Seaworthy packing guide and container loading planning instructions

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Foreword

The right kind of packing and protection, cost-effective loading planning of the cargo transport unit (CTU), efficient loading, and adequate cargo securing and lashing play a key role in smooth and business-supporting production and transport chains. It is important to the various parties in the production and transport chain that the goods are delivered to the recipients in impeccable condition and in the agreed schedule and that the transport equipment is not damaged. Cargo damage always causes indirect costs and harm. Not all damage is compensable or measurable with money. Most cargo damage could be prevented with the right planning and packing.

In transport packing, safety is of particular importance. The purpose of the package is to contain the product, to protect the product from the environment and the environment from the product, to facilitate the handling of the product, to enable and withstand safe securing and lashing during transport, and to provide information about the product with different kinds of labelling. Different modes of transport pose different challenges to the successful execution of the different stages of the production and transport chain. Particularly the stresses during maritime transport differ greatly from the challenges of other modes of transport. A seaworthy package is not precisely defined as a product, and there is no generally recognised standard for it. In other words, a seaworthy package is a package that provides sufficient protection against the mechanical and climatic stresses of maritime transport.

Inadequate and incorrect packing may cause damage to the product during the journey. Inappropriate packing may also prevent adequate cargo securing and lashing and thus cause hazards to people, goods and the environment during the transport chain. Due to inappropriate packing and insufficient cargo securing and lashing, products need to be re-produced and re-transported, which burdens the environment and causes undesirable follow-up effects for the parties. It has been said that an inappropriate and broken package is the most unecological one.

Inadequate loading plans result in underutilisation of transport capacity and resources. They also cause unnecessary idling of the machines used for loading. Together, these cause environmental burden and negative environmental impacts. As loading situations can be very fast-paced, inadequate advance planning of loading also jeopardises occupational safety.

The purpose of the “Seaworthy packing guide and container loading planning instructions” produced in the MeriDiLogis project is to reduce cargo damage, improve transport safety, increase risk management, as well as to improve the loading and utilisation rate of CTUs and streamline their loading process. This guide has been produced in close co-operation with parties operating in the sector and participating in various transport chains. Warm thanks to the co-operation partners and all those involved in the MeriDiLogis project, the steering group and the funders, who made the creation of the “Seaworthy packing guide and container loading planning instructions” possible.

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Terms and concepts used in this guide

AEO (Authorised Economic Operator): An AEO (Authorised Economic Operator) is a business whose customs clearance and logistics operations have been granted a security certificate by Customs and is therefore entitled to benefits across the EU (Finnish Customs 2023).

Break bulk (general cargo): Types of cargo that are loaded to a ship either in unitised form such as palletised, bagged, strapped, bundled, drummed or crated, or as (non-unitised general cargo). Typical examples of break bulk include e.g. steel pipes and various pieces of equipment, that are loaded to a ship by a roll-trailer (mafi), container platform, as bundled, or individually. The loading method depends on the cargo and the type of ship (RoRo, StoRo, LoLo).

Cargo owner: Means the one having title to the cargo as per relevant records and documentation. Depending on the terms of the trade and transport contract(s), the cargo owner can be either the seller or the buyer of goods.

Cargo roll-trailer (or mafi roll): A wheeled cargo handling unit (owned by a shipping company, port, or a terminal) used especially in a port and on board of a ship, also to load and unload breakbulk cargo.

Cargo sweat: Droplets of water formed on the surface of cargo holds of a ship, cargo transport unit and goods inside. Cargo sweat will form when the temperature of the cargo is less than the **dew point** of the air which surrounds it. Cargo sweating occurs, when a ship moves from warm climate zone to a cold (winter) zone, or vice versa. Cargo can be damaged by the water droplets dripping from the overheads of the cargo holds, or top and walls of the cargo transport unit if it is not packed and protected properly.

Cargo transport unit (CTU): Cargo transport units include containers, platforms, roll-trailers (or mafi rolls), Ro-Ro cassettes, swap bodies, cargo spaces of vehicles, semi-trailers and full trailers, railway wagons and other similar units used for transport.

