specified proportion of the breaking strength and denotes the force that should not be exceeded in securing service. The term lashing capacity (LC), used in national and regional standards, corresponds to the MSL. Values for BL, MSL or LC are indicated in units of force, i.e. kilonewton (kN) or dekanewton (daN).

2.5.2 The relation between MSL and the breaking strength is shown in the table below. The figures are consistent with Annex 13 of the IMO Code of Safe Practice for Cargo Stowage and Securing. Corresponding relations according to standards may differ slightly.

Material	MSL
shackles, rings, deck eyes, turnbuckles of mild steel	50% of breaking strength
fibre ropes	33% of breaking strength
web lashings (single use)	75% of breaking strength[1]
web lashings (reusable)	50% of breaking strength
wire ropes (single use)	80% of breaking strength
wire ropes (reusable)	30% of breaking strength
steel band (single use)	70% of breaking strength[2]

chains	50% of breaking strength
[1] Maximum allowed elongation 9% at MSL.	
[2] It is recommended to use 50%.	

Table 10-3 Lashing material MSL

2.5.3 The values of MSL quoted in the table above rely on the material passing over smooth or smoothed edges. Sharp edges and corners will substantially reduce these values. Wherever possible or practicable, appropriate edge protectors should be used (see Figure 10-17 and Figure 10-18)

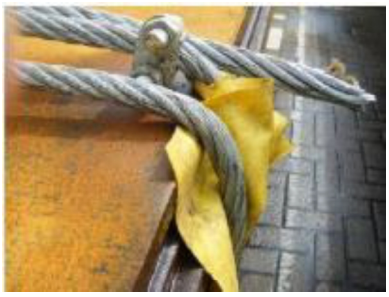


Figure 10-17 Poor edge protection

Figure 10-18 Edge protectors

2.5.4 Lashings transfer forces under a certain elastic elongation only. They act like a spring. If loaded more than the specific MSL, elongation may become permanent, and the lashing will fall slack. New wire and fibre ropes or lashings may show some permanent elongation until gaining the desired elasticity after repeated re-tensioning. Lashings should be given a pretension, in order to minimize cargo movement. However, the initial pre-tension should never exceed 50% of the MSL.

2.5.5 Fibre ropes of the materials manila, hemp, sisal or manila-sisal-mix and moreover synthetic fibre ropes may be used for lashing purposes. If their MSL is not supplied by the manufacturer or chandler, rules of thumb may be used for estimating the MSL with d = rope diameter in cm:

Natural fibre ropes:	$MSL = 2 \cdot d^2$ [kN]
Polypropylene ropes:	$MSL = 4 \cdot d^2$ [kN]
Polyester ropes:	$MSL = 5 \cdot d^2$ [kN]
Polyamide ropes:	$MSL = 7 \cdot d^2$ [kN]

Composite ropes made of synthetic fibre and integrated soft wire strings provide suitable stiffness for handling, knotting and tightening and less elongation under load. The strength of this rope is only marginally greater than that made of plain synthetic fibre.

2.5.6 There is no strength reduction to fibre ropes due to bends at round corners. Rope lashings should be attached as double, triple or fourfold strings and tensioned by means of wooden turn sticks. Knots should be of a professional type, e.g. bowline knot and double half hitch[32]. Fibre ropes are highly sensitive against chafing at sharp corners or obstructions.

2.5.7 Web lashings may be reusable devices with integrated ratchet tensioner or one-way hardware, available with removable tensioning and lockable devices. The permitted securing load is generally labelled and certified as lashing capacity LC. There is no rule of thumb available for estimating the MSL due to different base materials and fabrication qualities. The fastening of web lashings by means of knots reduces their strength considerably and should therefore not be applied.

2.5.8 The elastic elongation of web lashings, when loaded to their specific MSL should not exceed 9%. Web lashings should be protected against chafing at sharp corners, against

[32] Knots will reduce the strength of the rope.

mechanical wear and tear in general and against chemical agents like solvents, acids and others.

2.5.9 Wire rope used for lashing purposes in CTUs for sea transport consists of steel wires with a nominal BL of around 1.6 kN/mm^2 and the favourite construction 6 x 19 + 1FC, i.e. 6 strands of 19 wires and 1 fibre core (see Figure 10-19). If a certified figure of MSL is not available, the MSL for one-way use may be estimated by MSL = 40 · d^2 [kN]. Other available lashing wire constructions with a greater number of fibre cores and less metallic cross section have a considerably lesser strength related to the outer diameter. The elastic elongation of a lashing wire rope is about 1.6% when loaded to one-way MSL, but an initial permanent elongation should be expected after the first tensioning, if the wire rope is new.

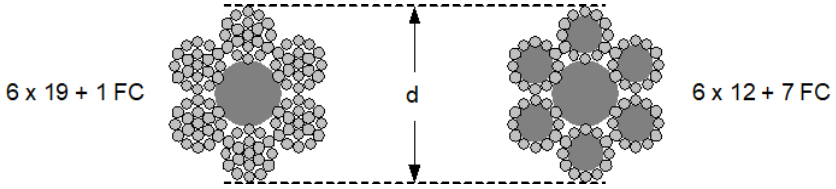


Figure 10-19 Typical lashing wire rope construction

2.5.10 Narrow rounded bends reduce the strength of wire ropes considerably. The residual strength of each part of the rope at the bend depends on the ratio of bend diameter to the rope diameter as shown in the table below.

ratio: bend diameter/rope diameter	1	2	3	4	5
residual strength with rope steady in the bend	65%	76%	85%	93%	100%

Table 10-4 Bend diameter

Bending a wire rope around sharp corners, like passing it through the edged hole of an eye-plate, reduces its strength even more. The residual MSL after a 180° turn through such an eye-plate is only about 25% of the MSL of the plain rope, if steady in the bend.

2.5.11 Wire rope lashings in sea transport are usually assembled by means of wire rope clips. It is of utmost importance that these clips are of appropriate size and applied in correct number, direction and tightness. Recommended types of such wire rope lashing assemblies are shown in Figure 10-20. A typical improper assembly is shown in Figure 10-21.

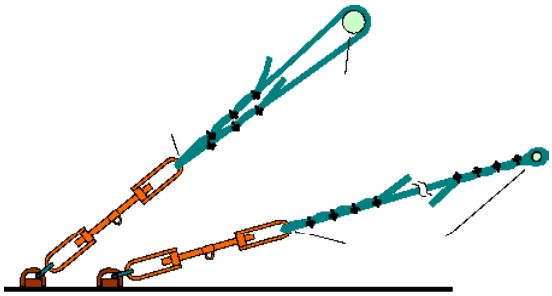


Figure 10-20 Recommended assemblies for wire rope lashing

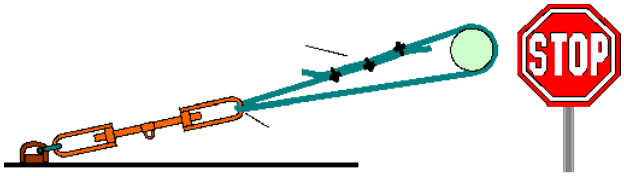


Figure 10-21 Improper assembly for wire rope lashing

2.5.12 Tensioning and joining devices associated with wire rope lashings in sea transport are generally not standardized. The MSL of turnbuckles and lashing shackles should be specified and documented by the manufacturer and at least match the MSL of the wire rope part of the lashing. If manufacturer information is not available, the MSL of turnbuckles and shackles made of ordinary mild steel may be estimated by MSL = 10 · d^2 [kN] with d = diameter of thread of turnbuckle or shackle bolt in cm.

2.5.13 Wire rope lashings in road transport are specified as reusable material of distinguished strength in terms of lashing capacity (LC), which should be taken as MSL. Connections elements like shackles, hooks, thimbles, tensioning devices or tension indicators are accordingly standardized by design and strength. The use of wire rope clips for forming soft eyes has not been envisaged. Assembled lashing devices are supplied with a label containing identification and strength data (see Figure 10-22). When using such material, the manufacturer's instructions should be observed.

Figure 10-22 Standard wire lashing used in road transport with gripping tackle

2.5.14 Lashing chains used in sea transport are generally long link chains of grade 8 steel. A 13 mm chain of grade 8 steel has a MSL of 100 kN. The MSL for other dimensions and steel qualities should be obtained from the manufacturer's specification. The elastic elongation of the above long link chains is about 1% when loaded to their MSL. Long link chains are sensitive against guiding them around bends of less than about 10 cm radius. The favourite tensioning device is a lever with a so-called climbing hook for re-tightening the lashing during service (see Figure 10-23). Manufacturer's instructions and, when existing, national regulations on the use of the tensioning lever and re-tensioning under load should be strictly observed.

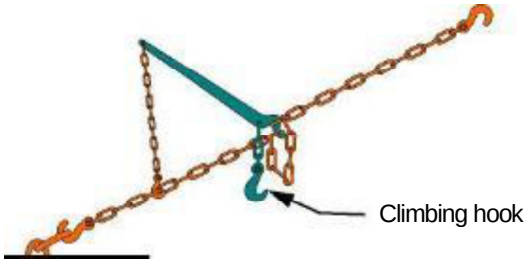


Figure 10-23 Long link lashing chain with lever tensioner

2.5.15 Chain lashings used in road and rail transport according to European standards are mainly short link chains. Long link chains are generally reserved for the transport of logs. Short link chains have an elastic elongation of about 1.5%, when loaded to their MSL. The standard includes various systems of tensioners, specially adapted hooks, damping devices and devices to shorten a chain to the desired loaded length. Chain compound assemblies may be supplied with a label containing identification and strength data (see Figure 10-24). Manufacturer's instructions on the use of the equipment should be strictly observed.

Figure 10-24 Standard chain lashing with shortening hook

2.5.16 Steel band for securing purposes is generally made of high tension steel with a normal breaking strength of 0.8 to 1.0 kN/mm^2. Steel bands are most commonly used for unitizing packages to form greater blocks of cargo (see Figure 10-25). In sea transport, such steel bands are also used to "tie down" packages to flatracks, platforms or roll-trailers. The bands are tensioned and locked by special manual or pneumatic tools. Subsequent re-tensioning is not possible. The low flexibility of the band material with about 0.3% elongation, when loaded to its MSL, makes steel band sensitive for loosing pre-tension if cargo shrinks or settles down. Therefore, the suitability of steel band for cargo securing is limited and national restrictions on their use in road or rail transport should always be considered. The use of steel bands for lashing purposes should be avoided on open CTUs as a broken lashing could be of great danger if it hangs outside the CTU.

Figure 10-25 Metal ingots unitized by steel banding (securing not completed)

2.5.17 Twisted soft wire should be used for minor securing demands only. The strength of soft wire lashings in terms of MSL is scarcely determinable and their elastic elongation and restoring force is poor.

2.5.18 Modular lashing systems with ready-made web lashings are available in particular for general purpose containers, to secure cargo against movement towards the door. The number of lashings should be calculated depending on the mass of the cargo, the lashing capacity of the belts, the lashing angle and the MSL of the lashing points in the container (see Appendix 10.4.4).

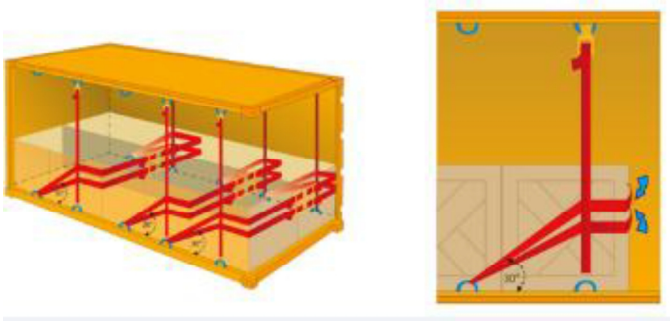


Figure 10-26 Modular lashing system

2.5.19 In the example shown in Figure 10-26, the belts are connected to the lashing points of the CTU with special fittings and are pre-tensioned by means of buckles and a tensioning tool. More information may be obtained from the producers or suppliers of such modular systems.

3 Principles of packing

3.1 Bedding arrangements in containers

3.1.1 Containers are designed according to ISO standards, amongst others, in such a way that the permissible payload P, if homogeneously distributed over the entire loading floor, can safely be transferred to the four corner posts under all conditions of carriage. This includes a safety margin for temporary weight increase due to vertical accelerations during a sea passage. When the payload is not homogeneously distributed over the loading floor, the limitations for concentrated loads should be considered. It may be necessary to transfer the weight to the corner posts by supporting the cargo on strong timber or steel beams as appropriate (see Figure 10-27).

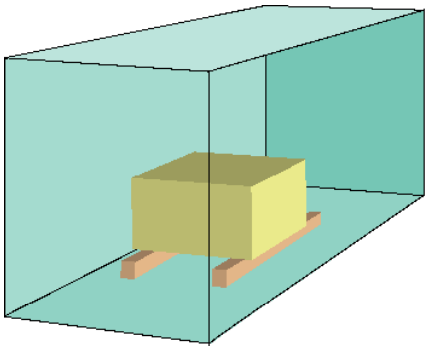


Figure 10-27 Load transfer beams

3.1.2 The necessary length (L_R) of these beams depends on the cargo weight mass and their mutual distance (B). It is important to make the distance B of the longitudinal beams as large as possible in order to minimise the stress onto the cross-members of the container floor. The beams must have sufficient strength for effectively spreading the load. Their necessary dimensions should be determined by the cargo mass and the intended spreading effect, expressed by their “free length”. This simple arrangement complies with the principles of structural engineering. There is no benefit of flooring the area under the

cargo item with beams of lesser strength.

3.1.2.1 Step 1 - Minimum length

.1 The bedding beams must be long enough to cover the distance of the container's floor so that load from the cargo will not overstress the floor.

.2 The minimum length depends on the following factors (see Figure 10-28):

- The cargo mass (in tonnes)
- The spacing of the beams, B (in meters)

.3 Table 10-5 below gives the minimum required length, LR, of longitudinal bedding beams based on these two factors.

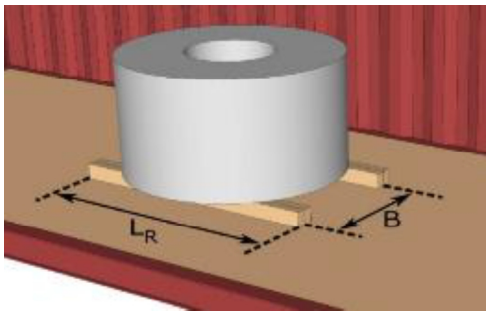


Figure 10-28 Minimum length

Minimum required length of longitudinal bedding beams, LR, [m]							
Spacing between beams, B [m]	Cargo mass [tonne]						
	4	8	12	16	20	24	28
0.50	1.2	2.4	3.6	4.8	6	-	-
0.75	1.0	2.1	3.1	4.1	5.1	6.2	-
1.00	0.9	1.7	2.6	3.4	4.3	5.2	6.0
1.25	0.7	1.4	2.1	2.8	3.5	4.2	4.9
1.50	-	1.1	1.6	2.1	2.6	3.2	3.7
1.75	-	0.7	1.1	1.5	1.8	2.2	3.0
2.00	-	-	0.6	0.8	1.3	2.1	3.0

Table 10-5

3.1.2.2 Step 2 - Minimum dimensions

.1 The proper size of the bedding beams depends on the bending resistance (section modulus) that is required of the beams for them to successfully transfer the load from the cargo over the required floor length. The required section modulus depends on the following factors (see Figure 10-29):

- The cargo mass (in tonnes)
- The minimum length of the beams, LR (in meters), as given by table below
- The length of the footprint of the cargo on the beams, LC (in meters)
- The strength of the material of the bending beams,

.2 When wooden beams are used, the section modulus is calculated by the cross section. It is recommended that square sections are used to ensure the beams stability with a height and width of "a" measured in mm (see Figure 10-30).

.3 Table 10-6 below shows the minimum value of "a" based on the cargo mass and the free length of the beams.

.4 Free length is defined as:

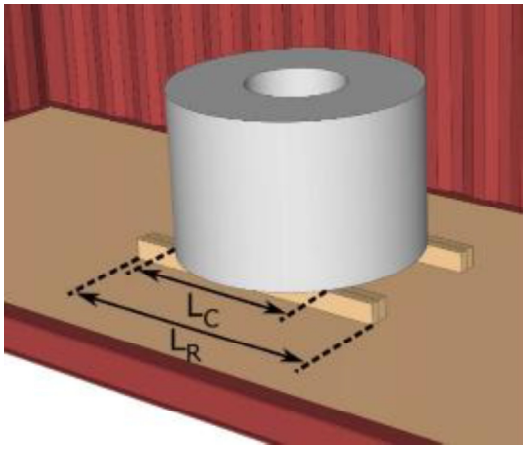


Figure 10-29 Minimum dimensions

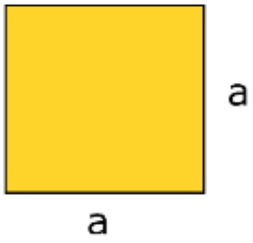


Figure 10-30 Definition of height and width, "a" for wooden beams with a square cross section

$$\frac{L_R - L_C}{2}$$

Minimum height and width, "a", of a pair of square wooden beams with σp = 1.5 kN/cm² [mm]							
Free length $(L_R - L_C)/2$ [m]	Cargo mass [tonne]						
	4	8	12	16	20	24	28
0.25	79	99	114	125	135	143	151
0.50	99	125	143	158	170	181	190
0.75	114	143	164	181	194	207	218
1.00	125	158	181	199	214	227	239
1.25	135	170	194	214	231	245	258
1.50	143	181	207	227	245	260	274
1.75	151	190	218	239	258	274	289
2.00	158	199	227	250	270	287	302

Table 10-6

.5 When steel beams are used, the section modulus depends on which type of profile is used. Table 10-7 below gives the minimum size (in mm) to use for standard HEB profiles based on the cargo mass and the free length of the beams (see Figure 10-31)

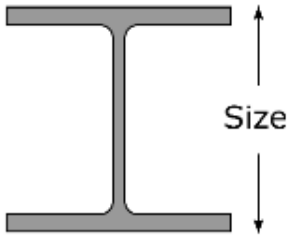


Figure 10-31 Definition of size for HEB steel profiles

Minimum size of a pair of HEB steel beams with σp = 15 kN/cm^2 [mm]							
Free length $(L_R - L_C)/2$ [m]	Cargo mass [tonne]						
	4	8	12	16	20	24	28
0.25	100	100	100	100	100	100	100
0.50	100	100	100	120	120	140	140
0.75	100	100	100	120	140	140	160
1.00	100	100	120	120	140	140	160
1.25	100	100	120	140	140	160	160
1.50	100	120	140	140	160	160	180
1.75	100	120	140	160	160	180	180
2.00	100	120	140	160	180	180	180

Table 10-7

.6 If multiple pairs of beams or beams with a different cross section are used, they shall have the same combined section modulus as the beams represented in the tables above. Furthermore, the required section modulus is proportional to the bending strengths, σp, given in each of the tables above.

3.2 Bedding arrangements on flatracks and platform containers and in road vehicles

3.2.1 CTUs with longitudinal structural beams do not require the bedding arrangements described in clause 3.1 of this annex but still do require beams to be placed under heavy cargo items to ensure that there are no areas where forces are concentrated and to ensure that the forces are transmitted to the longitudinal structural beams.

3.2.2 The bedding arrangement for these types of CTU should be placed transversally so that they land on the longitudinal structural beams.

3.2.3 The bedding arrangement should also support the cargo item so that no part of the cargo items is landed on the cargo deck. This is particularly true when transporting coiled materials and the bedding arrangement can incorporate wedge beams to prevent the coil (eye to the side) from rolling.

3.2.4 If bedding beams cannot be used for concentrated loads on flatracks or platform containers and road trailers, the load may have to be reduced against the maximum payload. The permissible load should be designed in consultation with the CTU operator.

3.3 Load distribution

3.3.1 In order to enable safe handling and transport of CTUs, all relevant limitations that restricts

the allowable eccentricity of the centre of gravity for combined mass of the cargo, securing equipment and bedding arrangement must be considered. The allowable mass of cargo and securing materials based on the position of the centre of gravity may be visualized through a Load Distribution Diagram, in which a limiting curve is plotted based on all applicable restrictions (see Figure 10-32 and Figure 10-34 below). The precise longitudinal position of the centre of gravity of the cargo may be determined by calculation (see Appendix 10.4.3).

3.3.2 Where containers, including flatracks or platforms, will be lifted and handled in a level state during transport, the cargo should be so arranged and secured in the container that its joint centre of gravity is close to the mid-length and mid-width of the container. The eccentricity of the centre of gravity of the container's gross mass should not exceed ±5% in general. As a rule of thumb this can be taken as 60% of the cargo's total mass in 50% of the container's length.

