

Chapter 6

CTU properties

Note: Definitions are given in chapter 2.

6.1 Introduction

6.1.1 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.

6.1.2 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.

6.2 Freight containers

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

6.2.2 The maximum gross mass and the permitted payload of a freight container depend on standardized design parameters. The International Convention for Safe Containers requires each freight container to carry a CSC safety approval plate, where the maximum permitted gross mass is specified (see subsection 8.2.1 and annex 4, section 1). Additionally, the tare mass and the payload are marked in painted letters on the door or on the rear end of the freight container.

6.2.3 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 and require special attention when used for intermodal transport, in particular for the stowage in stacks on seagoing vessels (see subsections 7.3.1 and 8.2.1).

6.2.4 General purpose freight containers are available as closed freight 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 7, section 3).

6.2.5 Most general purpose freight 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. Recently built freight containers have, in many cases, anchor points with an MSL of 20 kN. The lashing points at the top side rails have an MSL of at least 5 kN.*

6.2.6 Floors on freight containers covered by the CSC are only required to withstand an axle load of 5,460 kg or 2,730 kg per wheel† although they may be built to withstand a greater axle load. The CTU operator can provide more precise information.

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

† International Convention for Safe Containers, 1972, Annex II.

- 6.2.7 Closed freight 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 freight container is intensified and a limited exchange of air and humidity with the ambient atmosphere is established.
- 6.2.8 An open top container is similar to a closed freight 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 freight container.
- 6.2.9 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 freight containers, the side curtain provides limited or no restraint capability. Open side containers are not covered by ISO standards.
- 6.2.10 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.
- 6.2.11 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 lashing brackets are welded to the outer sides of the longitudinal bottom girders with an MSL of at least 30 kN according to the standard. In many cases the lashing points have an MSL of 50 kN. Cargo may also be secured in longitudinal direction by shoring to the end walls of flatracks. These end walls may be additionally equipped with lashing points of at least 10 kN MSL.
- 6.2.12 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 is similar to that of general purpose freight 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.
- 6.2.13 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.
- 6.2.14 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 freight 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 freight containers.

6.3 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.

6.4 Swap bodies

- 6.4.1 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. Swap bodies are generally 2.5 m or 2.55 m wide and are subdivided into three length categories:
- Class A: 12.2 to 13.6 m long (maximum gross mass 34 tons);
 - Class B: 30ft (9.125 m long);
 - Class C: 7.15, 7.45 or 7.82 m long (maximum gross mass 16 tons).
- 6.4.2 Swap bodies are fixed and secured to the vehicles with the same devices as freight containers, but owing to the size difference, these fittings are not always located at the swap body corners.

- 6.4.3 Stackable swap bodies have top fittings enabling the handling with standard freight container handling equipment. Alternatively, the swap body may be handled using grapple arms, inserted into the four recesses in the bottom structure. Swap bodies not suitable for stacking can only be handled with grapple 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.
- 6.4.4 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. Class C swap bodies complying with standard EN 283 have a defined boundary strength: the front and the rear end are capable to withstand a load equal to 40% of the permitted payload, the sides are capable to withstand 30% of the permitted payload. For a cover-stake body the drop sides are designed to withstand a force equal to 24% of the maximum permitted payload and the remaining part of the side is designed to withstand 6% of the maximum permitted payload. The sides in a curtain sided swap body may not be used for cargo securing unless purposely designed to do so.
- 6.4.5 Floors of swap bodies are built to withstand corresponding axle loads of 4,400 kg and wheel loads of 2,200 kg (reference: EN 283). Such axle loads are typical for forklift trucks with a lifting capacity of 2.5 tons.
- 6.4.6 The curtain-sided swap body is designed similarly to a standard curtain side semi-trailer. It has an enclosed structure with rigid roof and end walls and a floor. The sides consist of removable canvas or plastic material. The side boundary may be enforced by battens.
- 6.4.7 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.
- 6.4.8 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 frame work.
- 6.4.9 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.

6.5 Roll trailers

- 6.5.1 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.
- 6.5.2 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 freight containers and swap bodies.

6.6 Road vehicles

- 6.6.1 Road vehicles are available in a number of different formats and designs.
- 6.6.2 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.
- 6.6.3 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.
- 6.6.4 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.
- 6.6.5 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 7, subsection 3.1.7). Applicable national regulations on this matter should be observed. In particular closed freight 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.

- 6.6.6** 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.
- 6.6.7** 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 are 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.
- 6.6.8** 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.
- 6.7 Railway wagons**
- 6.7.1** 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 freight 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.
- 6.7.2** The first mentioned purpose is exclusively served by open wagons, which are specifically fitted with devices for securing freight 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.
- 6.7.3** 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.
- 6.7.4** 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 are provided in annex 4, subsection 5.1.5.
- 6.7.5** 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 4, subsection 5.1.6.
- 6.7.6** 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.
- 6.7.7** When a railway ferry is operating between railway systems of different gauges, wagons which are capable of 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.

Chapter 7

CTU suitability

7.1 Suitability in general

- 7.1.1** Freight 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 subsection 8.2.1).
- 7.1.2** Freight 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 subsection 8.2.2).
- 7.1.3** 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.

7.2 Suitability for the cargo

- 7.2.1** 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. Freight containers, closed or sheeted swap bodies, semi-trailers and other road vehicles are suitable for most cargoes.
- 7.2.2** 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 section 9.4).
- 7.2.3** 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 freight containers however allow only restricted air changes. Therefore, specially designed containers with increased ventilation may be preferred for such sensitive cargo.
- 7.2.4** 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.
- 7.2.5** 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. Bracing and blocking against the frame of the CTU and/or lashing to the securing points is necessary (see annex 7, section 4.3). As the lashing capacity of the securing points in general purpose freight containers is limited, such standard containers might not be appropriate for certain large and heavy cargo items. Instead, platforms or flatracks could be used.
- 7.2.6** 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.
- 7.2.7** 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/cm² which may limit package masses to approximately 3 to 3.5 tons depending

on the type of forklift truck used. 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. For load distribution, see annex 7, section 3.1.

- 7.2.8 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.
- 7.2.9 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 the shape of a pyramid and securing by lashing is extremely difficult in a freight 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.
- 7.2.10 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* and prepared, operational restrictions regarding the permissible payload should be observed (see annex 7, section 5).

7.3 Suitability for the transport mode

- 7.3.1 Freight containers, including swap bodies and regional containers designed for stacking and approved under the CSC are basically suitable for all modes of transport. However, freight containers having an allowable stacking mass of less than 192,000 kg marked on the approval plate (see annex 4, section 1) 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 freight containers and swap bodies may have a gross mass of 34 tons 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.
- 7.3.2 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 4, section 5.1), the railway operator should be contacted when necessary, in order to prevent overloading.
- 7.3.3 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 grapple arms and approved for rail transport.
- 7.3.4 **CTUs on ro-ro ships**
- 7.3.4.1 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.
- 7.3.4.2 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 the following table:†

Gross vehicle mass (GVM (tons))	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	$\frac{\text{GVM} \times 10 \times 1.2}{n}$
$20 < \text{GVM} \leq 30$	3	
$30 < \text{GVM} \leq 40$	4	
$40 < \text{GVM} \leq 50$	5	
$50 < \text{GVM} \leq 60$	6	

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

* False bulkheads may be fitted at the rear (door) end as required.

† See IMO Resolution A.581(14).