CLP Regulation (the EU’s Regulation on classification, labelling and packaging of substances and mixtures): The Regulation 1272/2008 of the European Parliament and of the Council on classification, labelling and packaging of chemicals, which has been amended and changed several times since its publication.

Condensation: The change of the state of matter from the gas phase into the liquid phase, and is the reverse of vaporisation. As an example, the process where water vapour becomes liquid and condenses as droplets on the surfaces of goods and materials. Condensation happens when either the air is cooled to its **dew point**, or it becomes so saturated with water vapour that it cannot hold any more water.

Consignor (shipper): A company or a person who sends, receives (or signs over) a shipment of goods by the sea. Usually a consignor or a shipper works on behalf of the cargo-owner, and is responsible for organising the transport of goods from one place to another. A consignor/shipper makes a reservation for the shipment of cargo either with a shipping company, or a shipping agent.

Consolidation of cargo: Multiple parcels or shipments that are put together into one large shipment or container and transported by a carrier by road, sea or air. Consolidated freight can be shipments from multiple consignors to save space when shipping multiple small items to the same destination, city, port or country.

Containerisation (in this guide): Container stuffing or container loading, which is the process of unitisation of cargoes, packing and securing them into the container before shipping.

Corrosion: The gradual deterioration of metal materials by chemical or electrochemical reaction with their environment. In the reaction, metal reacts with an oxidant such as oxygen, hydrogen or hydroxide, resulting metal salts. Rusting, the formation of iron oxides, is a well-known example of electrochemical corrosion. Metallic objects which are exposed to the weather, salt water, acids, or other hostile environments are prone to corrosion. Corrosion degrades the useful properties of materials and structures including strength, appearance and permeability to liquids and gases.

CTPAT (Customs Trade Partnership Against Terrorism): A voluntary supply chain security programme led by the U.S. Customs and Border Protection, focusing on enhancing the security of private companies' supply chains against terrorism.

CTU Code (IMO/ILO/UNECE Code of Practice for Packing of Cargo Units): The CTU Code of the United Nations' International Maritime Organization (IMO), the International Labour Organization (ILO) and the United Nations Economic Commission for Europe (UNECE) is a recommendation-like code, which comprehensively incorporates the international packing guidelines for the safe maritime and land (road and rail) transport of cargo transport units.

Dew point: The temperature to which air must be cooled to become saturated with water vapour. When cooled below the dew point, moisture capacity is reduced and airborne water vapour will condense to form liquid water known as dew. When the temperature is below the freezing point of water, the dew point is called the **frost point**, as frost is formed via deposition rather than condensation.

Dry cargo container: A general shipping container used for transporting all types of dry goods, except liquids. The most common sizes are 20 foot (ft), 40 ft or 45 ft.

Flatbed or container platform: A container without any side walls or roof. It is designed for shipping of extremely heavy, odd-shaped and large cargo (e.g. airplane parts, heavy machinery) that cannot be transported in any other types of containers.

Flat rack container: A steel-made container designed for transport of large and heavy (oversized) goods that do not fit in an ordinary container. Flat racks only have sides on the short side of the container (the bulkheads) so the cargo can stick out the side of the container during transportation and can be loaded and unloaded either from the top or from the side. Flat racks are also available with bendable bulkheads or without heads. Most common sizes are 20 feet and 40 feet. Typical goods transported on flat racks include different types of project cargo, e.g. parts of a power plant or a production line, or large equipment.

Friction: A physical force that resists the sliding or rolling of one solid object over another. Friction causes objects to slow down and eventually stop moving.

Friction coefficient: Coefficient of friction (COF) is defined as the ratio between friction force and normal force. It can be used to compare the friction of different materials. The smaller the COF value, the lower the friction resistance. In cargo loading and securing, indicative dynamic friction coefficients are determined for different pairs of materials (that are typically used) to help to prepare the cargo securing and lashing measures.

Full container load (FCL): Refers to a container load, where the shipment or cargo requires the full space of the container. All the cargo inside of the container is owned by the same shipper, and the container space is not shared by any other cargo.

Full truck load (FTL): The transport of a single, dedicated truck load directly from a shipper to their customer or another location (without terminal handling).