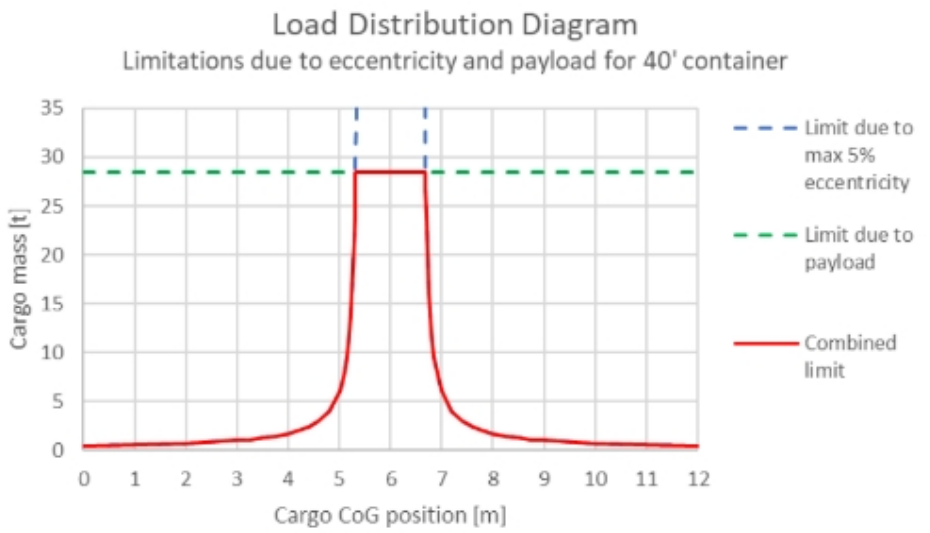


Figure 10-32 An example of a load distribution diagram for the safe loading and handling of a 40 ft container,

based on the following parameters:

- Tare mass of container: 4000 kg
- Max payload: 28 500 kg
- Maximum eccentricity: ±5% of the container's length

3.3.3 Roll trailers have structural properties similar to platforms but are less sensitive to concentrated loads due to the usual wheel support at about ¾ of their length from the gooseneck tunnel end. As they are generally handled without lifting, the longitudinal position of the cargo centre of gravity is also not as critical but may further be restricted by the allowable deck and ramp capacities of the ship.

3.3.4 Swap bodies have structural properties similar to containers, but in most cases have a smaller tare mass and less overall strength. They are normally not stackable. The loading instructions given under clauses 3.1.2 and 3.3.3 should be applied to swap bodies as appropriate.

3.3.5 Road trucks and road trailers are in particular sensitive regarding the position of the centre of gravity of the cargo packed in them, due to manufacturer's specified axle loads for maintaining steering and braking ability as well as the infrastructure's restrictions for vehicle gross mass as well as axle and bogie loads. In case of semi-trailers, the maximum king pin load, resulting from the towing trucks restrictions, must also be considered. Individual

vehicles may be equipped with specific diagrams. Generally, the maximum payload may be utilised only when the centre of gravity (CoG) is positioned within narrow boundaries about half the length of the loading space (see Figure 10-33).

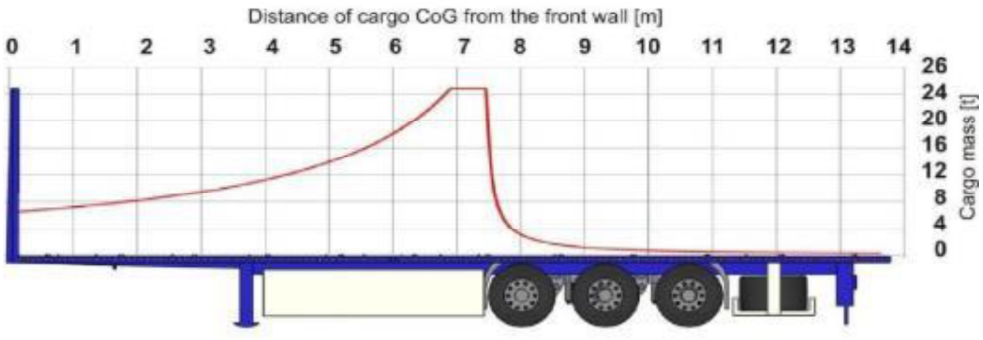


Figure 10-33 An example of a load distribution diagram for a semi-trailer

3.3.6 Railway routes are generally classified into line categories, by which permissible gross masses for wagons, axle loads and loads per metre length of cargo space are allocated to each railway wagon. The applicable figures should be observed in view of the intended route of the wagon. Tolerable concentrated loads are graded depending on their bedding length. The appropriate load figures are marked on the wagons. The transverse and longitudinal eccentricity of cargo centre of gravity from wagon centrelines is limited by defined relations of transverse wheel loads and longitudinal axle/bogie loads. The proper loading of railway wagons should be supervised by specifically trained persons.

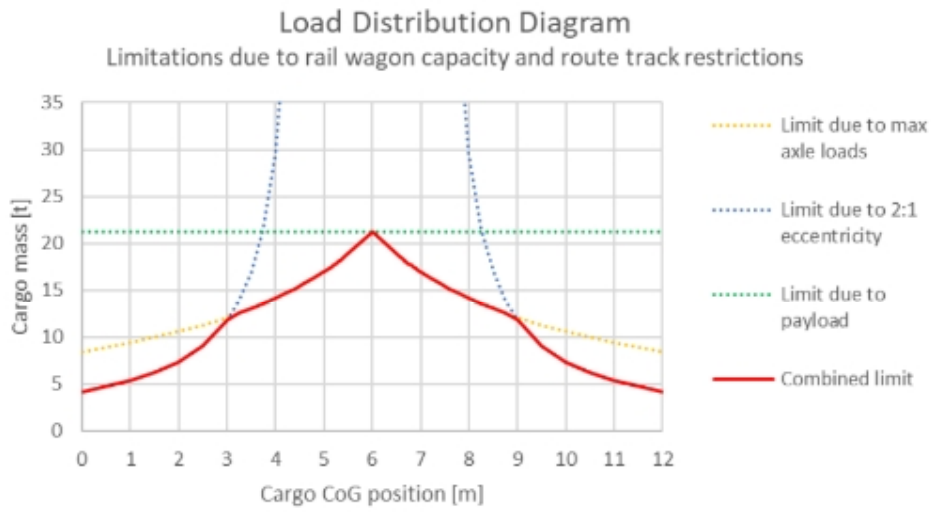


Figure 10-34 An example of a load distribution diagram for a 40 ft container on a two-axle rail wagon

based on the following parameters:

- Maximum gross mass for wagon: 36 000 kg
- Tare mass of wagon: 10 800 kg
- Tare mass of container: 4000 kg
- Max cargo mass (payload): 21 200 kg
- Maximum axle load: 18 000 kg
- Distance between axles: 8 m
- Maximum difference between weight on axles: 2:1 (i.e. no axle may carry more than twice the weight of the other).

3.3.7 Load Distribution Diagrams for different modes of transport may be superimposed to show the combined limiting curve for the whole intended voyage, as illustrated in the example in Figure 10-35.

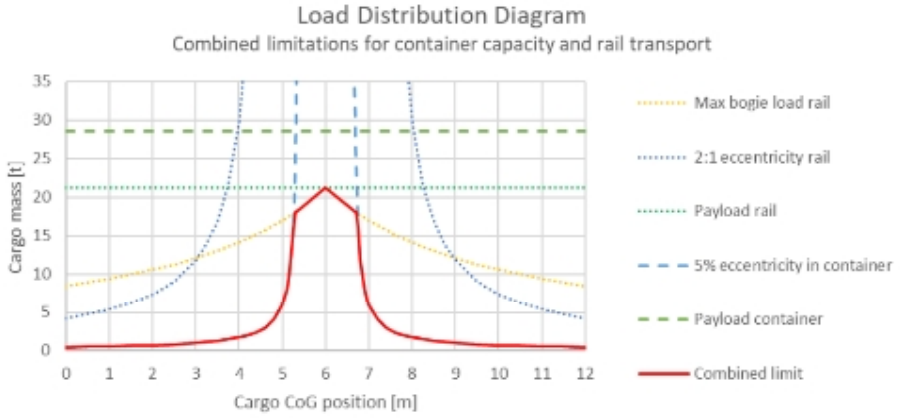


Figure 10-35 An example of a combined load distribution diagram for the handling and capacity of a 40 ft container as well as transport on a two-axle rail wagon

3.4 General stowage/packing techniques

3.4.1 Stowage and packing techniques should be suitable to the nature of the cargo with regard to weight, shape, structural strength and climatic conditions. This includes the proper use of dunnage material (see clause 2.1 of this annex), the selection of the appropriate method of mechanical handling and the proper stowage of vented packages. The concept of stowage should incorporate the feasibility of smooth unloading.

3.4.2 Any marking on parcels should be strictly observed. Cargoes marked "this way up" should not only be stowed upright but also kept upright during entire handling. Goods which may be subject to inspection by the carrier or by authorities, like dangerous goods or goods liable to Customs duty, should, if possible, be stowed at the door end of the CTU.

3.4.3 When packing mixed cargoes, their compatibility should be considered. Irrespective of the regulations for the stowage of dangerous goods (see Chapter 11 of this Code) the following general rules are applicable:

- Heavier cargoes should not be stowed on top of lighter cargoes. This will also provide for the centre of gravity of the CTU in a level not exceeding half the height of the CTU;
- Heavy units should not be stowed on top of fragile parcels;
- Sharp-edged pieces should not be stowed on top of units with weak surfaces;
- Liquid cargoes should not be stowed on solid cargoes;
- Dusty or dirty cargoes should not be placed near to clean and easily soiled cargoes like foodstuff in porous packaging;
- Cargoes emitting moisture should not be stowed on or near to cargoes sensitive to moisture;
- Odorous cargoes should not be stowed in the vicinity of cargoes easily absorbing odour;
- Incompatible cargoes should be packed into the same CTU only if their stow is appropriately separated and/or the goods are effectively protected by suitable sheathing material.

3.4.4 Stacking of sensitive cartons of uniform size and shape should be precise in a way that the mass from above is transferred to the vertical boards of the cartons below. If necessary, e.g. due to lateral leeway of the stack in the CTU, intermediate sheets of fibreboard, plywood or pallets should be placed between layers of the stack (see Figure 10-36 and Figure 10-37). Cartons of irregular shape and/or size should be stacked only with due consideration of their structural hardiness. Gaps and irregularities of level should be stuffed or equalized by means of dunnage.

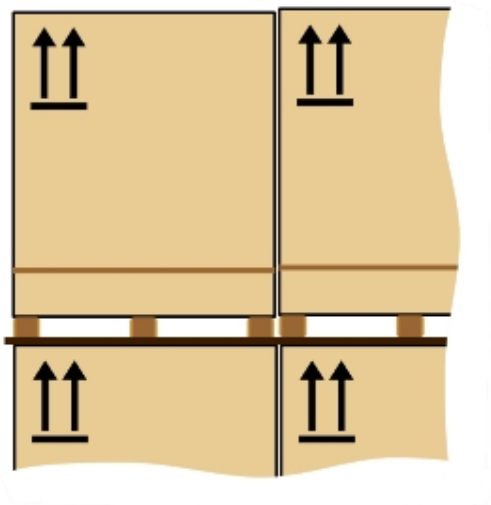


Figure 10-36 With intermediate board

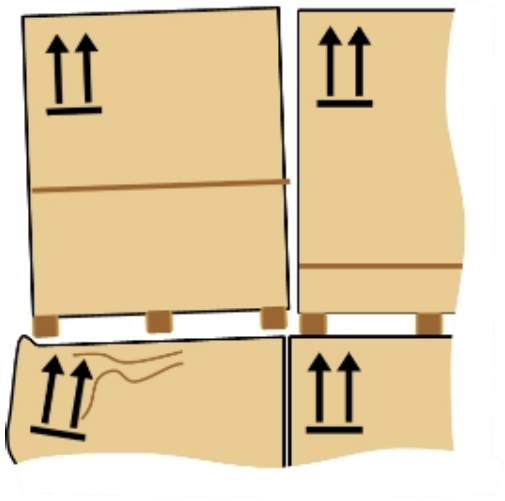


Figure 10-37 Without intermediate board

3.4.5 Packages with a less defined shape like bags or bales may be stacked in an interlocking

pattern, also called cross-tie, thereby creating a solid pile that may be secured by blocking or fencing (see Figure 10-38). Round longish units like pipes may be stacked into the grooves of the layer below. However, care should be taken of the lateral forces produced by top layers in the grooves of the bottom layers, which may locally overload the side walls of the CTU if the friction between the pipes is low.

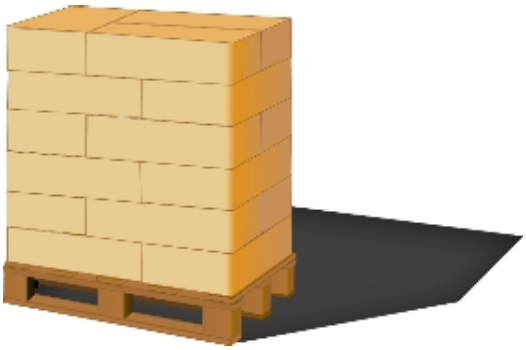


Figure 10-38 Cross-tie stowage

3.4.6 Uniform parcels like drums or standardized pallets should be packed in a way that minimizes lost space and provides a tight stow at the same time. Drums may be stowed either in regular lines, also called "soldier stowage", or into the vertical grooves, also called "offset stowage" (see Figure 10-39 and Figure 10-40). With small drums the offset packing is more effective, while with greater drum diameters the advantage may be with the soldier stow. Pallet dimensions are widely standardized and adapted to the inner width and length of cargo spaces in road trucks, road trailers and swap bodies, but not throughout to the inner dimensions of containers.

Figure 10-39 Mixed stow, dry over wet goods

Figure 10-40 Mixed stow, use of pallets

3.4.7 Near to completion of packing a CTU, care should be taken to build a firm face of the cargo so as to prevent a "fall out" when the CTU is opened. If there is any doubt about the stability of the face, further steps should be taken such as strapping top layers of cargo back to securing points or building a timber fence between the rear posts in a CTU (see clause 2.3.4 of this annex). It should be borne in mind, that a container on a trailer usually inclines towards the doors aft and that cargo may move against the doors due to vibration induced shift or by jolts during transport.

3.5 Cargo handling

3.5.1 Relevant regulations on the use of personnel protection equipment (helmet, shoes, gloves and clothing) should be adhered to. Personnel should have been instructed on ergonomic aspects of manual lifting of weighty parcels. Weight limitations of parcels to be lifted and carried by persons should be observed.

3.5.2 Forklift trucks, used for driving inside roofed CTUs, should have a short lifting mast and a

low driver's overhead guard. If the lift truck operates inside a CTU care should be taken of the exhaust gases and equipment with electric power supply or similar should be used. The truck should be equipped with adequate lighting so that the operator can place packages accurately. Forklift trucks s operated by a combustion engine should comply with national combustion emission standards. Forklift trucks s with engines burning LPG fuel should not be used in enclosed space, in order to prevent the accumulation of explosive gas mixtures from unexpected leaks.

3.5.3 Where there is a risk of explosion due to the vapours, fumes or dust given off by the cargo, all electrical equipment mounted on the forklift trucks should be evaluated to ensure that they are safe for flammable and explosive atmospheres.

3.5.4 Driving forklift trucks into swap bodies, semi-trailers or other supported CTUs should be done slowly, in particular with careful starting and braking, in order to avoid dangerous horizontal forces to the supports of the CTU.

3.5.5 If CTUs are to be packed with forklift trucks from the side, significant lateral impact forces to the CTU should be avoided. Such lateral forces may occur when packages or overpacks are pushed across the loading area. If, during such operations, there is a risk of turning the CTU over packers may consider packing either from both sides to the centre line of the CTU or by using forklift trucks with higher capacity and long forks, which would permit accurate placement without pushing.

3.5.6 If persons need to access the roof of a CTU, e.g. for filling the CTU with a free-flowing bulk cargo, the load-bearing capability of the roof should be considered. Roofs of containers are designed for and tested with a load of 300 kg (660 lbs), which acts uniformly on an area of 600 x 300 mm (24 x 12 inches) in the weakest region of the roof (reference: CSC, Annex II). Practically, no more than two persons should work on a container roof simultaneously.

3.5.7 When loading or unloading heavy parcels with C-hooks through doors or from the sides of a CTU, care should be taken, that the transverse or longitudinal girders of the roof or side walls are struck neither by the hook nor the cargo. The movement of the unit should be controlled by appropriate means, e.g. guide ropes. Relevant regulations for the prevention of accidents should be observed.

4 Securing of cargo in CTUs

4.1 Aims and principles of securing

4.1.1 Arrangements or stacks of cargo items should be packed in a way so as not to deform and to remain in place and upright with no tilting by their static friction and by their inherent stability, while packing or unpacking a CTU is in progress. This guarantees the safety of packers before additional securing devices are put in place or after such devices have been removed for unpacking.

4.1.2 During transport the CTU may be subjected to vertical, longitudinal and transverse accelerations, which cause forces to each cargo item, which are proportional to its mass. It should not be assumed, that because a package is heavy, it will not move during transport. The relevant accelerations are outlined in chapter 5 of this Code in units of g, indicating the corresponding forces in units of weight of the distinguished cargo item. These forces may easily exceed the capability of static friction and tilting stability, so that cargo items may slide or tilt over. In addition, the CTU may be simultaneously subjected to temporary vertical accelerations, which cause a weight decrease, thereby reduce the friction and the inherent tilting stability, thus promoting sliding and tipping. Any securing of cargo should aim at the avoidance of such unwanted cargo behaviour. All parts of the cargo should remain in place and neither slide nor tip under the stipulated accelerations of the CTU during the intended route of transport.

4.1.3 Practical securing of cargo may be approached by three distinguished principles, which may be used individually or combined as appropriate:

- Direct securing is affected by the immediate transfer of forces from the cargo to the CTU by means of blocking, lashings or locking devices (see clause 4.1.7 of this annex). The securing capacity is proportional to the MSL of the securing devices;

- Friction securing is achieved by so-called tie-down or top-over lashings which, by their pre-tension, increase the apparent weight of the cargo and thereby the friction to the loading ground and also the tilting stability. The securing effect is proportional to the pretension of the lashings. Anti-slip material in the sliding surfaces considerably increases the effect of such lashings;
- Compacting cargo by bundling, strapping or wrapping is an auxiliary measure of securing that should always be combined with measures of direct securing or friction securing.

4.1.4 Lashings used for direct securing will inevitably elongate under external forces, thus permitting the package a degree of movement. To minimize this movement, (horizontal or lateral sliding, tipping or racking) it should be ensured that the:

- Lashing material has appropriate load-deformation characteristics (see clause 2.5 of this annex);
- Length of the lashing is kept as short as practicable; and
- Direction of the lashing is as close as possible to the direction of the intended restraining effect.

A good pre-tension in lashings will also contribute to minimizing cargo motions, but the pretension should never exceed 50% of the MSL of the lashing. Direct securing by stiff pressure elements (shoring beams or stanchions) or by locking devices (locking cones or twist-locks) will not allow significant cargo motion and should therefore be the preferred method of direct securing.

4.1.5 Lashings used for friction securing should be able to maintain the vital pre-tension for a longer period and should not fall slack from minor settling or shrinking of the cargo. Therefore, synthetic fibre web lashings should be preferred to e.g. chains or steel band lashings. The pre-tension of tie-down lashings does in principle does not fall under the limitation stated above for direct lashings, but will generally not be greater than 20% of the MSL of the lashing with manually operated tensioners. Care should be taken to establish this pretension on both sides of the lashing as far as is practical. For assessing a friction securing arrangement by calculation, the labelled standard pre-tension[33] should be used. If such marking is not available, a rule of thumb value of 10% of the breaking strength of the lashing, but not more than 10 kN, should be used for calculation.

4.1.6 Arrangements of direct securing devices should be homogeneous in a way that each device in the arrangement takes its share of the restraining forces appropriate to its strength. Unavoidable differences in load distribution within complex arrangements may be compensated for by the application of a safety factor. Nevertheless, devices of diverging load-deformation properties should not be placed in parallel, unless used for the distinguishable purposes of sliding prevention and tipping prevention. If, for instance, timber blocking and direct web lashing is used in parallel against sliding, the stiffer timber blocking should be dimensioned so as to resist the expected load alone. This restriction does not apply to the combination of tie-down lashings and e.g. timber blocking.

4.1.7 Any cargo securing measures should be applied in a manner that does not affect, deform or impair the package or the CTU. Permanent securing equipment incorporated into a CTU should be used whenever possible or necessary. Where this is not possible the following should apply:

4.1.7.1 Blocking should be braced against structurally significant components of the CTU, which may be corner posts and bottom rails.

4.1.7.2 Additional shoring may be made against the boundary side and front walls so long as the forces are distributed by spreader beams as shown in Figure 10-41.

[33] Standard tension force $_{STF}$ according to EN 12195-2

Figure 10-41 Boundary blocking arrangement

4.1.8 The CTU doors may be tested to withstand a force equivalent to a percentage of the CTU's payload, however, for cargoes that are liable to collapse, such as small hand-packed packaged and pallets with low integral stability, the doors should not be used as the only mean to constrain the cargo as there is a risk of the cargo falling onto those who open the CTU for inspection or unpacking. A possible falling out of cargo can be prevented by spring lashing (see Figure 10-65), a modular lashing system (see Figure 10-26), a tarpaulin (see Figure 10-42) or nets or net-curtains (see Figure 10-43).

4.1.9 Cargo should never be secured by blocking or lashing against the CTU roof except for designs that permit this method of securing.

Figure 10-42 Tarpaulin used solely to prevent small and light packages from falling out when stowed close to the door.

Figure 10-43 Net-curtain used to prevent small and light packages from falling out when stowed close to the door.

4.1.10 During transport, in particular at suitable occasions of a multimodal transport route, securing arrangements in CTUs should be checked and upgraded if necessary and as far as practicable. This includes re-tightening of lashings and wire rope clips and adjusting of blocking arrangements.

4.2 Transport Stability Level, TSL

4.2.1 Importance of package stability

4.2.1.1 Consignors should ensure that formed packages are capable of withstanding the hazards of environmental exposure, storage, handling and transport. Overpacks should retain their integrity during transport, failure to do so increases the risk of the cargo being damaged or the CTU stability being adversely affected.

4.2.1.2 To assist Packers in their role, the transport stability of the packages may be

determined by practical tests, in which the packages capability of withstanding horizontal forces without substantial deformation is verified. Upon completion of such tests, the package may be marked with its corresponding Transport Stability Level (TSL), as given in Table 10-8 Transport Stability Level.

Transport Stability Level TSL	**Horizontal acceleration a**
TSL 1	$\mathbf{a \geq 1.0g}$
TSL 2	$\mathbf{0{,}8g \leq a < 1.0g}$
TSL 3	$\mathbf{0{,}5g \leq a < 0{,}8g}$
TSL 4	$\mathbf{0{,}35g \leq a < 0{,}5g}$
TSL 5	$\mathbf{0{,}18g \leq a < 0{,}35g}$
a_g = gravity acceleration 9,81 m/s^2 Note: Below 0,18*g* no TSL marking allowed	

Table 10-8 Transport Stability Level

4.2.1.3 The TSL when associated with the CTUs boundary strength can indicate the need for additional securing of the cargo and should be determined in each specific case.

4.2.2 Determine the TSL

4.2.2.1 The TSL of a package can be determined through practical tests by exposing the package to the horizontal acceleration corresponding to the sought TSL level according to Table 10-8, for example by inclination tests as described in Appendix 10.5, with the addition that the maximum inclination angle shall be retained for at least 5 seconds and that the required inclination angle, to simulate the desired horizontal acceleration, shall be determined based on the internal friction of the goods in the package.

4.2.2.2 During the tests, the package should be prevented from sliding on the test platform by a measure that does not influence the package stability.

4.2.2.3 The package shall be tested 3 times in the lengthwise as well as in the sideways direction respectively. Asymmetrical cargo shall be tested in the most unstable directions. A separate test sample may be used in each test direction. No correction of the test samples may be done during the test.

4.2.2.4 After the test sequence, the permanent deformation of any part of the test sample from the primary location shall not exceed 60 mm in any direction. The maximum deformation may be measured on the front or back side of the test sample based on the primary vertical projection.

4.2.2.5 Furthermore, the test sample may not tip up or fall over during the tests.

4.2.2.6 No signs of visible leakage from the test sample are allowed after the test.

4.2.3 Marking of TSL

4.2.3.1 All packages which have a tested TSL should be marked with this, either on a separate label or incorporated with other markings on the units.

4.2.3.2 The TSL marking should:

.1 be marked on at least one side of each package,

.2 use letters or numbers of at least 12 mm height,

.3 be visible and readable,

.4 be displayed on a background of contrasting colour on the external surface of the package,

4.2.3.3 It is possible that test results for TSL differ in different directions depending on the shape of the package and therefore the lowest value for length and width directions should be displayed as per examples below (see Figure 10-44 and Figure 10-45).

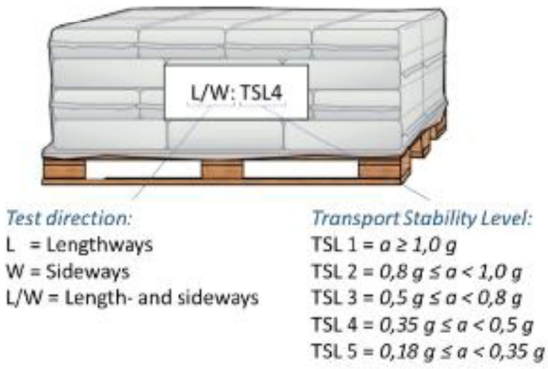


Figure 10-44 Marking of Transport Stability Level 4 in both length (L) and width (W) directions

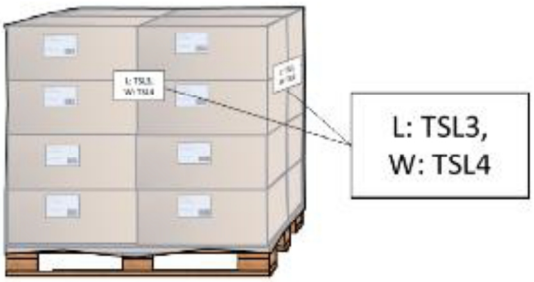


Figure 10-45 Marking of Transport Stability Level 3 in length (L) and 4 in width (W) directions

4.2.4 Practical applications for packages with known TSL

4.2.4.1 Bottom blocking

.1 If the value of the directional TSL for a package (see Table 10-8) is equal to or exceeds the directional acceleration coefficients (Chapter 6, clause 6.3) for the intended transport mode, bottom blocking should be sufficient to prevent the cargo from sliding. When using bottom blocking only, Table 10-9 below indicates the lowest required TSL to secure cargo in different directions and different modes of transport (see Figure 10-46).

The lowest required TSL for securing the cargo using bottom blocking only			
Mode of transport	**Sideways**	**Forward**	**Backward**
Road	TSL3	TSL2	TSL3
Rail	TSL3	TSL3	TSL3
Sea Area A	TSL3	TSL3	TSL3
Sea Area B	TSL2	TSL2	TSL2
Sea Area C	TSL2	TSL2	TSL2
The TSL values for the sea areas in longitudinal direction apply to internal friction μ<0.5			

Table 10-9 Required TSL for bottom blocking as the sole cargo securing method

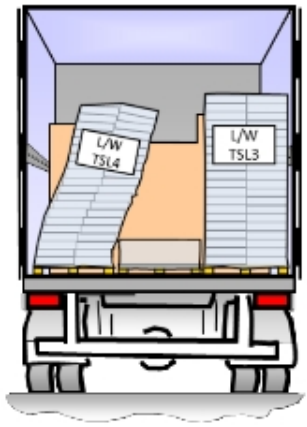


Figure 10-46 TSL Comparison

A package marked with TSL 3 or better may be bottom blocked sideways during road transport, while a package marked with TSL 4 risk collapsing in this situation.

4.2.4.2 Blocking against the side of the CTU

The TSL of the package indicates if the strength of the boundaries of the CTU is sufficient for blocking the packages or if additional securing methods are required by other means, e.g. lashings, in order not to overstress the CTU's boundary walls (see Table 10-10 and Figure 10-47).

The lowest required TSL to block the cargo against the boundary walls of the CTU (evenly distributed cargo)						
Standard	EN 12642:2016				EN 283	ISO 1496
CTU	L-vehicle			XL-vehicle	Swap-body	Container
Mode of transport	Box	Drop-sides	Curtain-sider	Box/Dropside/ Curtainsider		
Road	TSL5	TSL5	TSL4	TSL5	TSL5	TSL5
Rail	TSL5	TSL5	TSL4	TSL5	TSL5	TSL5
Sea Area A	TSL5	TSL5	TSL4	TSL5	TSL5	TSL5
Sea Area B	TSL3	TSL3	TSL3	TSL4	TSL3	TSL5
Sea Area C	TSL3	TSL3	TSL2	TSL3	TSL3	TSL5

Table 10-10 Required TSL for blocking only against the sides of CTUs

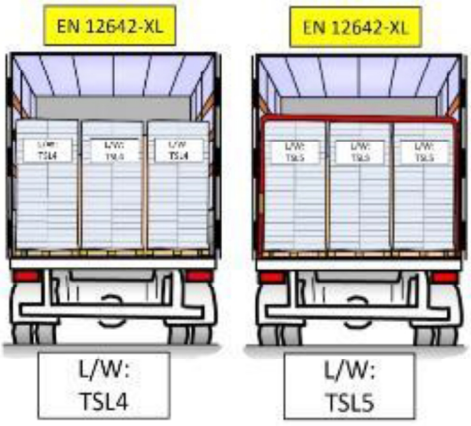


Figure 10-47 Blocking against boundary comparison

During transport in sea area B in a road vehicle complying with standard EN 12642- XL, packages marked with TSL 4 or better may be secured by blocking against the CTU's sides only, whilst packages marked with TSL 5 needs additional securing measures, e.g. top-over lashings.

4.2.4.3 Selecting packaging to minimize breakage

.1 If frequent breakage occurs during transport, the packaging may need improving. In such case, testing of TSL may be used as a tool for investigating the cause of the breakage, deciding on additional measures or new methods for packaging and verifying that these new measures provide a better transport stability.

.2 Furthermore, a consignor or consignee may implement requirements of a minimum TSL for their packages, for themselves or for contracted partners, to minimize the risk of breakage and to make the cargo securing more efficient and safer.

4.3 Tightly arranged cargoes

4.3.1 A vital prerequisite of cargo items for a tight stowage arrangement is their insensibility against mutual physical contact. Cargo parcels in form of cartons, boxes, cases, crates, barrels, drums, bundles, bales, bags, bottles, reels etc. or pallets containing the aforesaid items are usually packed into a CTU in a tight arrangement in order to utilize the cargo space, to prevent cargo items from tumbling around and to enable measures of common securing against transverse and longitudinal movement during transport.

4.3.2 A tight stow of uniform or variable cargo items should be planned and arranged according to principles of good packing practice, in particular observing the advice given in clause 3.4 of this annex. If coherence between items or tilting stability of items is poor, additional measures of compacting may be necessary like hooping or strapping batches of cargo items with steel or plastic tape or plastic sheeting. Gaps between cargo items or between cargo and CTU boundaries should be filled as necessary (see clauses 2.3.7 to 2.3.9 of this annex). Direct contact of cargo items with CTU boundaries may require an interlayer of protecting material (see clause 2.1 of this annex).

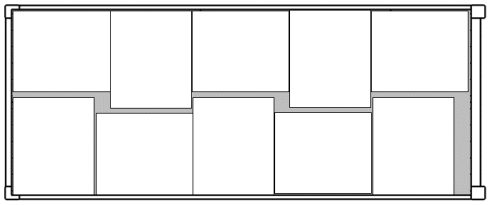


Figure 10-48 Packing 1,000 x 1,200 mm unit loads into a 20 ft container

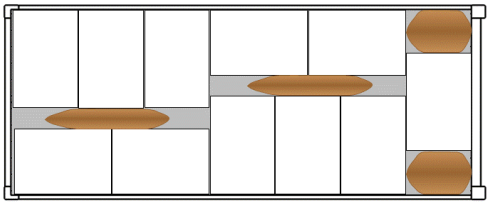


Figure 10-49 Packing 800 x 1,200 mm unit loads into a 20 ft container

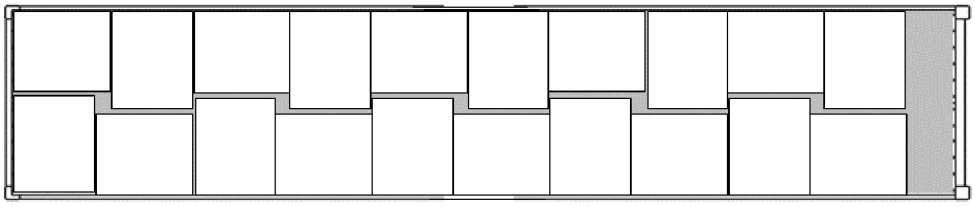


Figure 10-50 Packing 1,000 x 1,200 mm unit loads into a 40 ft container

Note: The void areas (grey shaded) shown in Figure 10-48 to Figure 10-50 should be filled when necessary (see clause 2.3.7 of this annex)

4.3.3 CTUs with strong cargo space boundaries may inherently satisfy transverse and longitudinal securing requirements in many cases, depending on the type of CTU, the intended route of transport and appropriate friction among cargo items and between cargo and stowage ground. The following balance demonstrates the confinement of tightly stowed cargo within strong cargo space boundaries:

$$c_{x,y} \cdot m \cdot g \leq r_{x,y} \cdot P \cdot g + \mu \cdot c_z \cdot m \cdot g \; [kN]$$

Equation 4

Where:

$c_{x,y}$	=	horizontal acceleration coefficient in the relevant mode of transport (see Chapter 6.3)
m	=	mass of cargo packed [tonne]
g	=	gravity acceleration 9.81 m/s^2
$r_{x,y}$	=	CTU wall resistance coefficient (see Annex 4 of this Code)
P	=	maximum payload of CTU [tonne]
μ	=	applicable friction factor between cargo and stowage ground (see Appendix 10.2)
c_z	=	vertical acceleration coefficient in the relevant mode of transport (see Chapter 6.3)

4.3.4 Critical situations may arise, e.g., with a fully packed container in road transport, where longitudinal securing should be able to withstand an acceleration of 0.8 g. The longitudinal wall resistance factor of 0.4 should be combined with a friction factor of at least 0.4 for satisfying the securing balance. If a balance cannot be satisfied, the mass of cargo should be reduced or the longitudinal forces transferred to the main structure of the container. The latter can be achieved by intermediate transverse bulkheads of cross beams (see clause 4.3.7 of this annex) or by other suitable means. When bracing against the rear corner frames, vertical timber battens (VB) should be inserted into the shoring slots between the slot bars and the bracing battens (BB) fitted against this. Where required nails or other fixings can be used to stabilise the bracing battens.

4.3.5 When the door end of a CTU is designed to provide a defined wall resistance (e.g. the doors of a general purpose container (see Supplement 1.1.1.5), the doors may be considered as a strong cargo space boundary, provided the cargo is stowed to avoid impact loads to the door end and to prevent the cargo from falling out when the doors are opened.

4.3.6 Where there is the need to stack packages in an incomplete second layer at the centre of the CTU, additional longitudinal blocking can be adopted (see Figure 10-51 to Figure 10-54).

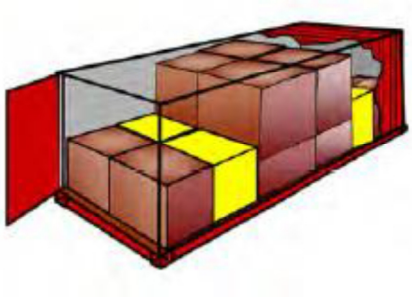


Figure 10-51 Threshold by height

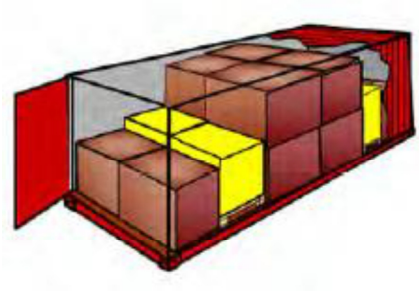


Figure 10-52 Threshold by elevation

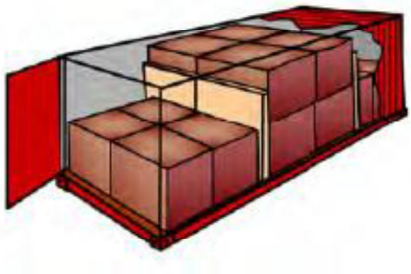


Figure 10-53 Threshold by board

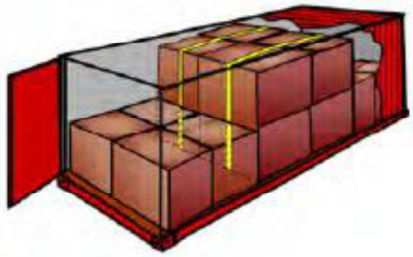


Figure 10-54 Round turn lashing

4.3.7 Transverse cross beams in a CTU, intended to restrain a block of packages in front of the door (see Figure 10-55) or at intermediate positions within the CTU, should be sufficiently dimensioned in their cross section, in order to withstand the expected longitudinal forces from the cargo. Such members act as beams, which are fixed at their ends and loaded homogeneously over their entire length of about 2.4 metres. Their bending strength is decisive for the force that can be resisted. The required number of such battens together with their dimensions may be identified by calculations, which is shown in Appendix 10.4.1 to this annex. Wherever possible such battens should be braced against the solid frame structure, such as bottom or top rails or corner posts. While it is recognised that this type of blocking is not possible on all types of CTUs, any that has a shoring slot built into the rear frame can accommodate this blocking technique. Alternative blocking can be achieved by forcing the battens into the solid corrugations of the side walls of the CTU (see Figure 10-56). However, since these methods have limited strength, they should be used in combination with friction increasing material and/or limited cargo weight. The blocking capacity, BC, of a 75 x 100 mm beam inserted into the corrugation of a container is 500 daN if it is placed at half the height of the container and 750 daN if it is placed at the floor.

Figure 10-55 Shoring bars

Shoring bars inserted in the shoring slots and supported by uprights placed against the doors

Figure 10-56 Cross beams

Cross beams inserted in the corrugations supported by shoring beams against the corner posts

4.3.8 When a temporary wooden structure is used to block the cargo against the end walls of platform and flatrack type CTUs, this should be supported against the corner posts and the shoring beams should be placed as far out towards the sides as the cargo permits (see Figure 10-57). Stanchions, produced from wooden beams with a cross section of 75 x 75 mm, may often be inserted into pockets along the sides of the platforms to prevent the cargo from sliding sideways (see Figure 10-58).

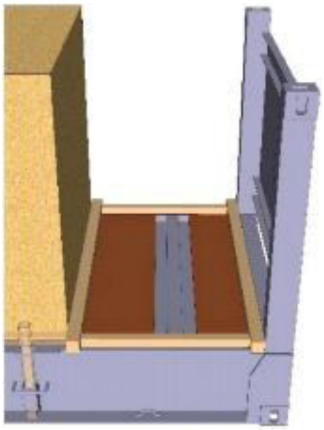


Figure 10-57 Wooden structure for blocking against the end wall of flat rack

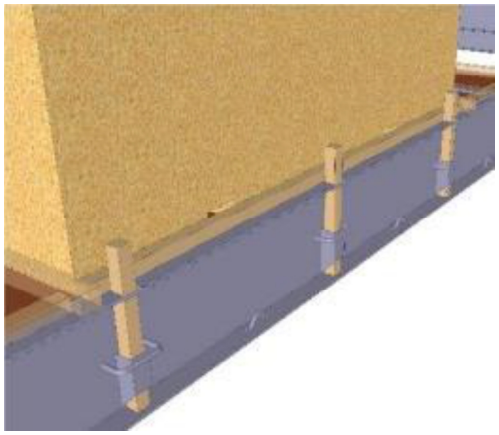


Figure 10-58 Stanchions preventing sideways sliding on platform CTUs [image to be replaced with a better one]

4.3.9 CTUs with weak cargo space boundaries like certain road vehicles and swap bodies will regularly require additional securing measures against sliding and tipping of a block of tightly stowed cargo. These measures should also contribute to compacting the block of cargo. The favourite method in this situation is friction-securing by so-called top-over lashings. For obtaining a reasonable securing effect from friction lashings, the friction factor between cargo and stowage ground should be sufficient and the inherent elasticity of the lashings should be able to maintain the pre-tension throughout the course of transport. The following balance demonstrates the confinement of tightly stowed cargo within weak cargo space boundaries and an additional securing force against sliding:

$$c_{x,y} \cdot m \cdot g \leq r_{x,y} \cdot P \cdot g + \mu \cdot c_z \cdot m \cdot g + F_{sec}\ [kN]$$

Equation 5

Where:

$c_{x,y}$	=	horizontal acceleration coefficient in the relevant mode of transport (see Chapter 6.3)
m	=	mass of cargo packed [tonne]
g	=	gravity acceleration 9.81 m/s^2
$r_{x,y}$	=	CTU wall resistance coefficient (see Chapter 7 of this Code)
P	=	maximum payload of CTU [tonne]
μ	=	applicable friction factor between cargo and stowage ground (see Appendix 10.2)
c_z	=	vertical acceleration coefficient in the relevant mode of transport (see Chapter 6.3)
F_{sec}	=	additional securing force

4.3.9.1 If a wall resistance coefficient is not specified for the distinguished CTU, it should be set to zero. The additional securing (F_{sec}) may consist of blocking the base of the cargo against stronger footing of the otherwise weak cargo space boundary or against stanchions of the cargo space boundary system. Such stanchions may be interconnected by pendants above the cargo for increasing their resistance potential. Alternatively, the additional securing force may be obtained by direct securing methods or top-over lashings. F_{sec} per top-over lashing is: F_V μ, where F_V is the total vertical force from the pre-tension. For vertical lashings F_V is 1.8 times the pre-tension in the lashing. For direct lashing arrangements μ should be set to 75% of the friction factor.

4.3.10 On CTUs without boundaries the entire securing effect should be accomplished by securing measures like top-over lashings, friction increasing material and, if the CTU is a flatrack, by longitudinal blocking against the end-walls. The following balance demonstrates the securing of tightly stowed cargo on a CTU without cargo space boundaries:

$$c_{x,y} \cdot m \cdot g \leq \mu \cdot c_z \cdot m \cdot g + F_{sec}\ [kN]$$

Equation 6

Where:

$c_{x,y}$	=	horizontal acceleration coefficient in the relevant mode of transport (see Chapter 6.3)
m	=	mass of cargo packed [tonne]
g	=	gravity acceleration 9.81 m/s^2
μ	=	applicable friction factor between cargo and stowage ground (see Appendix 10.2)
c_z	=	vertical acceleration coefficient in the relevant mode of transport (see Chapter 6.3)
F_{sec}	=	additional securing force

4.3.10.1 For $F_{sec,}$ see clause 4.3.9.1 in this annex. It should be noted that even in case of a friction factor that outnumbers the external acceleration coefficients, without cargo space boundaries a minimum number of top-over lashings is imperative for avoiding migration of the cargo due to shocks or vibration of the CTU during transport.

4.4 Individually secured packages and large unpackaged articles

4.4.1 Packages and articles of greater size, mass or shape or units with sensitive exterior facing, which does not allow direct contact to other units or CTU boundaries, should be individually secured. The securing arrangement should be designed to prevent sliding and, where necessary, tipping, both in the longitudinal and transverse direction. Securing against tipping is necessary, if the following condition is true (see also Figure 10-59):

$$c_{x,y} \cdot d \geq c_z \cdot b$$

Equation 7

Where:

$c_{x,y}$	=	horizontal acceleration coefficient in the relevant mode of transport (see Chapter 6.3)
d	=	vertical distance from centre of gravity of the package to its tipping axis [m]
c_z	=	vertical acceleration coefficient in the relevant mode of transport (see Chapter 6.3)
b	=	horizontal distance from centre of gravity of the package to its tipping axis [m]

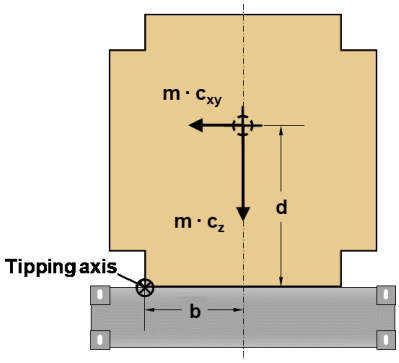


Figure 10-59 Tipping criterion

4.4.2 Individually secured packages and articles should preferably be secured by a direct securing method, i.e. by direct transfer of securing forces from the package to the CTU by means of lashings and/or blocking.

4.4.2.1 A direct lashing will be between fixed fastening points on the package/article and the CTU and the effective strength of such a lashing is limited by the weakest element within the device, which includes fastening points on the package as well as fastening points on the CTU.

.1 For sliding prevention by lashings, the vertical lashing angle should preferably be in the range of 30° to 60° (see Figure 10-60). For tipping prevention, the lashings should be positioned in a way that provides effective levers related to the applicable tipping axis (see Figure 10-61).

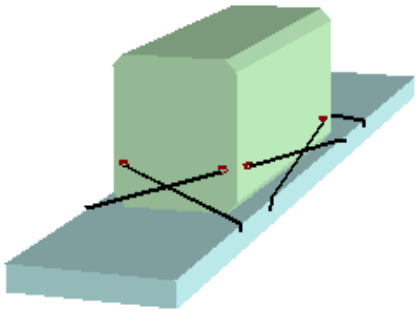


Figure 10-60 Direct lashing against sliding

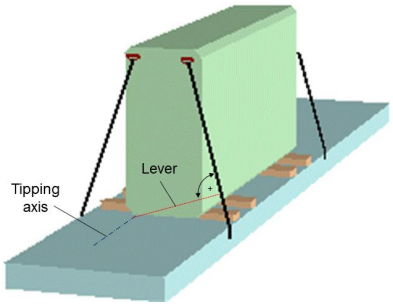


Figure 10-61 Direct lashing against tipping

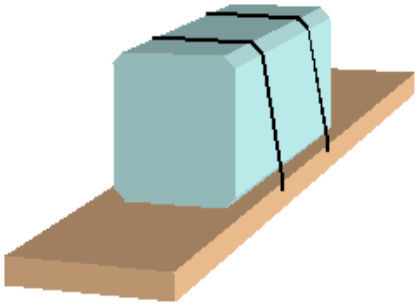


Figure 10-62 Top over lashing

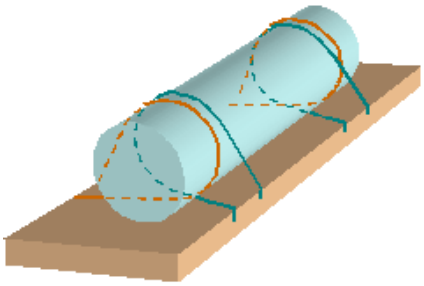


Figure 10-63 Vertical half-loop lashing

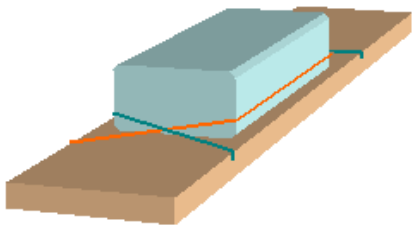


Figure 10-64 Horizontal half-loop lashing

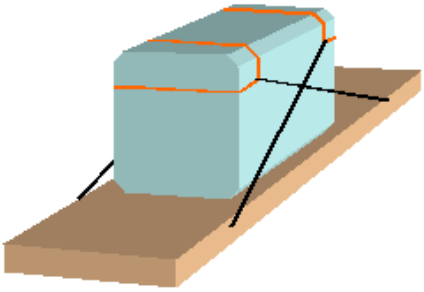


Figure 10-65 Spring lashing

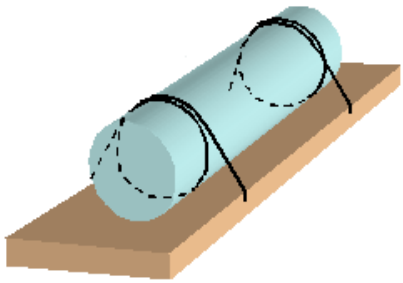


Figure 10-66 Silly-loop lashing

4.4.3 Packages and articles without securing points should be either secured by blocking against

solid structures of the CTU or by top-over, half-loop or spring lashings (see Figure 10-62 to Figure 10-66).

4.4.3.1 Loop lashings with their ends fastened to either side (see Figure 10-66), also called "silly-loops", do not provide any direct securing effect and may permit the package/article to roll and therefore are not recommended

4.4.3.2 Lashing corner fittings are available to provide alternative lashing to the spring lashing (see Figure 10-65).

4.4.3.3 Any lashing method adopted will require that the lashing material stretches in order to develop a restraining force. As the material relaxes, the tension in the lashing will slowly reduce, therefore it is important that the guidance given in clause 4.1.4 of this annex should be followed.

4.4.4 CTUs with strong cargo space boundaries favour the method of blocking for securing a particular package or article. This method will minimize cargo mobility. Care should be taken that the restraining forces are transferred to the CTU boundaries in a way that excludes local overloading. Forces acting to CTU walls should be transferred by means of spreader beams (see clauses 2.3.1 to 2.3.4 of this Annex). Very heavy packages or articles, e.g. steel coils or blocks of marble, may require a combination of blocking and lashing, however with observation of the restrictions identified in clause 4.1.6 of this annex (see Figure 10-67). Articles with sensitive surfaces may rule out the blocking method and should be secured by lashings only.

Figure 10-67 Transverse blocking of steel slab

4.4.5 Individual securing of packages or articles in CTUs with weak cargo space boundaries and in CTUs without boundaries requires predominantly the method of lashing. Where applicable, blocking may be additionally applied, but if used in parallel with lashings, the restrictions set out in clause 4.1.6 of this annex should be observed. Although the provision of good friction in the bedding of a package or article is recommended in any case, the use of top-over lashings for sliding prevention is discouraged unless the cargo has limited mass. Top-over lashings may be suitable for tipping prevention. In particular over-width packages or articles, often shipped on flat bed CTUs, should not be secured solely by top-over lashings (see Figure 10-68). The use of half loops and/or spring lashings is strongly recommended (see Figure 10-69 and Figure 10-70).

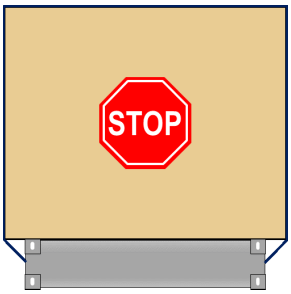


Figure 10-68 Top-over lashing

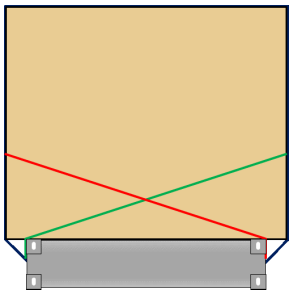


Figure 10-69 Top over and horizontal half-loop

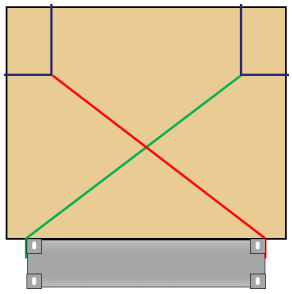


Figure 10-70 Transverse spring lashing

4.4.6 Where horizontal half loops are used, a means should be provided to prevent the loops from sliding down the package/article.

4.4.7 Alternatively, an over-width package or article can be secured by half-loops over the corners as shown in Figure 10-71.

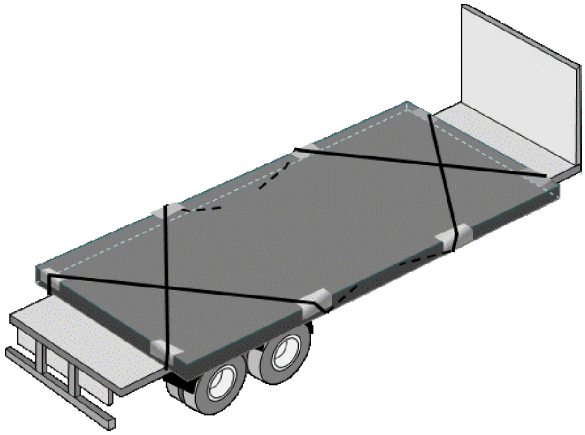


Figure 10-71 Over-width package secured by half-loops

4.5 Evaluation of securing arrangements

4.5.1 Evaluation of securing arrangements means making up a balance of expected external forces and moments against the securing potential of the planned or implemented securing arrangement. Expected external forces should be determined by multiplying the applicable acceleration coefficient, given in Chapter 6 of this Code, with the weight of the package or block of packages in question. Clause 6.3 distinguishes three modes of transport, road, rail and sea. The sea transport mode is further subdivided into three categories of severity of ship motions, aligned to the significant wave height of distinguished sea areas. Therefore, the selection of the applicable acceleration factor requires the full information on the intended mode and route of transport. Due consideration should be given to possible multimodal transport, in order to identify the acceleration figures for the most demanding mode or leg of the transport route. These figures should be finally used for the evaluation of the securing arrangement.

$$F_{x,y} = m \cdot g \cdot c_{x,y}$$

Equation 8

Where:

$F_{x,y}$ = expected external force [kN]

m = mass of cargo to be evaluated [tonne]

g = gravity acceleration 9.81m/s^2

$c_{x,y}$ = horizontal acceleration coefficient in the relevant mode of transport (see Chapter 6.3)

4.5.2 The assessment of the securing potential includes the assumption of a friction factor, based on the combination of materials (see Appendix 10.2) and the character of the securing arrangement (clause 2.2.2 of this annex), and, if applicable, the determination of the inherent tilting stability of the cargo (clause 4.3.1 of this Annex). Any other securing devices used for blocking, shoring or lashing should be estimated by their strength in terms of MSL and relevant application parameters like securing angle and pre-tension. These figures are required for evaluating the securing arrangement.

4.5.3 In many cases the evaluation of a securing arrangement may be accomplished by means of a simple rule of thumb. However, such rules of thumb may be applicable for certain distinguished conditions of transport only, e.g. for sea transport, and may overshoot or fall short in other conditions. It is therefore advisable to phrase such rules of thumb for distinguished modes of transport and use them accordingly. Any phrasing of a rule of thumb should undergo a first-time check by means of an advanced assessment method.

4.5.4 Standardized assessment methods for the evaluation of securing arrangements may consist of appropriate pre-calculated tables, based on balance calculations, which give quick answers regarding the adequacy of a securing arrangement (see Supplement 8). Such methods may be directed to specific modes of transport.

4.5.5 Evaluation of securing arrangements may be carried out by balancing forces and moments by an elementary calculation (see Supplement 9). However, the particular method used should be approved and suitable for the intended purpose and mode of transport. Specific guidance may be found in the IMO Code of Safe Practice for Cargo Stowage and Securing (CSS Code) and in various other standards and guidelines issued by regional or national authorities and industry groups covering various modes of transport. References:

- IMO CSS Code, Annex 13, for sea transport;
- European standard EN 12195-1:2010, for road transport;
- International Union of Railways (UIC), Agreement governing the exchange and use of wagons between Railway Undertakings (RIV 2000) Annex II, for rail transport.

4.5.6 The suitability of a specific securing arrangement may be evaluated and approved by an inclination test. The test may be used to demonstrate resistance against any specified external acceleration. The corresponding test-angle depends on the existing friction factor for a sliding resistance test, or on the relation between the height and the width of cargo for a tipping resistance test (see Appendix 10.3 to this annex).

5 Packing bulk material

5.1 Non-regulated liquids in tank CTUs

5.1.1 Tank CTUs filled with liquids having a viscosity less than 2,680 mm^2/s at 20°C and to be transported by road, rail or sea should be filled to at least 80% of their volume for avoiding dangerous surging, but never more than 95% of their volume, unless specified otherwise. A filing ratio of maximum 20% is also accepted. A filling ratio of more than 20% and less than 80% should only be permitted when the tank shell is subdivided, by partitions or surge plates, into sections of not more than 7,500 l capacity.

5.1.2 The tank shell and all fittings, valves and gaskets should be compatible with the goods to

be carried in that tank. In case of doubt, the owner or operator of the tank should be contacted. All valves should be correctly closed and checked for leak tightness.

5.1.3 For the transport of foodstuffs, the tank should comply with the following requirements:

- All parts of the tank which are in direct contact with the food stuff should be so conditioned that the overall food-grade property of the tank is guaranteed;
- The tank should be easily accessible and suitable for cleaning and disinfection;
- Inspection of the interior should be possible;
- The exterior should be conspicuously marked with a marking “FOR FOODSTUFFS ONLY” or with a similar wording.

5.2 Liquids in flexitanks

5.2.1 The term flexitank has been used to describe the bag in which the cargo is carried, but for the safe transport of bulk liquids in CTU the whole system needs to be considered. A new term, a flexitank system has been developed specifically for containers and is defined as a “system used for the transport of a liquid commodity which comprises a flexitank, a restraining system, a constraining system and a general-purpose container”. Packers of all CTU types carrying bulk liquids in flexitanks should be aware that proper securing of the flexitank is essential for safe transport and should follow the installation advice provided by the flexitank supplier.

5.2.2 Flexitanks used for the transport of bulk liquids by road, rail or sea should carry a label that confirms the type approval by a recognized consultative body. The flexitank manufacturer’s fitting instructions should always be followed, and the cargo intended to be carried should be checked for compatibility with the material of the flexitank. The transport of dangerous goods in flexitanks is prohibited.

5.2.3 During transport the contents of a flexitank will be subject to dynamic forces without significant retention from friction. These forces will act upon the boundaries of the CTU and may cause damage or complete failure.

5.2.4 Therefore, the payload of a CTU should be appropriately reduced, when it is used for carrying a filled flexitank. The reduction depends on the type of CTU and on the mode of transport. When a flexitank is used in a general purpose CTU, the mass of the liquid in the flexitank should not exceed a value agreed with the CTU operator, to prevent the CTU from suffering bulging damages (see Figure 10-72).

Figure 10-72 Damaged CTU side wall

5.2.5 Road vehicles intended to carry loaded flexitanks should have boundaries of a certified strength that is sufficient to confine the weight of the cargo under the accepted load assumptions. The certification of fitness of the vehicle should explicitly address the bulk transport of liquid under the assumption of zero-friction. Nevertheless, the lining of the bottom of the loading area with friction increasing material and the application of over-the-top fibre lashings every two metres is recommended for stabilizing the position and the strength of the flexitank.

5.2.6 During intermodal transport the forces experienced by the CTU will be magnified by the

potential sloshing of the liquid in the flexitank. Therefore, the correct handling of the CTU during transfers and on the various modal vehicles is essential. Improper handling or storage can cause a failure of the flexitanks and the partial or total loss of the cargo.

5.2.7 Flexitank operation

5.2.7.1 Commodity considerations

.1 General:

- Flexitanks shall only be offered to transport non-regulated (non-dangerous) substances when the flexitank is suitable and the materials of construction are resistant and compatible with the substance temperatures likely to be encountered at the time of filling and during transport.
- All parties are required to undertake an appropriate risk assessment before accepting any cargo for transport in a flexitank container system.
- All parties are required to exercise responsible care and ensure safe and reliable flexitank systems conforming to all relevant regulations.

.2 Dangerous Goods:

- Cargoes regulated as Dangerous Goods shall not be transported in flexitanks, therefore cargo included in IMDG Code (International Maritime Dangerous Goods Code) Dangerous Goods List, chapter 3.2 which provides the UN Number, Proper Shipping Name and Class of Dangerous Goods together with provisions for transport of substances classified as Dangerous Goods is not allowed to be transported in a flexitank.
- Liquids meeting the classification requirements of the applicable dangerous goods regulations for relevant mode of transport are dangerous goods and are not allowed to be transported in flexitanks.

.3 Non-regulated goods:

- Non-regulated cargo is allowed for carriage in flexitanks, provided it is suitable for flexitank transport and the flexitank materials of construction are resistant and compatible with temperatures likely to be encountered during transport.
- The carriage needs to comply with the maritime and national legislation for governing maximum gross mass of the flexitank system.
- The carriage needs to comply with national, or modal transport legislation or directives, and an authorisation for the transport of flexitanks may be required.

Note: Although the cargo might be classified as non-regulated by the criteria of the regulatory process, the cargo might contain hazards and risk. Therefore, the Safety Data Sheet (SDS) should be referred to and the required safety provisions should be implemented.

5.2.7.2 Flexitank application

Shipper must be aware of their responsibilities and liabilities when transporting bulk liquids in flexitanks. In addition to the chemical compatibility of the flexitank with the cargo, shippers should be aware of any potential changes that may occur during transport or the potential effect of a catastrophic failure, such as:

- Certain cargoes, such as wine, may be subject to fermentation during transport and the selection of the flexitank must be appropriate for the cargo carried. Improper selection may result in the flexitank expanding and damaging the container structure.
- Many of the cargoes carried in flexitanks (such as foodstuffs, wines and spirits) present little risk to the infrastructure should there be a serious leak, while others (such as oils and latex) may severely impact the operation of a facility (ship, terminal, roadway etc.) should a similar leak occur.
- Environmental controls may require that a leak of some easily disposed cargoes, such as wine, beer and fruit juices, require containment, dilution or cleaning before it enters the wastewater system.

5.2.7.3 Flexitank selection

When selecting a flexitank shipper and / or packers should:

- carry out appropriate risk assessments of the flexitank system and the cargo to ensure safe and reliable processes.
- select a flexitank manufacturer who has had their flexitank tested, certified and listed in the Container Owners Association (COA) Flexitank Quality Management List (FQML) with the status COA Member Certificate of Compliance[34].

5.2.7.4 CTU checks

.1 On arrival the CTU should be checked in accordance with Chapter 9 (clauses 9.1 and 9.2) and Annex 5 of this Code. Deficiencies should be notified to the CTU operator and returned for replacement.

.2 CTUs supplied for transporting a flexitank should be checked to ensure that there are no deficiencies that may puncture the flexitank such as:

- nails and screws
- splinters and broken flooring
- gouges in the flooring
- miss-aligned flooring or walls
- sharp edges at welds and repairs

.3 Where such deficiencies are found the CTU operator should be notified and a replacement CTU be provided or temporary repair be done and agreed with the CTU operator, such as covering the with a suitable protective lining.

5.2.7.5 Fitting, filling & securing

Note: Always operate the flexitank system in accordance with the manufacturer's instructions and best practice to ensure safe and reliable outcome.

.1 Fitting:

- The CTU should be prepared and the flexitank should be installed according to the manufacturer's installation instructions using trained personnel.
- If the cargo has a thick consistency and requires heating to improve unpacking then the heating pads (water or electric) should be installed underneath or to the sides of the flexitank.

Before filling starts, the installation should be checked to ensure the system has been fitted in accordance with the manufacturer's instructions and that there are no signs of damage to any constituent part of the flexitank system.

.2 Filling

For filling an empty flexitank the left-hand door of the CTU should be firmly closed so that the inserted barrier is appropriately supported (see Figure 10-73). The flexitank should be filled at a controlled rate. The use of spill protection devices like collecting bag or drip tray is recommended.

[34] Using a flexitank that has not been certified and listed in the COA FQML does not mean that it is not suitable for the cargo, however, the risk of an incident or damage to the CTU may be increased.

Figure 10-73 Container fitted with flexitank

Overfilling a flexitank can result in damage to the CTU and loss of cargo. Stop filling:

- once the target volume has been reached,
- if the flexitank or any constituent parts becomes trapped,
- if there are signs of the flexitank or the valve leaking.

Do not restart filling until the deficiency has been rectified.

.3 Closing:

On completion of filling the flexitank:

- the CTU should be closed ensuring that the valve does not obstruct the door operation or be forced out of position when closing the door,
- No part of the flexitank or shoring bars or bulkhead should touch either door when fully filled;
- Where required the Shipper should also provide a VGM for the CTU (freight container). Under the current terms of SOLAS, bulk liquid cargoes can only have a VGM produced by method 1, therefore, on completion of packing and after the container has been sealed, the packer should weigh the packed and sealed container on a calibrated weighing device.

5.2.7.6 Container CTU Markings

After filling and sealing the flexitank, the door of the CTU should be closed and a marking(s) applied to indicate that the CTU is carrying a flexitank.

5.2.8 Discharging cargo

5.2.8.1 Only the right hand door of the CTU should be opened until the majority of the cargo has been emptied from the flexitank.

5.2.8.2 If heating pads have been requested and fitted, then these should be activated before the emptying process starts and only trained and competent personnel should conduct the heating, The internal pressure of the flexitank will force the majority of the cargo out of the flexitank, but additional procedures may be required to fully empty the flexitank.

5.2.9 Environment: disposal and recycling

5.2.9.1 After discharge of the flexitank cargo, the flexitank, linings and all equipment should be completely removed from the CTU and safely disposed of or recycled for other use as agreed between the Shipper and the Consignee.

5.2.9.2 It is probable that a small amount of residue will remain in the flexitank once the emptying process has been completed. This may affect the recycling of the flexitank after use.

5.2.9.3 The CTU should be cleaned, and any marks fitted to the exterior removed. The empty CTU should then be returned to the CTU Operator notifying them of any deficiencies or damage that occurred during the flexitank transport process.

5.3 Solid dry bulk cargoes

5.3.1 General

5.3.1.1 Regulated and non-regulated solid bulk cargoes may be packed into a CTU provided the boundaries of the cargo spaces are capable to withstand the static and dynamic forces of the bulk material under the foreseeable transport conditions (see Chapter 6 of this Code).

5.3.1.2 Wherever possible, bulk solids should be packed into bulk CTUs and evenly distributed in a manner that minimises movements that could result in damage to the CTU or leakage of the cargo. However, general purpose CTUs are also permitted for use to carry bulk solids (see clause 5.3.3.1 of this annex).

5.3.1.3 The density of bulk solids often means that smaller cargo spaces are normally required, such as the 20 ft general purpose container or 30ft bulk container. However, the design requirements of the 20 ft containers are not always fully suitable for such cargoes, especially free flowing powders and granules. For instance, extremely free flowing materials can damage the side (see Figure 10-74) and end walls due to stresses induced during intermodal transport where there is high sideway acceleration, such as turning a sharp corner on a road vehicle.

Figure 10-74 Bulging wall

5.3.1.4 Additionally, containers, like many other types of CTU, are normally fitted with full width, full height rear doors which is the only means by which the cargo can be packed and unpacked. When transporting free flowing materials, opening the rear doors may result in the cargo falling from the container with the associated injury to cargo handlers and loss of cargo. Therefore, in order to transport powders and granules in GP containers, false walls, known as bulkheads, should be erected at the rear end to retain the cargo when one or both doors are opened.

5.3.1.5 Containers are not designed or tested for packing with the container positioned at an angle greater than [45] degrees and under no circumstances should it be stood on its endwall. When unpacking by tipping the container the unpacker must satisfy themselves that the operation is safe, and that the container is not damaged during the operation.

5.3.1.6 Substances which may become liquid at temperatures likely to be encountered during transport are not permitted in either bulk or general purpose CTUs.

5.3.2 Substances which meet the criteria for inclusion in a hazard class of the applicable dangerous goods regulations for relevant modes of transport are dangerous goods. Such goods are permitted for transport unpacked in a bulk CTU only if this is individually permitted by the applicable dangerous goods regulations for relevant modes of transport and when all their provisions are complied with. Only substances exhibiting a very low degree of hazard are permitted in bulk. They can be identified by an entry in column 13 of the Dangerous Goods List (IMDG Code). For dangerous goods, the mandatory provisions of the IMDG Code shall be observed in addition to following recommendations of this Code, which apply to all solid bulk cargoes.

5.3.3 Use of Bulkheads

5.3.3.1 For the transport of solid bulk cargoes in containers, preferably non-pressurized containers for dry bulk, designed and tested in accordance with ISO 1496- 4, should be used. When general cargo containers for general purpose according to ISO 1496-1 are used, applicable dangerous goods regulations require that the end walls are strengthened to the same level as provided in ISO 1496-4. In case of solid bulk cargoes which are not subject to the applicable dangerous goods regulations, a similar reinforcement of the end walls is recommended.

Figure 10-75 False bulkhead

5.3.3.2 Reinforcement can normally be fulfilled by fitting a partial height false bulkhead against the front wall (see Figure 10-75). The front false bulkhead consists of two full-width plywood panels with horizontal softwood timber cross beams extending the whole width of the CTU and resting against the strong corner posts. The panels should be plywood (internal grade) and have a minimum thickness of 12 mm. The height of the panels should be at least 200 mm above the height of the cargo when packed but at least 1,800mm high with the lower panels as high as possible (preferably 1,200 mm high). When the cargo is very fluid greater hight may be required. Panels with a height less 600 mm should have one full width 150 x 50 mm softwood timber cross beams and all other panel heights at least two full width beams.

5.3.3.3 At the door end, the applicable dangerous goods regulations for relevant modes of transport requires that "*operational equipment of bulk containers designed to be emptied by tilting shall be capable of withstanding the total filling mass in the tilted orientation*." This means that the rear bulkhead should be sufficiently strong so as to retain the cargo with the door open.

5.3.3.4 Many closed containers are equipped with shoring slots in the door corner posts which are suitable to accommodate transverse steel bars of 60 mm square cross section. This arrangement is particularly designed to strengthen the freight container door end for taking a load of 0.6*P*, as required for solid bulk cargoes. These bars should be properly inserted. The relevant transport capability of the CTU should be demonstrated by a case-related certificate issued by a recognized consultative body or by an independent cargo surveyor. This requirement applies to multi-purpose containers and to similar closed CTUs on road vehicles, which are not explicitly designed to carry bulk cargoes.

5.3.3.5 Timber beams may be used so long as they satisfy the strength requirements, however, the length of the beams should be long enough so that they are not able to slide out when moved horizontally (see Figure 10-76 and Figure 10-77).

Figure 10-76 Beam too short

Figure 10-77 Beams too short

5.3.4 Preparation of CTUs for the carriage of bulk cargoes

5.3.4.1 A CTU intended to carry a bulk cargo should be cleaned and prepared adequately. It may be necessary to place plywood facing not only the front wall but also to the side walls of the CTU to protect them from bulging or scratching (see Figure 10-78). A cargo specific siftproof liner should be used for accommodating bulk cargoes like grain, coffee beans or similar sensible materials (see Figure 10-79).

Figure 10-78 Lining a 40 ft container with chipboard

Figure 10-79 CTU with liner bag for accommodating a sensitive bulk cargo

5.3.4.2 When using box type CTUs, it should be recognised that it will have been used to transport a variety of cargoes, some of which may constitute a contaminate to powder or granule cargoes carried subsequently. While CTU operator will endeavour to ensure that CTUs are clean before delivery to a shipper, it is the shippers' responsibility to ensure that the CTU is fit for use before loading. Likewise, after the shipment has been

made, it is the unpacker's responsibility to ensure that the interior is clean, and all traces of the cargo carried removed. Siftproof liners make the cleaning process easier, but they do not totally eliminate the need for pre and post laden cleaning.

5.3.4.3 Small and fine powders and grains if not contained within a liner may fall out through the doors during transport due to vibration. It is therefore recommended that all dry bulk cargoes are only carried within a suitable liner.

Figure 10-80 Lined container packed with scrap

5.3.4.4 If crude or dirty material will be transported, the CTU boundaries should be lined with plywood or chipboard for avoiding mechanical wastage of the CTU (see Figure 10-80). In all cases an appropriate door protection should be installed consisting of battens fitted into suitable recesses and complemented by a strong plywood liner.

5.3.4.5 Scrap and similar waste material to be carried in bulk in a CTU should be sufficiently dry to avoid leakage and subsequent contamination of the environment or other CTUs, if stacked ashore or transported in a ship.

5.3.5 Abrasive cargoes, such as sugar and some grains, can cause damage to the liner if the flow of the material is directed directly at the liner, particularly during gravity loading through the top hatches (floor) or thrown or pneumatic loading through the rear doors (roof or front wall). These loading methods do have restrictions, and it requires the loading operators to understand the "flowability" of the product being loaded so that it is evenly distributed across the entire container by gradually withdrawing the conveyor / blow pipe. Powders and grains which have a high angle of repose may settle unevenly and cause the eccentricity of the bulk material in the CTU which could result in handling difficulties. Depending on the internal friction and the angle of repose of the solid bulk cargo, the CTU may be inclined to a certain degree, to facilitate the loading or unloading operation. However, it should always be ensured that the walls of the CTU are not overstressed by the filling operation. It is not acceptable to turn a CTU by 90° to an upright position for filling, unless the CTU is especially approved for this method of handling.

5.3.6 Packing problems

5.3.6.1 It is frequently seen that the packing method used may cause damage to the CTU's interior surfaces even when a liner has been fitted. Damage can be caused by a number of ways:

- abrasion;
- wear;
- tearing,

resulting in additional costs for cleaning and remedial work on the CTU's interior. Damage to a liner used to render a CTU siftproof may result in substantial cleaning costs onboard ship and in terminals. Therefore, correct supervision and spot checking of packing operations should be performed regularly.

5.3.7 Unpacking dry bulk cargoes

5.3.7.1 Unpacking regulated dry bulk cargoes may require specialist discharge equipment to ensure that there is no escape of the cargo during the process. Fine powder if it becomes airborne may present a risk of explosion.

5.3.7.2 Unpacking CTUs is generally far easier than loading as gravity can greatly assist the process. All box types of CTU apart from the vertical hopper type can be tipped either on specialist tipping equipment or, as is becoming more popular, using tipping chassis / trailers. During the tipping operation, extra care should be taken to ensure that:

.1 the CTU is not overstressed during the unpacking operation.

.2 the rear doors or wall are not over stressed and, for CTUs with rear doors and wherever possible, the rear false bulkhead should take all of the load caused by the tipped load.

.3 that the tipping device is stable and that the risk of it falling is minimised

Note: Containers are not designed or tested for tipping discharge, therefore, the consignee must satisfy themselves that the operation is safe, and that the container is not damaged during the operation.

5.3.7.3 Specialist bulk containers, such as shown in Figure 10-81 are designed with discharge hatches and a front or rear structure that can withstand the forces associated with a tipped load.

5.3.7.4 Discharging a CTU generally is undertaken using a tundish system attached to the rear of the container, a piped discharge or a general discharge into a receiving hopper. As the following three pictures show the CTU will need to be tipped to a lesser or greater degree.

Figure 10-81 Tundish discharge

Figure 10-82 Grid discharge

Figure 10-83 Piped discharge

5.3.7.5 CTUs can be tipped in one of three ways, using the trailer chassis (Figure 10-81 and Figure 10-84), a tipping platform (Figure 10-85) or a tipping frame (Figure 10-82, Figure 10-83 and Figure 10-86). Using the chassis or a platform means that CTU does not need to be lifted off the road vehicle, which in the case of some specialist CTUs with a gross mass of 38 tonnes would require special handling equipment. A tipping frame may be able to lift the CTU directly off the trailer as shown in Figure 10-86 or may require handling equipment that positions the CTU within the frame (see Figure 10-82).

Figure 10-84 40 ft Tipping trailer

Figure 10-85 100 tonne Tipping platform

Figure 10-86 40 ft Tipping frame

5.3.7.6 When handling CTUs, especially longer than 20 ft, extra care is required to ensure that the stability of the CTU is maintained during the whole unpacking process. As the cargoes moves within the CTU during the operation, the centre of gravity will change, and if associated with potentially uneven ground or side winds, the stability may be compromised, resulting in the CTU falling.

Figure 10-87 Locking twistlock

Figure 10-88 Backstop (viewed from rear of trailer)

5.3.8 When tipping a container on a trailer, it is important to ensure that the container is properly attached and there is no risk of the unit moving during the unpack process. Sudden movement of the cargo can place extraordinary loads on the twistlocks, therefore, it is essential that the correct attachment devices are used and properly tightened. Figure 10-87 shows a tightened screw-down twistlock which should be used at all four corners and Figure 10-88 shows a backstop, which prevents the container from slipping.

5.4 Packing of perishable cargoes

5.4.1 General

5.4.1.1 Perishable cargoes often require specialist transport facilities and can cover a variety of products. Efficient transportation is crucial to ensure safe delivery. Each type, whether dairy products or live animals, necessitates specific conditions during transport. In the context of this clause, perishables are usually, but not always, foodstuffs. Without careful treatment, the time taken to deteriorate to a condition which will either reduce the value or render it unsalable may become unacceptably short.

5.4.1.2 Careful consideration of the factors affecting the "shelf life" of perishables should be made and transport conditions during the "storage life" of the cargo correctly applied. Perishables require specific storage conditions to remain safe for consumption. It's important to keep high-risk foods refrigerated to prevent food poisoning.

5.4.1.3 Specific requirements for some perishable cargoes, include horticultural products such as flowering bulbs and fresh flowers, are not subject to this section of the Code.

5.4.1.4 Many cargoes considered as perishable and can be shipped in general purpose CTUs, and often are covered by specific transport requirements. Shippers should ensure that the CTUs selected have been prepared accordingly. This Code cannot provide specific guidance or recommendations on the preparation of the CTU and this clause only

considers refrigerated cargoes.

5.4.1.5 Packing of refrigerated cargoes is one of the more important factors in all types of transport and is particularly affected by the packaging of the commodity, whether it be carton, pallet, net bag or hanging meat. The stow should be stable to avoid damage during handling and in transit yet it should permit air to circulate freely through and around the commodity.

5.4.2 Packing conditions

5.4.2.1 There are various makes and models of refrigerated containers in use. When exporting temperature, atmospheric and time sensitive commodities, shippers should liaise accordingly with the carrier to ensure a container fit for purpose is supplied that is capable of operating to desired and mutually agreed requirements.

5.4.2.2 Maintaining proper conditions during shipment from the packing shed to the market is an important factor in minimising quality loss.

5.4.2.3 Problems could occur in the carriage of perishable cargo due to the lack of adequate and accurate carriage instructions issued by shippers. It is extremely important that rational procedural precautions are routinely adopted, and instructions are always given in writing to all parties in the transport chain. Shippers should ensure that all documentation shows the Set Point temperature and atmospheric conditions settings. It is recommended that the information contained in the electronic Pre-receival Advice should be made available to all parties in the transport chain.

5.4.2.4 The shipper is in the best position to know the optimum temperature and container vent settings (or Fresh Air Exchange rates) for the carriage of his product and his reefer instructions should be followed unless they are obviously wrong or raise a natural uncertainty. In that event, clarification should be sought. Carriage instructions given to a shipping company should be complete, adequate and accurate to avoid the risk of damage to the cargo.

5.4.2.5 The successful delivery of fruit, vegetable and horticultural produce from origin to destination in refrigerated containers is also dependent on the maintenance of suitable storage and packing conditions during transport.

5.4.2.6 The quality of the produce can be maintained only if each link in the chain continuously maintains the integrity of the chain.

5.4.3 Packing refrigerated cargoes

5.4.3.1 When packing refrigerated CTUs the perishable cargo should be precooled to the required transport temperature (see Supplement 10.7).

5.4.3.2 Perishable Meats, Fish and Seafood: Frozen and Fresh

Proper packing, diligent handling, temperature control and effective cold chain management are crucial throughout the journey for the safe delivery to consignees.

5.4.3.3 Perishable Dairy Products: Eggs, Milk, Cheese, Yogurt, Ice Cream

Temperature control is crucial to prevent bacteria growth and to maintain freshness and quality.

5.4.3.4 Transporting Live Seafood, Animals, Plants, and Fresh-Cut Flowers

The transportation of live seafood, animals, plants, and fresh-cut flowers requires careful handling to maintain their freshness and quality throughout the journey. Specialized logistics companies are often used to provide expertise in handling these unique cargo types while adhering to regulations for optimal delivery conditions.

5.4.3.5 Other Frozen or Wet Products

In addition to the more commonly known perishable goods like meat and dairy products, there are several other frozen or wet products that fall under the category of perishable cargo. These can include items such as frozen fruits and vegetables, ice cream, seafood, juices, and even certain chemicals that require specific temperature control. The transportation of these items requires careful handling and adherence to refrigeration standards to ensure their quality and safety during transit.

5.4.4 For further details and guidance on packing chilled and frozen cargoes see Supplement 10.

Appendix 10.1. Packaging marks

Note: The labels and marks required for the transport of dangerous goods can be found in the applicable dangerous goods transport regulations and are not included in this Code.

1 Introduction

1.1 Packages are often marked with handling instructions in the language of the country of origin. While this may safeguard the consignment to some extent, it is of little value for goods consigned to, or through, countries using different languages, and of no value at all if people handling the packages are illiterate.

1.2 Pictorial symbols offer the best possibility of conveying the consignor's intention and their adoption will, therefore, undoubtedly reduce loss and damage through incorrect handling.

1.3 The use of pictorial symbols does not provide any guarantee of satisfactory handling; proper protective packaging is therefore of primary importance.

1.4 The symbols shown in this annex are those most regularly exhibited. These and others are shown in ISO standard 780[35].

2 Symbols

2.1 Display of symbols

2.1.1 Symbols should preferably be stencilled directly on the package or may appear on a decal. It is recommended that the symbols be painted, printed or otherwise reproduced as specified in this ISO standard. They need not be framed by border lines.

2.1.2 The graphical design of each symbol should have only one meaning; symbols are purposely designed so that they can also be stencilled without changing the graphics.

2.2 Colour of symbols

2.2.1 The colour used for symbols should be black. If the colour of the package is such that the black symbol would not show clearly, a panel of a suitable contrasting colour, preferably white, should be provided as a background.

2.2.2 Care should be taken to avoid the use of colours which could result in confusion with the labelling of dangerous goods. The use of red, orange or yellow should be avoided unless regional or national regulations require such use.

2.3 Size of symbols

For normal purposes the overall height of the symbols should be 100 mm, 150 mm or 200 mm. The size or shape of the package may, however, necessitate use of larger or smaller sizes for the symbols.

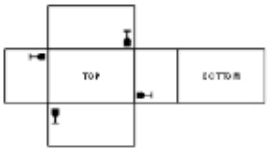
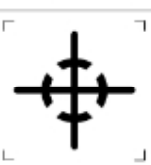
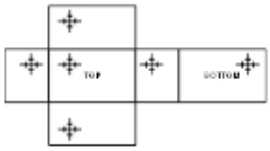
2.4 Positioning of symbols

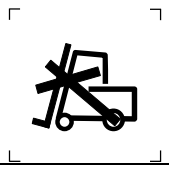
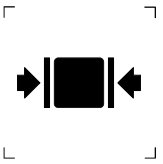
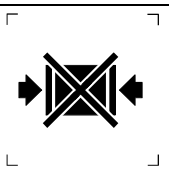
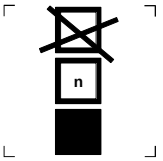
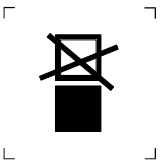
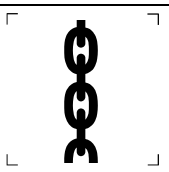
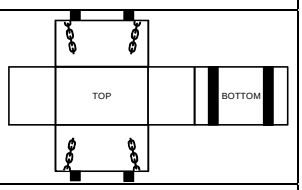
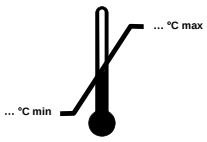
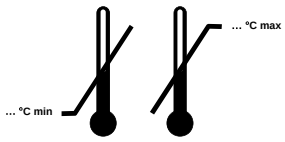
Particular attention should be paid to the correct application of the symbols, as faulty application may lead to misinterpretation. Symbols No. 7 and No. 16 should be applied in their correct respective positions and in appropriate respective places in order to convey the meaning clearly and fully.

[35] ISO standard 780, Packaging – Pictorial markings for handling of goods.

3 Handling instructions

Handling instructions should be indicated on transport packages by using the corresponding symbols given in the following table.

No	Instruction / Information	Symbol	Meaning	Guidance	Representation
1	FRAGILE		Contents of the package are fragile therefore it shall be handled with care	"Fragile" shall be shown near the left hand upper corner on all four upright sides of the package	
2	USE NO HAND HOOKS		Hooks are prohibited for handling the transport package		
3	THIS WAY UP		Indicates the correct upright position of the transport package.	"This way up" shall appear in the same position as required for the "Fragile" symbol. Where both symbols are present, "This way up" shall appear nearer to the corner.	
4	KEEP AWAY FROM SUNLIGHT		Transport package shall not be exposed to sunlight		
5	PROTECT FROM RADIOACTIVE SOURCES		Contents of the package may deteriorate or may be rendered totally unusable by penetrating radiation		
6	KEEP AWAY FROM RAIN		Transport package shall be kept away from rain		
7	CENTRE OF GRAVITY		Indicates the centre of gravity of the transport package which will be handled as a single unit.	Where possible, "Centre of gravity" shall be placed on all six sides but at least on the four lateral side relating to the actual location of the centre of gravity.	
8	DO NOT ROLL		Transport package shall not be rolled		
9	DO NOT USE HAND TRUCK HERE		Hand trucks shall not be placed on this side when handling the transport package		

No	Instruction / Information	Symbol	Meaning	Guidance	Representation
10	USE NO FORKS		Transport package should not be handled by forklift truck		
11	CLAMP AS INDICATED		Clamps shall be placed on the sides indicated for handling the transport packages	1) only appropriately marked packages should be handled by by clamps 2) The symbol shall be positioned on two opposite faces of the package so that it is in the visual range of the clamp truck operator when approaching to carry out operation The symbol shall not be marked on those faces of the package intended to be gripped by the clamps	
12	DO NOT CLAMP AS INDICATED		Transport package should not be handled by clamps on the sides indicated		
13	STACKING LIMIT BY MASS		Indicates the maximum stacking mass permitted on the transport package		
14	STACKING LIMITED BY NUMBER		Maximum number of identical packages which may be stacked on one another, where "n" is the limiting number		
15	DO NOT STACK		Stacking of the transport package is not allowed and no packages should be placed on the transport package.		
16	SLING HERE		Slings shall be placed where indicated for lifting the transport package.	"Sling here" shall be placed on at ;east two opposite faces of the package.	
17	TEMPERATURE LIMITS		Indicates temperature limits within which the transport package shall be stored and handled		

Appendix 10.2. Friction factors

Different material contacts have different friction factors. The table below shows recommended values for the friction factors. The values are valid provided that both contact surfaces are "swept clean" and free from any impurities. The values are valid for the static friction. In case of direct lashings, where the cargo has to move little before the elongation of the lashings provides the desired restraint force, the dynamic friction applies, which is to be taken as 75% of the static friction.

Material combination in contact surface	Dry	Wet
SAWN TIMBER/WOODEN PALLET		
Sawn timber/wooden pallet against fabric base laminate/plywood	0.45	0.45
Sawn timber/wooden pallet against grooved aluminium	0.4	0.4
Sawn timber/wooden pallet against stainless steel sheet	0.3	0.3
Sawn timber/wooden pallet against shrink film	0.3	0.3
PLANED WOOD		
Planed wood against fabric base laminate/plywood	0.3	0.3
Planed wood against grooved aluminium	0.25	0.25
Planed wood against stainless steel sheet	0.2	0.2
PLASTIC PALLETS		
Plastic pallet against fabric base laminates/plywood	0.2	0.2
Plastic pallet against grooved aluminium	0.15	0.15
Plastic pallet against stainless steel sheet	0.15	0.15
CARDBOARD (UNTREATED)		
Cardboard against cardboard	0.5	-
Cardboard against wooden pallet	0.5	-
BIG BAG		
Big bag against wooden pallet	0.4	-
STEEL AND SHEET METAL		
Unpainted metal with rough surface against unpainted rough metal	0.4	-
Painted metal with rough surface against painted rough metal	0.3	-
Painted metal with smooth surface against painted smooth metal	0.2	-
Metal with smooth surface against metal with smooth surface	0.2	

Material combination in contact surface	Dry	Wet
STEEL CRATES		
Steel crate against fabric based laminate/plywood	0.45	0.45
Steel crate against grooved aluminium	0.3	0.3
Steel crate against stainless steel sheet	0.2	0.2
CONCRETE		
Concrete with rough surface against sawn wood	0.7	0.7
Concrete with smooth surface against sawn wood	0.55	0.55
ANTI-SLIP MATERIAL		
Rubber against other materials when contact surfaces are clean	0.6	0.6
Materials other than rubber against other materials	as certified or tested according to appendix 10.3	

Friction factors (μ) should be applicable to the actual conditions of transport. When a combination of contact surfaces is missing in the table above or if its friction factor cannot be verified in another way, the maximum allowable friction factor of 0.3 should be used. If the surface contacts are not swept clean, the maximum allowable friction factor of 0.3 or, when lower, the value in the table should be used. If the surface contacts are not free from frost, ice and snow a static friction factor of 0.2 should be used, unless the table shows a lower value. For oily and greasy surfaces or when slip sheets have been used a friction factor of 0.1 applies.

Appendix 10.3. Practical methods for the determination of the friction factor *μ*

To determine the friction factor μ two alternative methods are given. A practical approach to make an assumption on the applicable friction factor is the inclination test which can be carried out by any party involved in the packing of a CTU. The alternative method to determine the exact friction factor is the pulling test which however needs laboratory equipment.

1 Inclination test

The factor μ indicates how easily a cargo will slide if the cargo platform is tilted. A method to find μ is to incline a cargo platform carrying the cargo in question and measure the angle (α) at which the cargo starts to slide. This gives the friction factor $\mu = 0.925 \cdot \tan \alpha$. Five tests should be done under practical and realistic conditions, the highest and lowest values should be ignored and the average of the remaining three used to determine the friction factor.

2 Pulling test

2.1 The test rig consists of the following components:

- Horizontal floor with a surface representing the cargo platform;
- Test device for tensile tests;
- Connecting device between the test equipment and the bottom of the package;
- PC based evaluation system.

The tensile device should comply with ISO standard 7500-1.

2.2 The test conditions should correspond to real ones; the contact surfaces should be swept clean and free from impurities. Tests should be executed in an atmospheric condition 5 in accordance with ISO 2233:2001 at a temperature of + 20°C and 65% relative humidity.

2.3 The pulling speed should be 100 mm /min, the sampling rate should be at least 50 Hz.

2.4 A measurement of pulling force and way of displacement is made with the same test object in one arrangement with a respective glide path of 50 mm to 85 mm for each stroke. At least three individual strokes should be carried out with an intermediate unloading of at least 30% of the pulling force per measurement (see also Figure 10.3-1).

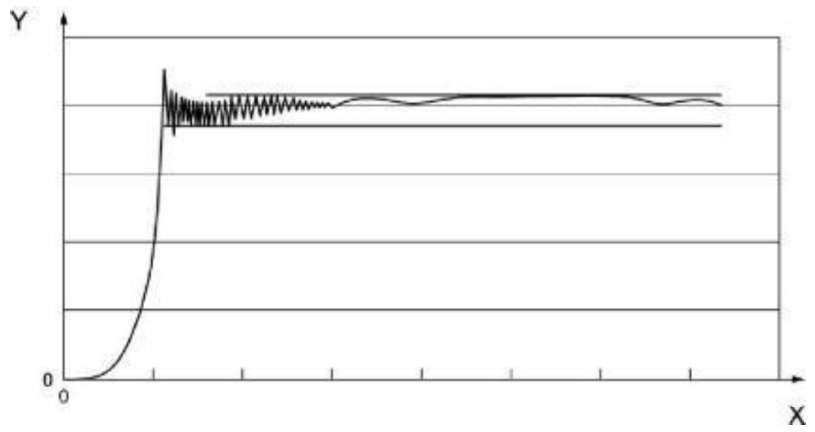


Figure 10.3-1

Key: Y - Pulling force X - Direction of displacement

2.5 A measurement series consists of three measurements for each of three strokes. The test piece and/or anti slip material should be replaced for each measurement, so that any influence of material

wear on the result of the measurement can be excluded.

2.6 The friction factor μ should be determined according to the equation mentioned below, taking into account the three medium values of each of the three measurements:

$$\mu = (\text{pulling force} \cdot 0.95) / (\text{weight} \cdot 0.925)$$

2.7 For a most realistic determination of frictional forces and friction factors, multiple measurements series should be executed, each with different test samples for cargo area, anti-slip mat and load bearer or load.

2.8 If the measurement condition differs from what is specified above, the test conditions should be documented in the test report.

Appendix 10.4. Specific packing and securing calculations

1 Resistivity of transverse battens

The attainable resistance forces F of an arrangement of battens may be determined by the formula (see also Figure 10.4-1):

$$F = n \cdot \frac{w^2 - h}{28 - L} \cdot [kN]$$

Equation 9

Where:

n	=	number of battens
w	=	thickness of battens [cm]
h	=	height of battens [cm]
L	=	free length of battens [m]

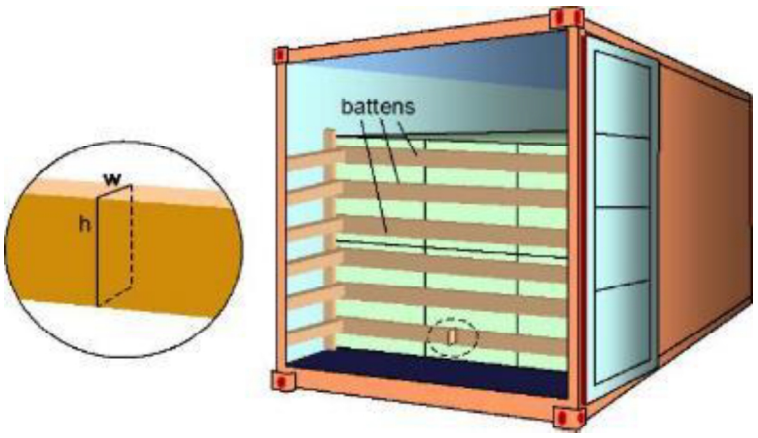


Figure 10.4-1 Transverse battens in a container

Example:

A fence of six battens has been arranged. The battens have a free length L = 2.2 m and the cross-section w = 5 cm, h = 10 cm. The total attainable resistance force is:

$$F = n \cdot \frac{w^2 \cdot h}{28 \cdot L} = 6 \cdot \frac{5^2 \cdot 10}{28 \cdot 2.2} = 24kN$$

This force of 24 kN would be sufficient to restrain a cargo mass [m] of 7.5 tonnes, subjected to accelerations in sea area C with 0.4 g longitudinally (c_x) and 0.8 g vertically (c_z). The container is stowed longitudinally. With a friction factor between cargo and container floor of μ = 0.4 the following balance calculation shows:

$$c_z \cdot m \cdot g < \mu \cdot m \cdot (1 - c_z) \cdot g + F\ [kN]$$

$$0.4 \cdot 7.5 \cdot 9.81 < 0.4 \cdot 7.5 \cdot 0.2 \cdot 9.81 + 24\ [kN]$$

$$29 < 6 + 24\ [kN]$$

2 Bedding a concentrated load in a general-purpose container

2.1 Introduction

2.1.1 Bedding arrangements for concentrated loads in general purpose containers should be designed in consultation with the CTU operator.

2.1.2 The minimum length and bending resistance (section modulus) of bedding beams should be taken from the tables in clause 3.1 of Annex 10or by the formulas presented below.

2.2 Minimum length

2.2.1 The minimum length of bedding beams, LR, can be calculated by following formula:

$$L_R = 0.165 \cdot m \cdot (2.3 - B)$$

Equation 10

Where:

L_R = Minimum length of bedding beams [m]
m = mass of cargo [tonne]
B = Spacing of bedding beams [m]

2.2.2 In addition, where the cargo mass is greater than 50% of the Payload, the length of bedding beams, LR, should also not be less than:

$$L_R = \left(\frac{m}{P} - 0.5\right) \cdot L_{CTU}$$

Equation 11

Where:

L_R = Minimum length of bedding beams [m]
m = mass of cargo [tonne]
P = Payload of the CTU [tonne]
L_{CTU} = Length of the CTU [m]

2.3 Minimum section modulus

2.3.1 The minimum section modulus, W, for bedding beams can be calculated by the following formula:

$$W = \frac{125 \cdot m \cdot g \cdot (L_R - L_C)}{n \cdot \sigma_p}$$

Equation 12

Where:

W = Minimum section modulus of bedding beams [cm^3]
m = mass of cargo [tonne]
L_R = Minimum length of bedding beams as given in Appendix 10.4.2.2clause 2.2 of this Appendix [m]
L_C = Length of cargo footprint on bedding beams [m]
n = number of bedding beams
σ_p = Permissible bending stress of material in beams [N/mm^2]

3 Longitudinal position of the centre of gravity of cargo

The longitudinal position of the centre of gravity of the cargo should be used in connection with specific load distribution rules and diagrams of CTUs[36]. The longitudinal position of the centre of gravity of the cargo within the inner length of a packed CTU is at the distance d from the front, obtained by the formula (see also Figure 10.4-2):

$$d = \frac{\Sigma(m_n - d_n)}{\Sigma m_n}$$

Equation 13

Where:

d	=	distance of common centre of gravity of the cargo from the front of the stowage area [m]
m_n	=	mass of the individual packages or overpack [tonne]
d_n	=	distance of centre of gravity of mass m_n from the front of the stowage area [m]

[36] Examples of load distribution diagrams for containers, trailer and railway wagons are provided in Annex 10.3.3.

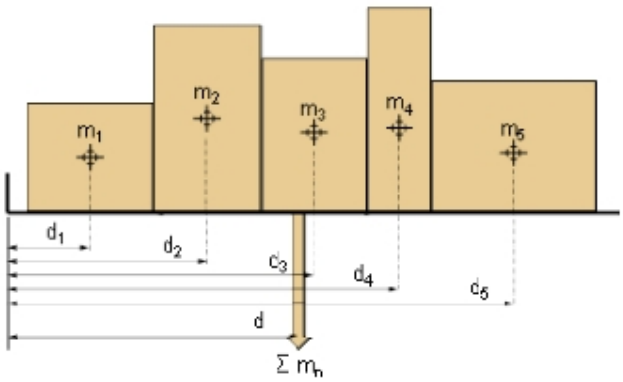


Figure 10.4-2 Determination of longitudinal centre of gravity

Example:

A 20 ft container is packed with five groups of cargo parcels as follows:

	m_n [tonne]	dn [m]	Mn · dn [tonne m]
1	**3.5**	**0.7**	**2.45**
2	**4.2**	**1.4**	**5.88**
3	**3.7**	**3.0**	**11.10**
4	**2.2**	**3.5**	**8.36**
5	**4.9**	**5.1**	**24.99**
Σm_n = 18.5		**$\Sigma(m_n \cdot d_n)$ = 52.78**	

$$d = \frac{\Sigma(m_n - d_n)}{\Sigma m_n} = \frac{52.78}{18.5} = 2.85\ m$$

4 Cargo securing with dunnage bags

4.1 Introduction

4.1.1 Accelerations in different directions during transport may cause movements of cargo, either sliding or tipping. Dunnage bags, or air bags, used as blocking devices may be able to prevent these movements.

4.1.2 The size and strength of the dunnage bag are to be adjusted to the cargo weight so that the permissible Blocking Capacity (BC) of the dunnage bag, without risk of breaking it, is larger than the force the cargo needs to be supported with:

$$BC \geq F_{CARGO}$$

4.2 Force on dunnage bag from cargo (F_{CARGO})

4.2.1 The maximum force, with which rigid cargo may impact a dunnage bag, depends on the cargo's mass, size and friction against the surface and the dimensioning accelerations according to the formulas below:

Sliding

$$F_{CARGO} = m \cdot g \cdot \left(c_{x,y} - \mu \cdot 0.75 \cdot c_z\right) [kN]$$

Equation 14

Tipping

$$F_{CARGO} = m \cdot g \cdot \left(c_{x,y} - \frac{b_p}{h_p} \cdot c_z\right) [kN]$$

Equation 15

Where:

F_{CARGO}	=	force on the dunnage bag caused by the cargo [kN]
m	=	mass of cargo [tonne]
$c_{x,y}$	=	Horizontal acceleration, expressed in g, that acts on the cargo in longitudinal or transverse directions
c_z	=	Vertical acceleration that acts on the cargo, expressed in g
μ	=	Friction factor for the contact surface between the cargo and the cargo deck or between different packages
b_p	=	Package width for tipping sideways, or alternatively the length of the cargo for tipping forward or backward
h_p	=	package height [m]

4.2.2 The load on the dunnage bag is determined by the movement (sliding or tipping) and the mode of transport that gives the largest force on the dunnage bag from the cargo.

4.2.3 Only the cargo mass that actually acts on the dunnage bag that should be used in the above formulas. If the dunnage bag is used to prevent movement forwards, when breaking for example, the mass of the cargo behind the dunnage bag should be used in the formulas.

4.2.4 If the dunnage bag instead is used to prevent movement sideways, the largest total mass of the cargo that either is on the right or left side of the dunnage bag should be used, that is, either the mass m_1 or m_2 (see Figure 10.4-3).

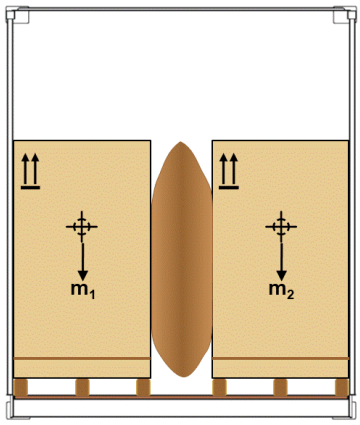


Figure 10.4-3 Equal height packages

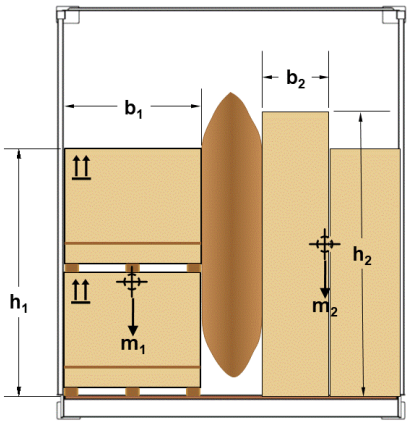


Figure 10.4-4 Unequal height packages

4.2.5 In order to have some safety margin in the calculations, the lowest friction factor should be used, either the one between the cargo in the bottom layer and the platform or between the layers of cargo.

4.2.6 If the package on each side of the dunnage bag has different forms, when tipping the relationship between the cargo width and height of the cargo stack that has the smallest value of b_p / h_p is chosen.

4.2.7 However, in both cases the total mass of the cargo that is on the same side of the dunnage bag should be used, that is, either the mass m_1 or m_2 in Figure 10.4-4.

4.3 Blocking Capacity of the dunnage bag (BC)

The force that the dunnage bag is able to withstand, i.e. its Blocking Capacity depends on the area of the dunnage bag which the cargo is resting against and the maximum allowable working pressure. The force of the dunnage bag is calculated from:

$$BC = A \cdot 10 \cdot g \cdot P_B \cdot SF \ [kN]$$

Equation 16

Where:

BC	=	force that the dunnage bag is able to take up without exceeding the maximum allowable pressure, i.e., its Blocking Capacity [kN]
P_B	=	bursting pressure of the dunnage bag [bar]
A	=	contact area between the dunnage bag and the cargo [m^2]
SF	=	safety factor 0.75 for single use dunnage bags 0.5 for reusable dunnage bags

4.4 Contact area (A)

4.4.1 The contact area between the dunnage bag and the cargo depends on the size of the bag before it is inflated and the gap that the bag is filling. This area may be approximated by the following formula:

$$A = \left(b_{DB} - \pi \cdot \frac{d}{2}\right) \cdot \left(h_{DB} - \pi \cdot \frac{d}{2}\right)$$

Equation 17

Where:

A	=	contact area between the dunnage bag and the cargo [m^2]
b_{DB}	=	width of dunnage bag [m]
h_{DB}	=	height of dunnage bag [m]
d	=	gap between packages [m]
π	=	3.14

4.4.2 In order to provide a sufficient contact area, neither the width nor the height of the dunnage bag should be less than 2.5 times the size of the filled gap.

4.4.3 When a dunnage bag is used to secure a load, its working height must not exceed the height of the cargo or the boundary wall of an open vehicle. The maximum permissible height of a dunnage bag can be determined depending on the height of the cargo by using the following formula:

$$h_{DB} = h + (\pi - 1) \cdot \frac{d}{2}$$

Equation 18

Where:

h_{DB}	=	height of dunnage bag [m]
h	=	height of cargo [m]
d	=	gap between packages [m]
π	=	3.14

4.5 Pressure in the dunnage bag

4.5.1 To be fully effective the dunnage bag must be inflated to its operating pressure, taking into account the climatic conditions along the route of the CTU and in accordance with the manufacturer's recommendations. This may require that the dunnage bag is filled to a slight

overpressure so that if the ambient pressure rises or the air temperature falls there is no risk that the dunnage bag may become loose. Conversely, if the filling pressure is too high there is a risk of the dunnage bag bursting or damaging the cargo if the ambient pressure decreases, or if the air temperature rises.

4.5.2 The bursting pressure (P_B) of a dunnage bag depends on the quality and size of the bag and the gap that it is filling. The pressure exerted on a dunnage bag by the cargo forces should never be allowed to approach bursting pressure of the bag because of the risk of failure. A safety factor should, therefore, be incorporated and, if necessary, a dunnage bag with a higher bursting pressure selected.

4.5.3 Whenever dunnage bags mark with Level 1 to 5 according to the Association of American Railroads criteria, these have the following minimum bursting pressure:

Level 1 - 0.55 bar

Level 2 - 1.2 bar

Level 3 - 1.7 bar

Level 4 - 2.1 bar

Level 5 - 1.5 bar

Level 1 to 4 dunnage bags are tested at a gap of 30 cm while Level 5 dunnage bags are tested at a gap of 46 cm.

4.6 Recommended marking for dunnage bags

Blocking capacity in tonnes of various size dunnage bags having a bursting pressure of 1.7 bar at a gap of 30 cm						
Fillable gap size	Bursting pressure	Dunnage bag dimension (cm)				
		60 x 100	100 x 120	100 x 150	120 x 200	120 x 250
10 cm	2.3 bar	4.2	10	13	22	28
20cm	2.0 bar	1.9	6.0	8.1	15	19
30 cm	1.7 bar	n/a	3.3	4.6	9.5	13
45 cm	1.3 bar	n/a	n/a	n/a	4.1	5.6

Table 10.4-1 Blocking capacity example

Appendix 10.5. Practical inclination test for determination of the efficiency of cargo securing arrangements

1 The efficiency of a securing arrangement or the transport stability level (TSL) of a package can be tested by a practical inclining test in accordance with the following description.

2 The cargo (alternatively one section of the cargo) is placed on a road vehicle platform or similar and secured in the way intended to be tested.

3 To obtain the same loads in the securing arrangement or package in the inclining test as in calculations, the securing arrangement or package should be tested by gradually increasing the inclination of the platform to an angle, α, in accordance with the diagram below.

4 The inclination angle that should be used in the test is a function of the horizontal acceleration $c_{x,y}$ for the intended direction (forward, sideways or backward) and the vertical acceleration c_z.

.1 To test the efficiency of the securing arrangement in the lateral direction, the greatest of the following test angles should be used:

- The angle determined by the friction factor μ (for the sliding effect), or
- The angle determined by the ratio of $\frac{B}{n-h}$ (for the tilting effect).

.2 To test the efficiency of the securing arrangement in the longitudinal direction, the greatest of following test angles should be used:

- The angle determined by the friction factor μ (for the sliding effect), or

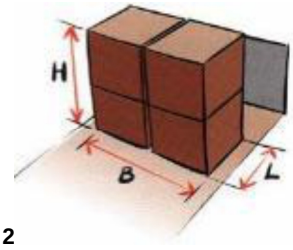
The angle determined by the ratio of $\frac{L}{H}$ (for the tilting effect).

.3 To test the TSL of a package in any direction the following test angles should be used:

- The angle determined by the internal friction factor μ on package without any package accessory.

5 Test of cargo securing arrangements

5.1 The lowest friction factor, between the cargo and the platform bed or between packages if over-stowed should be used. The definition of H, B, L and n is according to the sketches in Figure 10.5-1 and Figure 10.5-2.

<table>
<tr>
<td> 

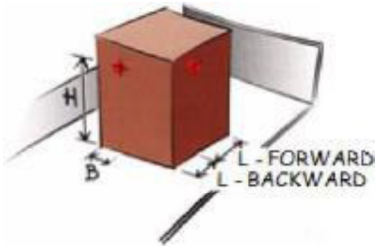
n = 2
Figure 10.5-1</td>
<td> 

Figure 10.5-2</td>
</tr>
<tr>
<td>Package or section with the centre of gravity close to its geometrical centre (L/2, B/2, H/2).

The number of loaded rows, n, in above section is 2.</td>
<td>Package with the centre of gravity away from its geometrical centre</td>
</tr>
</table>

L is always the length of one section also when several sections are placed behind each other.	

5.1.1 The required test angle α as function of $c_{x,y}$ (0.8 g, 0.7 g and 0.5 g) as well as μ, $\frac{B}{n-h}$ and $\frac{L}{H}$ when c_z is 1.0 g is taken from the diagram shown in Figure 10.5-3 or from Table 10.5-1 below.

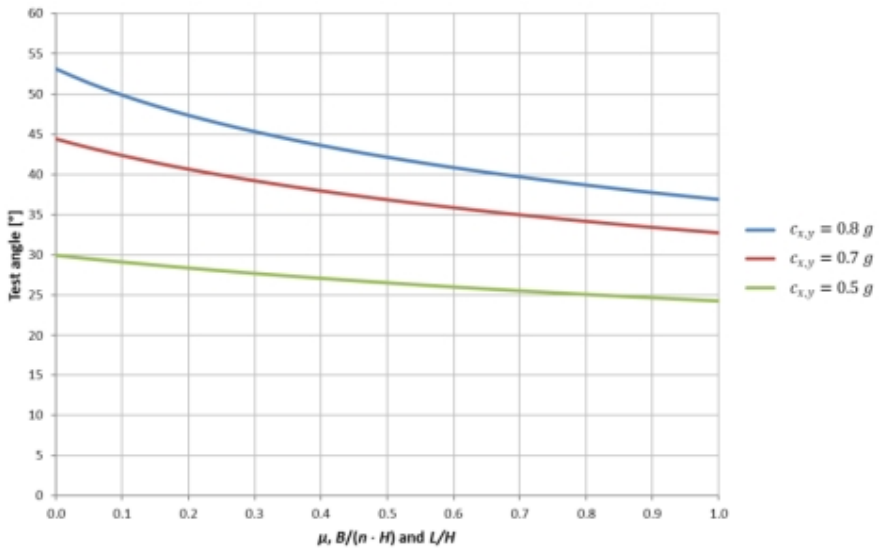


Figure 10.5-3

Example:

If μ and $\frac{B}{n-h}$ is 0.3 for sideways acceleration in transport area B (c_y = 0.7g) the cargo securing arrangement should be able to be inclined to approximately 39°, according to Figure 10.5-3 and Table 10.5-1.

5.1.2 In the Table 10.5-1 below the inclination α is calculated for different γ factors at the horizontal accelerations ($c_{x,y}$ = 0.8 g, 0.7 g and 0.5 g and c_z = 1.0 g).

The γ factor is defined as follows:

μ, $\frac{B}{n-h}$ and $\frac{L}{H}$, as required in clause 4 of this appendix.

γ factor \ $c_{x,y}$	0.8g	0.7g	0.5g
	Required test angle α in degrees		
0.00	53.1	44.4	30.0
0.05	51.4	43.3	29.6
0.10	49.9	42.4	29.2
0.15	48.5	41.5	28.8
0.20	47.3	40.7	28.4
0.25	46.3	39.9	28.1

0.30	45.3	39.2	27.7
0.35	44.4	38.6	27.4
0.40	43.6	38.0	27.1
0.45	42.8	37.4	26.8
0.50	42.1	36.9	26.6
0.55	41.5	36.4	26.3
0.60	40.8	35.9	26.0
0.65	40.2	35.4	25.8
0.70	39.7	35.0	25.6
0.75	39.2	34.6	25.3
0.80	38.7	34.2	25.1
0.85	38.2	33.8	24.9
0.90	37.7	33.4	24.7
0.95	37.3	33.1	24.5
1.00	36.9	32.8	24.3

Table 10.5-1

5.1.3 When testing in longitudinal direction for sea transport, the corresponding test angle obtained by Table 10.5-1 for the transverse direction may be used, or the required inclination angle, α, can be calculated by the following formula:

$$\alpha = arcsin\left(\frac{r + \gamma \cdot \sqrt{1 + \gamma^2 + r^2}}{1 + \gamma^2}\right)$$

Equation 19

Where:

$r = c_{x,y} - \gamma \cdot c_z$

5.2 The securing arrangement is regarded as complying with the requirements if the cargo is kept in position with limited movements when inclined to the prescribed inclination α.

5.3 The test method will subject the securing arrangement to stresses and great care should be taken to prevent the cargo from falling off the platform during the test. If large masses are to be tested the entire platform should be prevented from tipping as well.

Figure 10.5-4

Figure 10.5-5

5.4 Figure 10.5-4 and Figure 10.5-5 show tests to confirm the securing arrangements of a large package

for acceleration forces in longitudinal and transverse directions.

6 Test of Transport Stability Level (TSL)

6.1 The required test angle α as a function of chosen TSL (1 – 5) is taken from the diagram shown in Figure 10.5-6 or from the Table 10.5-2 below.

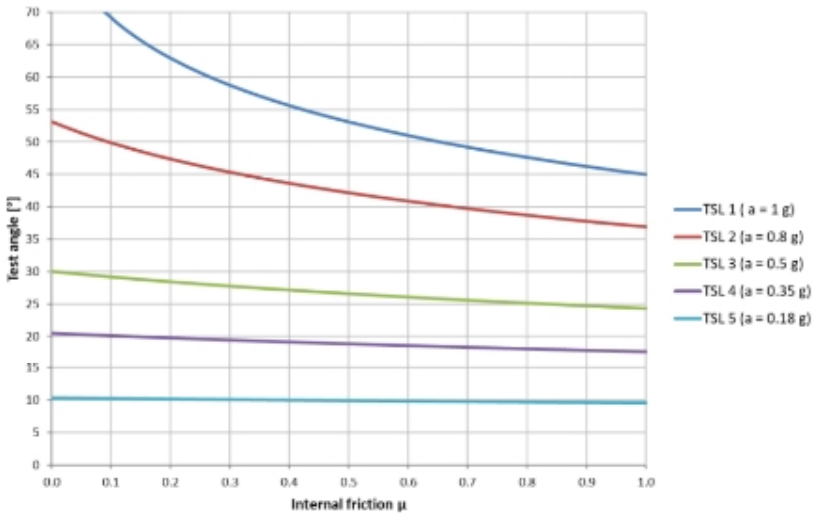


Figure 10.5-6

Example:

If the internal friction of a package is determined to be μ = 0.40 and the transport stability level chosen to be tested is TSL 3, the package should be able to be inclined to approximately 27°, according to Table 10.5-2.

In Table 10.5-2 the inclination α is calculated for different internal friction of a package at different TSL (1-5).

	TSL 1	TSL 2	TSL3	TSL4	TSL5
Internal friction μ	Required test angle in degrees				
0.00	90.0	53.1	30.0	20.5	10.4
0.05	74.5	51.4	29.6	20.3	10.3
0.10	69.3	49.9	29.2	20.1	10.3
0.15	65.7	48.5	28.8	19.9	10.2
0.20	63.0	47.3	28.4	19.8	10.2
0.25	60.7	46.3	28.1	19.6	10.1
0.30	58.8	45.3	27.7	19.4	10.1
0.35	57.1	44.4	27.4	19.3	10.1
0.40	55.6	43.6	27.1	19.1	10.0
0.45	54.3	42.8	26.8	19.0	10.0
0.50	53.1	42.1	26.6	18.9	9.9
0.55	52.0	41.5	26.3	18.7	9.9
0.60	51.0	40.8	26.0	18.6	9.9
0.65	50.1	40.2	25.8	18.5	9.8
0.70	49.2	39.7	25.6	18.3	9.8
0.75	48.4	39.2	25.3	18.2	9.7

0.80	47.6	38.7	25.1	18.1	9.7
0.85	46.9	38.2	24.9	18.0	9.7
0.90	46.2	37.7	24.7	17.9	9.6
0.95	45.6	37.3	24.5	17.7	9.6
1.00	45.0	36.9	24.3	17.6	9.6

Table 10.5-2

6.2 Figure 10.5-7 shows inclining tests to confirm the TSL of packages and Figure 10.5-8 shows measuring of the permanent deflection after three tests with the same specimen in one direction.

Figure 10.5-7

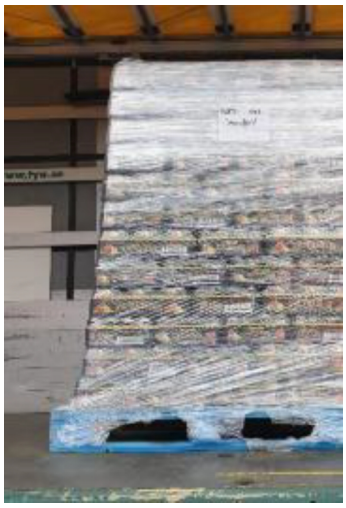


Figure 10.5-8

Annex 11. Pest contamination of freight containers and their cargoes[37]

1 General

Pest contamination and contaminants can travel on or in freight containers. The goods in the freight container can also contain such pests, regardless of the type of the goods being carried. They can cause serious damage to agricultural industries, the environment and economy.

Before using a freight container, make sure it is clean and free of pests and contaminants.

2 Areas where pest contamination is commonly found

3 Shared responsibility

Everyone along the supply chain has a responsibility to keep freight containers and their cargoes clean. For guidance on best practices to keep freight containers and cargoes clean, in accordance with roles and responsibilities of parties in the supply chain, please refer:

https://www.fao.org/documents/card/en/c/ca7963en

4 Detections

If pests or contaminants are detected:

- Before vessel loading: take the appropriate action to remove them and ensure freight container is clean.
- After vessel discharge: seek guidance from your National Plant Protection Organisation (NPPO)

5 Methods to remove contamination

5.1 If pest contamination is found, methods for removal or management may include any or all of the following;

5.1.1 Minor contamination can be removed using sweeping or vacuum cleaning, high pressure water wash or scraping.

5.1.2 More serious contamination may require:

- Sweeping or vacuum;
- Cleaning the interior of the freight container;

[37] This content is sourced from CPM Recommendation 6

- Washing, scraping or using other physical means to clean the interior or exterior of the freight container; or
- Using high-pressure washers.

5.2 Storage of containers in places where they are less likely to become contaminated (on hard surfaces such as concrete, gravel, or other surfaces that are free of plants and animals) is encouraged.

5.3 All relevant parties are encouraged to safely and securely dispose of contaminants to prevent spread, for example by collecting all sweepings and materials from vacuum cleaners for disposal.

5.4 Methods for safe storage, treatment or disposal of contaminants may include one or more of the following:

- Physical containment, such as bagging or placing in an airtight receptacle;
- Safe and appropriate chemical treatment;
- Temperature (heat or freezing) treatments;
- Incineration; or
- Deep burial.

5.5 If treatment should be necessary to neutralize pest contamination that cannot be safely removed from the freight container, NPPOs or other authorities may have requirements and guidance in place on the use of treatments.

5.6 Guidance on appropriate treatment options can be obtained from your NPPO or a local professional pest controller.

6 Disposal

Pests and contaminants must be disposed of safely to prevent their spread. The most common method is bagging: contaminants, as well as the bodies of pests or animals, are placed in bags, sealed, and then placed in a sealable containment bin for collection. Other disposal options may include incineration and deep burial.

7 Prevention

When freight containers and cargoes are moved to storage areas, packing areas, ports of loading, or are transiting through another country, preventative measures should be taken to avoid contamination. This includes preventing contamination of freight containers and cargoes that have already been inspected and cleaned. For guidance on establishing and maintaining pest free areas, please see this link: https://www.fao.org/documents/card/en/c/ca5844en.

8 Examples of pests and contaminants and where they are commonly found

khapra beetle skins in cross roll

Internal pests (such as khapra beetle)

Look for insects, larvae and/or larval skins in goods, in the joins between floors and walls of containers, and where possible, in the joins between floor panels and under floors of sea containers.

African big headed ant

Nesting pests (such as ants and bees)

Look for groups or nests in joins, gaps and spaces at ground level both in and on containers and their cargoes.

snail in forklift tyne pocket

Sheltering pests (such as snails)

Look for snails in a variety of colours, sizes and forms attached to containers.

stink bugs on container wall

Overwintering pests (such as stink bugs)

Look for pests sheltering in containers, and goods that have been stored outdoors.

egg mass on external surfaces

Egg laying pests (such as spongy moth)

Look for egg masses and pests on external container surfaces.

soil under container

Contaminants such as soil, seeds, plant and animal material

Look for contaminants on the base (including twist locks, side rails and forklift pockets), inside, and where possible, on the underside of containers.

Annex 12. CTU seal

1 Introduction

1.1 Many CTU types all have facilities for sealing them and their locations are discussed in this annex and in Appendix 12.2. Packers and shippers may elect to use these sealing points to temporarily secure CTUs to protect the cargo against theft during the packing process.

1.2 On completion of packing, packers and shippers may elect to seal the CTU for transport and that decision will depend on the mode of transport, the route that it follows, and the cargo carried. However, CTUs in international transport should be sealed by the shipper immediately upon completion of the packing process. Such seals should meet the standard of ISO 17712.

1.3 In this annex the placement, types of seal available and the methods of fixing of the seals are discussed. The removal of seals, especially High Security seals may require special equipment which is shown in Supplement 12 and Supplement 13.

1.4 The responsibilities of parties within supply chain[38] are shown in Appendix 12.1.

2 Sealing CTUs

2.1 Closed units used in each of the transport modes have similar securing methods. Box type CTUs with doors at the rear will have either vertically hinged swing doors, sliding, drop down door / ramp, or roller shutter doors.

Figure 12-1 Swing door (Road vehicle)

Figure 12-2 Sliding door (Rail Wagon)

Figure 12-3 Roller Shutter (Swap Body)

2.2 The different types of CTUs offer different door closing gear, swing doors can be fitted with two or one locking bars per door which can be surface mounted or enclosed in the door structure and the locking handle can be in the bottom quarter of the door or below the doors.

Figure 12-4 Surface mounted handles

Figure 12-5 : Roller shutter lock

Figure 12-6 : Recessed handled with protruding eyes

2.3 All the door locking devices work on two principles. A seal can either:

[38] As described in the WCO SAFE Framework of Standards, June 2011.

- be passed through the handle and secured against a fixed item on the CTU (see Figure 12-4 and Figure 12-5); or
- a fixed eye protruding from the CTU projects through the handle (see Figure 12-6**).**

2.4 Very often the choice for fixing the seal is obvious and where there are two or more handles generally the one that operates the inner lock rod of the right-hand door should be sealed. Some handles do not have apertures for seals,[39] while some CTUs will have multiple apertures suitable for seals.

Figure 12-7 Handle without aperture

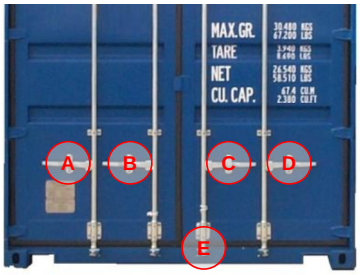


Figure 12-8 Multiple apertures

2.5 In Figure 12-8 the first choice should be at 'E' or 'C' (inner lock rod right hand door) and for additional security position 'B' (Inner lock rod left hand door). Where the CTU is involved in international transport, a high-security bolt seal fitted at position 'E'[40] provides the most secure solution especially for fitting and removal when a container is on a trailer.

2.6 The decision whether to seal the CTU and the choice of seal to be used will depend on the shipper, the value of the cargo, the type of CTU and the route. For CTUs that are making a number of stops to unpack one or more packages a clip may be sufficient. Single drop off trips may require an indicative seal. However, CTUs destined for international transport should be sealed with a high-security seal.

2.7 The sealing requirements for dry bulk, tank, open side and open top are shown in Appendix 12.2.

3 Seal Types

3.1 Mechanical Seals[41]

3.1.1 The choice of seal for a specific requirement will depend on many factors. It should be selected after full consideration of the user's performance requirements. The first decision is the appropriate seal classification (indicative, security or high security), followed by a decision on a particular type, make and model[42]. The seal purchaser should require from the seal vendor a certification of the seal's classification in accordance with the standard ISO 17712.

3.1.2 In general terms, a low strength indicative seal should be used where only indication of entry is desired. Where a physical barrier is a definitive requirement either a security or high-security seal should be used.

3.1.3 All seals should be easy to fit correctly on the item to be sealed and once in situ be easy to check for positive engagement of the locking mechanism(s). Correct handling and fitting of seals is at least equal if not greater in importance than selection of the correct seal. A poorly chosen but correctly fitted seal may provide security; however, a well-chosen but incorrectly fitted seal will provide no security.

3.1.4 Security and high-security seals should be sufficiently durable, strong and reliable so as to prevent accidental breakage and early deterioration (due to weather conditions, chemical

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[39] Generally left hand door handles

[40] The security cam type fitting is not fitted to all CTU.

[41] ISO 17712 Freight Containers – Mechanical Seals.

[42] Selection of a seal presumes the user has already considered the condition of the item to be sealed; some items, such as open flat or flatrack CTUs, are not suitable for any seal on the CTI itself. A seal is only one element in a security system; any seal will only be as good as the system into which it is introduced.

action, vibration, shock, etc.) in normal use.

3.2 Electronic Seals

3.2.1 An electronic seal[43] is described[44] as a read-only, non-reusable container seal conforming to the high-security seal defined in ISO 17712 and conforming to ISO 18185 or revision thereof that electronically evidences tampering or intrusion through the container doors.

3.2.2 Electronic seals can communicate either passively or actively with readers and other communication devices. The passive electronic seal relies on a signal from a reader to activate a response from the electronic seal while an active electronic seal is fitted with a battery and transmits a signal that can be interrogated by a reader or a communication device.

Figure 12-9
Electronic seal

3.3 Other Devices

3.3.1 Other devices such as sensors can report on the location of the CTU, condition of the cargo, and whether the CTU has been opened. This can be done in real time, when the CTU passes a communication portal or when the device data is downloaded.

3.3.2 Such devices are usually fitted by shippers on their, or the consignee's, behalf.

3.4 Further information on the selection of seals is shown in Supplement 11

4 Fitting seals

4.1 There have been a number of designs for the handle retainers and catches, but generally there are two generic designs in use illustrated in Figure 12-10 and Figure 12-11.

4.2 Figure 12-10 shows a design where the lock rod handle is attached to the catch which in turn is attached to the container using a rivet. As the catch has to rotate there is always a small gap between the catch and the retainer.

4.3 Figure 12-11 has the seal passing through the catch, the handle and a fixed arm on the retainer. This design means that there the seal is directly attached to the retainer and to remove the seal would require the seal or the retainer to be damaged. The type of handle, handle retainer and catch can also affect the security of the doors.

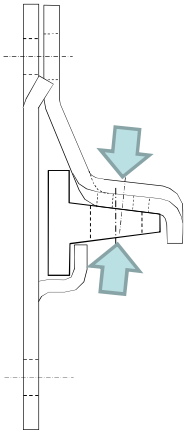

Figure 12-10 2 point seal

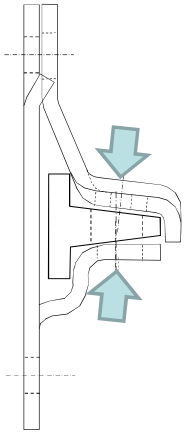

Figure 12-11 3 point seal

4.4 Before fitting the seal record the number of the CTU and the number(s) of the seal(s) to be fitted and where each is used (Right hand door inner cam keeper, rear hatch etc.).

4.5 Push the seal through all elements of the retainer, handle and clip and snap the two halves together.

[43] Also known as eSeals, and RFID tags.

[44] ISO 18185-1:2007 Freight containers – Electronic seals – Part 1 communication protocol.

Figure 12-12 ; Fitting a bolt seal

4.6 Once the seal has been fitted, give the bottom a number of sharp tugs and twist the two components to confirm that the seal is fully and properly engaged.

5 Removing seals

5.1 Stance

5.1.1 The height of the door handle and the seal varies depending on the type of CTU and the design of the door. Rigid vehicles and trailers are generally lower within a range of 1.1 and 1.6 m from the ground. Containers carried on a trailer will have the security cam fitted seal approximately 1.4 m from the ground, but the handles and any seals attached to them at a height of approximately 1.9 m (see Figure 12-13 and Figure 12-14).

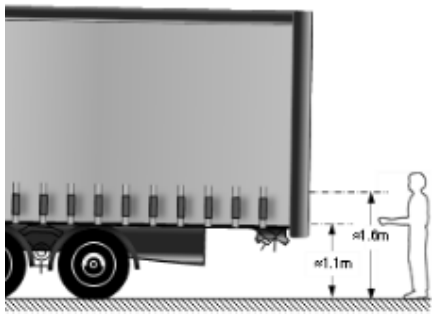

Figure 12-13 Seal heights - trailer

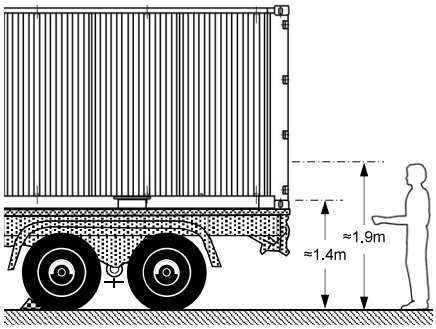

Figure 12-14 Seal heights - container

5.1.2 Seals attached to handles on container doors (approximately 1.9 m above the ground) will be about head height for the average person and attempting to cut through a bolt seal at that height is likely to result in a musculoskeletal injury.

5.1.3 The best posture for cutting seals is for the operator to stand upright with the angle at the elbow between 90° and 120° and the elbow in line or slightly forward of the body.

5.1.3.1 Avoid positions where the elbows are behind the body or above the shoulder.

5.1.3.2 When gripping the cutting tool, the wrist should be kept as straight as possible.

5.1.3.3 The best position of the cutting head will be approximately 0 to 15 cm above the height of the elbow. The height above ground level to the elbow for the average person is 109 cm. This means that the best position for the seal will be between 109 and 124 cm (1.09 and 1.24 m) above standing level.

Figure 12-15 Cutting the seal

5.1.4 Figure 12-15 shows a typical example of how many seals are actually cut. The operator has his back bent, the seal is well below the height of the elbow, the arms are almost straight, and the left wrist is cocked, while the right appears to be straight.

5.1.5 The length of the bolt cutter levers are very long compared to the movement of the cutting blades, therefore the hands have to "squeeze" in a considerable distance. See Supplement 12 for details of Cuttings Tools.

5.1.6 Cutting resistance is high as the blades start to cut and reduces to grow again as the cut finishes. Therefore, while the hands are wide apart the greatest inwards pressure is required.

5.2 Height adjustment

5.2.1 The normal height for the seals above ground level is between 1.09 and 1.24 m. This means that a normal person when cutting the lower seal position of a container mounted on a trailer and with an ideal stance would have their feet approximately 16 cm above ground level. For the higher seal position the foot position would be about 50 cm above the ground.

5.2.2 It is essential that the operator is able to gain a firm footing when cutting the seal. This may require the legs to be spread both laterally and longitudinally. The footing should be:

- Non-slip;
- Level;
- Free from debris and loose items.

There should also be no trip hazard or risk of the operator falling.

5.3 Further information on height adjustment can be found in Supplement 13.

Appendix 12.1. Responsibilities along the chain of custody

1 Cross-cutting responsibilities

1.1 There are responsibilities and principles that apply throughout the life cycle of a shipment of goods. The emphasis is on the relationships among parties upon changes in the custody or possession of the CTU. That emphasis does not reduce and should not obscure the fundamental responsibility of the shipper for the safe and secure stuffing and sealing of the container. Each party in possession of the CTU has security responsibilities while cargo is entrusted to them, whether at rest at a terminal or while moving between terminals.

1.2 Those responsibilities include:

- protecting the physical goods from tampering, theft, and damage;
- preventing illegal entry to guard against carriage of illicit goods and migrants;
- providing appropriate information to government authorities in a timely and accurate manner for security screening purposes[45]; and
- protecting the information related to the goods from tampering and unauthorised access. This responsibility applies equally to times before, during and after having custody of the goods.

1.3 Seals are an integral part of the chain of custody. The proper grade and application of the seal is addressed below. Where fitted, seals should be inspected by the receiving party at each change of custody for a packed CTU.

1.4 Inspecting a seal requires visual check for signs of tampering, comparison of the seal's identification number with the cargo documentation, and noting the inspection in the appropriate documentation. If the seal is missing, or shows signs of tampering, or shows a different identification number than the cargo documentation, then a number of actions are necessary:

1.4.1 The unpacker should bring the discrepancy to the attention of the consignee and note the discrepancy on the cargo documentation. In turn the consignee should notify the carrier and the shipper as well as Customs or law enforcement agencies, in accordance with national legislation. Where no such notification requirements exist, the consignee should refuse custody of the CTU pending communication with the carrier until such discrepancies can be resolved.

1.4.2 Seals may be changed on a CTU for legitimate reasons. Examples include inspections by an exporting Customs administration to verify compliance with export regulations; by a carrier to ensure safe blocking and bracing of the shipment; by an importing Customs administration to confirm cargo declarations; and by law enforcement officials concerned with other regulatory or criminal issues.

1.4.3 Seals that are replaced (see clause 1.4.2 above) by duly authorised public or private personnel should be replaced by one of the same or higher seal classification as defined in the standard ISO 17712 as the removed seal. The shipper or its recognized representative should be present when the duly authorised public or private personnel are removing the seal, should supply the replacement seal and ensure that the particulars of the action are noted, including the new seal number, on the cargo documentation.

2 Packing facility

2.1 The shipper is responsible for packing and securing the cargo within the CTU, for the accurate and complete description of the cargo and for verifying the mass of the packed CTU. Where required, the shipper is also responsible for affixing the cargo seal immediately upon the conclusion of the packing process, and for preparing documentation for the shipment, including the seal number.

2.2 Where required for international transport, the seal should be compliant with the definition of high-security mechanical seals in the standard ISO 17712. The seal should be applied to the CTU in a manner that avoids the vulnerability of the CTU door handle seal location to surreptitious tampering.

[45] This responsibility only refers to CTUs engaged in international transport.

Among the acceptable ways to do this are alternative seal locations that prevent swivelling of an outer door locking cam or the use of equivalent tamper evident measures, such as cable seals across the door locking bars.

2.3 The land transport operator picks up the CTU. The transport operator receives the documentation, inspects the seal and notes the condition on the documentation, and departs with the CTU.

3 Intermediate terminal

If the CTU movement is via an intermediate terminal, then the land transport operator transfers custody of the CTU to the terminal operator. The terminal operator receives the documentation and should inspect the seal and note its condition on the documentation. The terminal operator may send an electronic notification of receipt (status report) to other private parties to the shipment. The terminal operator prepares or stages the CTU for its next movement, which could be by road, rail or barge. Similar verification and documentation processes take place upon pickup or departure of the CTU from the intermediate terminal. It is rare that public sector agencies are involved in or informed about intermodal transfers at intermediate terminals.

4 Marine terminal

4.1 Upon arrival at the loading ocean terminal, the land transport operator transfers custody of the CTU to the terminal operator. The terminal operator receives the documentation and may send an electronic notification of receipt (status report) to other private parties to the shipment. The terminal operator prepares or stages the CTU for loading upon the ocean vessel.

4.2 The carrier or the marine terminal as agent for the carrier should inspect the condition of the seal and note it accordingly; this may be done at the ocean terminal gate or after entry to the terminal but before the CTU is loaded on the ship. Public agencies in the exporting nation review export documentation and undertake necessary export control and provide safety certifications. The Customs administrations that require advance information receive that information, review it, and either approve the CTU for loading (explicitly or tacitly) or issue “do not load” messages for CTUs that cannot be loaded pending further screening, including possible inspection.

4.3 For those countries that have export declaration and screening requirements, the carrier should require from the shipper documentation that the shipper has complied with the relevant requirements before loading the cargo for export. (the shipper is, however, responsible for compliance with all prevailing documentation and other pertinent export requirements). Where applicable, the ocean carrier should file its manifest information to those importing Customs agencies that require such information. Shipments for which “do-not-load” messages have been issued should not be loaded on board the vessel pending further screening.

5 Transhipment terminal

The transhipment terminal operator should inspect the seal between the off-loading and reloading of the CTUs. This requirement may be waived for transhipment terminals which have security plans that conform to the International Ship and Port Facility Security Code (ISPS).

6 Off-loading marine terminal

6.1 The consignee usually arranges for a Customs broker to facilitate clearance of the shipment in the off-loading ocean terminal. Generally, this requires that the cargo owner provide documentation to the broker in advance of arrival.

6.2 The ocean carrier may provide advance electronic cargo manifest information to the terminal operator and to the importing Customs administration as required. Customs may select CTUs for different levels of inspection immediately upon off-loading or later. Customs may inspect the condition of the seal and related documentation in addition to the cargo itself. If the CTU is to travel under Customs control to another location for clearance, then Customs at the off-loading terminal must affix a Customs seal to the CTU and note the documentation accordingly.

6.3 The consignee or Customs broker pays any duties and taxes due to Customs and arranges the Customs release of the shipment. Upon pickup for departure from the ocean terminal, the land

transport operator inspects and notes the condition of the seal and receives documentation from the terminal operator.

7 Intermediate terminal

The processes in intermediate terminals in the importing country are analogous to those in intermediate terminals in exporting countries.

8 Unpacking facility

8.1 Upon receipt of the CTU, the unpacker inspects the seal and notes any discrepancy on the documentation. The unpacker unpacks the CTU and verifies the count and condition of the cargo against the documentation.

8.2 If there is a shortage, damage, or an overage discrepancy, it is noted for claims or insurance purposes, and the shipment and its documentation are subject to audit and review. If there is an anomaly related to narcotics, contraband, stowaways or suspicious materials, the consignee, Customs or another law enforcement agency should be informed.

Appendix 12.2. Sealing requirements for special CTUs

1 Dry bulk CTUs

1.1 Units designed to carry a dry bulk cargo may have a number of loading and discharge hatches. Depending on the design there may be many loading hatches in the roof and one or more discharge hatches incorporated into the rear doors or in the front wall.

1.2 Each of the arrowed locations in Figure 12.2-1 will require sealing. Figure 12.2-3 and Figure 12.2-4 discharge hatch sealing points. Figure 12.2-2 shows an internal slide bolt to a loading hatch in the roof of the CTU that can lock the hatch closed when the CTU is not being used to transport a cargo that requires loading from above.

Figure 12.2-1 : Dry bulk sealing points

Figure 12.2-2: Roof hatch internal lock

Figure 12.2-3: Dry bulk discharge hatch (rear)

Figure 12.2-4: Dry bulk discharge hatch (front)

2 Tank CTUs

2.1 Like CTUs for dry bulk cargoes, tank containers and trailers may have multiple openings for loading and discharging.

2.2 The loading hatches in tank containers are generally secured using a number of wing nuts tightening round the manway hatch. The seal is fitted through a tang fitted to the rim plate and the hatch seal fitting.

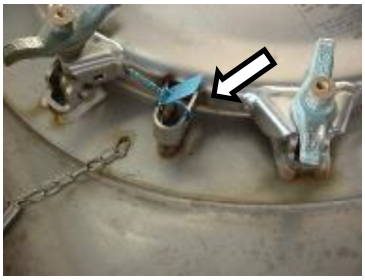

Figure 12.2-5: Manway hatch seal

Figure 12.2-6 : Seal tab

2.3 Top valves in tank containers may also need to be sealed, some have wires welded to the fixing nuts, while other will be sealed in the closed position.

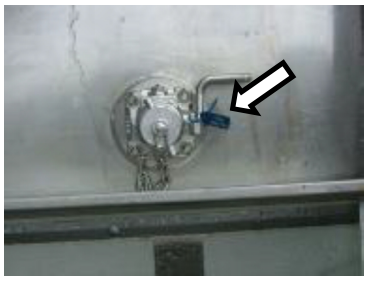

Figure 12.2-7: Top valve seal

Figure 12.2-8: Discharge vale seal

2.4 The discharge valve on many tanks may have one or two valves plus a closing cap. It is possible to seal all of these however the best sealing position is the main butterfly type valve. There the handle is sealed to the adjacent tank.

3 Open sided units

3.1 The World Customs Organisation defines all sheeted CTUs as open units.

3.2 There are two basic designs of sheeted attachment:

3.2.1 'Tautliner' where there are buckles used to tension the straps and the side sheet. Each buckle will have a hole through which the TIR cord will be passed (see Figure 12.2-9). The TIR cord may be secured with a sealing device at each end.

3.2.2 The second design has eyes that are placed over rings and the TIR cord is passed through the rings (see Figure 12.2-10), this design is most often used with open sided and open top containers.

Figure 12.2-9: Tautliner clip

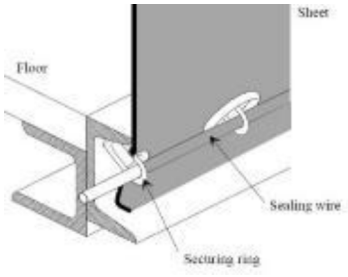

Figure 12.2-10: TIR wire fitting

3.3 The tautliner buckles do not require the TIR cord to be in place to close the curtain, whereas the ring and eye design requires the cord or else the curtain or top tarpaulin/tilt may easily detach.

4 Open Top CTUs

Figure 12.2-11 Open top CTU

4.1 In addition to the doors of an open top container the flexible top covering, when required and upon the completion of packing, should be sealed.

4.2 On arrival of the open top CTU, the packer should check that the top sheet appears to be in good condition with no holes or tears in the material. Patches are permitted so long as there are two visible seams attaching the patch to the sheet and there are no cut edges visible on the patch material and the sheet under the patch.

4.3 There should be removable or re-locatable roof bows fitted to all the sockets or pins to support the sheet when in place.

4.4 The TIR Convention requires that sheeted vehicles (including open top containers) be fitted with a strong canvas or plastic-covered or rubberized cloth[46], of sufficient strength, in good condition and made up in such a way that once the closing devices has been secured, it is impossible to gain access to the load compartment without leaving obvious traces.

4.5 The sheet should be affixed to the CTU by the following system:

- 4.5.1 metal rings fixed to the CTU;
- 4.5.2 eyelets let into the edge of the sheet; and
- 4.5.3 a fastening passing through the rings above the sheet and visible from the outside for its entire length.[47]

4.6 The fastening may be of the following specification:

- 4.6.1 steel wire rope of at least 3 mm diameter;
- 4.6.2 ropes of hemp or sisal of at least 8 mm diameter encased in a transparent sheath or un-stretchable plastic; or
- 4.6.3 rope consisting of batches of fibre-optic lines inside a spirally wound steel housing encased in a transparent sheath of un-stretchable plastic; or
- 4.6.4 ropes comprising a textile cord surrounded by at least four strands consisting solely of a steel wire and completely covering the core, under the condition that the ropes (without taking account the transparent sheath, if any) are not less than 3 mm in diameter.

4.7 In practice most open top containers are supplied with a steel wire rope encased in an un-stretchable plastic sheath.

4.8 Each type of fastening rope should be in one piece and should have a hard metal end-piece at each end. Each metal end-piece should allow the introduction of the thread or strap of a customs seal (see Figure 12.2-12).

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[46] Often referred to as a tilt

[47] On open top containers the design of the rear frame may prevent the sheet from being passed over onto the vertical rear face of the header, therefore the requirement for the rings to be visible is not possible.

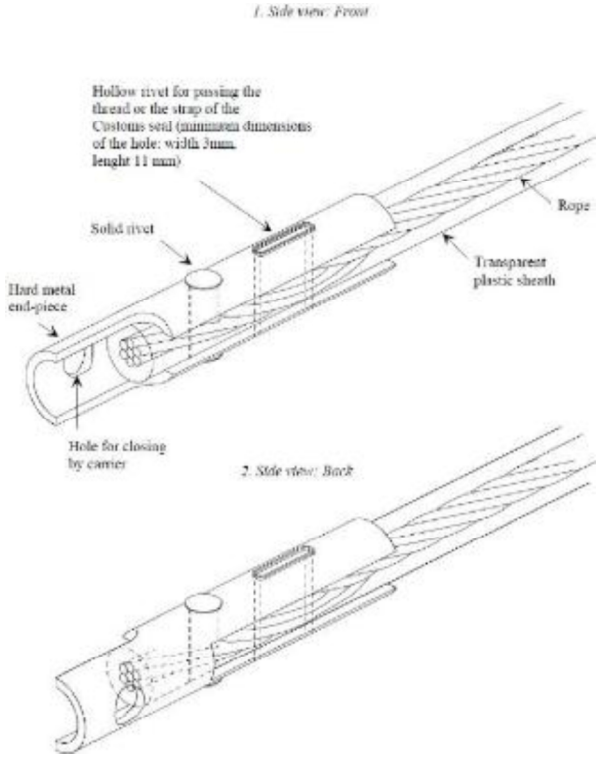

Figure 12.2-12 Fastening rope end pieces

4.9 On completion of packing the roof bows should be refitted and the sheet placed over the container making sure that all eyelets in the sheet are placed over a ring fitted on the CTU.

4.10 The fastening rope should then be passed through every ring on the outside of the sheet starting above the fastening rope retaining bracket or brackets, often found on the right side of the container towards the rear end. The fastening rope should be long enough so that the hard metal end-piece can be brought back to the retaining bracket.

4.11 The fastening rope should be tight to prevent edges of the sheet from being lifted.

4.12 Any additional length of the fastening rope should be restrained so that it cannot be slid out to loosen the securing of the sheet.

Figure 12.2-13 Fastening rope threading on open top CTU

4.13 A seal should be inserted through both hollow rivets of the metal end-pieces. Additional closures may be used to connect the two end–pieces through the round holes.

Annex 13. Topics for consideration in a training programme

Topics to be included in a training programme	
1	Consequences of badly packed and secured cargo • Injuries to persons and damage to the environment • Damage to all means of transport and CTUs • Damage to cargo • Economic consequences
2	Liabilities • Different parties involved in cargo transport • Legal responsibility • Goodwill responsibility • Quality assurance
3	Forces acting on the cargo during transport • Road transport • Rail transport • Sea transport
4	Basic principles for cargo packing and securing • Prevention from sliding • Prevention from tipping • Influence of friction • Basic principles for cargo securing • Dimensions of securing arrangements for combined transport
5	CTUs – types • Freight containers • Flats • Swap bodies • Road vehicles • Rail cars/wagons
6	Cargo care consciousness and cargo planning • Choice of transport means • Choice of CTU type • Check of CTU prior to packing • Cargo distribution in CTUs • Requirements from the receiver of cargo regarding cargo packing • Condensation risks in CTUs • Symbols for cargo handling
7	Different methods for cargo packing and securing • Lashing • Blocking arrangements • Increasing friction
8	Safe handling of packages • Manual handling • Mechanical handling devices • Personal protective equipment

Topics to be included in a training programme	
9	Equipment for securing and protection of cargo • Fixed equipment on CTUs • Reusable cargo-securing equipment • One-way equipment • Inspection and rejection of securing equipment
10	On completion of packing • Closing the CTU • Marking and placarding • Documentation • Verifying gross mass
11	Packing and securing unitized cargo • Cases • Palletized cargoes • Bales and bundles • Bags on pallets • Big bags • Slabs and panels • Barrels • Pipes • Cartons
12	Packing and securing of non-unitized cargo • Different types of packaged cargoes packed together • Packing of heavy and light cargoes together • Packing of rigid and non-rigid cargoes together • Packing of long and short cargoes together • Packing of high and low cargoes together • Packing of liquid and dry cargoes together
13	Packing and securing of paper products • General guidelines for the packing and securing of paper products • Vertical rolls • Horizontal rolls • Sheet paper on pallets
14	Packing and securing of cargo requiring special techniques • Steel coils • Cable drums • Wire rolls • Steel slabs • Steel plates • Big pipes • Stone blocks • Machines
15	Packing and securing of dangerous cargoes • Regulations for the transport of dangerous goods • Definitions • Packing regulations • Packing, separation and securing • Labelling, marking and placarding • Information transfer when transporting dangerous cargoes • Liabilities

16	Prevention of transport of prohibited cargoes including human trafficking, illegal wildlife trafficking, and illegal drugs • Common methods used to conceal movement of prohibited cargoes