Highest individual wave: Wave height is the vertical difference between the wave trough and the wave crest. The highest individual waves can be nearly two times higher than the significant wave height. The reported highest individual waves are not based on direct measurement, but are statistically estimated from the significant wave height. (Finnish Meteorological Institute 2022a).

INCOTERMS rules: Terms of trade and delivery for the sale of goods by the International Chamber of Commerce (ICC). The terms define the division(s) of responsibilities, duties and costs between seller and buyer on organisation of the transport of goods and risks involved. Some of the terms cover all transport modes and are suitable for door-to-door transports, while others are meant for maritime transport only.

Insulated container: A container with insulation to maintain the inner temperature as stable. Insulated containers are used for transports of temperature sensitive goods.

International Convention for Safe Containers (CSC Convention): An international convention on safety of containers by the United Nations International Maritime Organisation (IMO).

International Maritime Dangerous Goods Code (IMDG Code): An international convention for the maritime transport of dangerous goods in packaged form by the United Nations International Maritime Organisation (IMO). The code was developed to enhance and harmonise the safe carriage of dangerous goods and to prevent pollution to the environment. The code is updated every two years.

ISPM 15 standard: International Standards For Phytosanitary Measures for timber used in packing and securing cargo. The standards are compiled by the International Plant Protection Convention (IPPC) overseen by the United Nations Food and Agriculture Organisation (FAO). The main purpose of the standards is to prevent the spread of disease and insects that could negatively affect plants or forest ecosystems through the international transport and trade. The standards apply to all wooden packaging materials, including pallets, platforms, racks, crates, cases, barrels, and dunnage.

Invasive species: An invasive species is an organism that is not indigenous, or native, to a particular area and that have been introduced there by mankind either intentionally or unintentionally through natural channels such as oceans (see Regulation (EU) No 1143/2014 of the European Parliament and of the Council on the prevention and management of the introduction and spread of invasive alien species). Invasive species can threaten biodiversity, ecosystem services and cause harm to human industries.

Less than container load (LCL): A small maritime freight shipment wherein the shipper does not contract for a full container since the quantity of shipment is not adequate to contract for a full container.

Open top container (OTC): A container with an open top covered by a tarpaulin instead of a solid roof. The open top container is most commonly used if the product to be loaded into the container does not fit, due to its height, through the door of a regular container or can be loaded/unloaded only with a crane. The open top makes it possible to transport also overhigh cargo as it can be loaded from the top.

Out of Gauge (OOG): Cargo loads with dimensions exceeding the standard measures of a container.

Parcel (in shipping): An object, article, container, or quantity of something wrapped or packed up for transport.

Project Cargo (in this guide): A large or heavy cargo that often require special loading and unloading arrangements.

Refrigerated, or reefer container: Reefer containers are equipped with a refrigeration unit that is connected to the power supply on board the ship. Reefer containers are used for goods that need to be temperature controlled during shipping, such as food products, flowers, and pharmaceuticals.

Relative humidity: Relative humidity is the ratio of how much water vapour is in the air and how much water vapour the air could potentially contain at a given temperature. Relative humidity is normally expressed as a percentage; a higher percentage means that the air–water mixture is more humid. At 100% relative humidity, the air is saturated and is at its **dew point**. Relative humidity varies with the temperature of the air: colder air can hold less water vapour. So changing the temperature of air can change the relative humidity, even when the absolute humidity remains constant.

Resonance: A physical phenomenon that is created when one object vibrating at the same natural frequency of a second object forces that second object into vibrational motion. The resonance caused by movements of the ship or other vehicle can be so strong that it will damage the goods being transported.

Significant wave height (SWH, or H_s or H_{sig}): Wave height is the vertical difference between the wave trough and the wave crest. The significant wave height is a useful way to describe the sea state. It has been defined to approximate the wave heights visually estimated by experienced mariners. The significant wave height corresponds also the average of one third of the highest waves in a measured wave record when the sea is deep from the wave's standpoint (Finnish Meteorological Institute 2022a).

Tank container (tanktainer, ISO tank): A container meant for transport of dry and liquid bulk and gases, such as chemicals. Tank container consists of an insulated tank and a metal frame supporting it.

Ventilated container (”coffee container”): Also known as passive (naturally) ventilated containers. Ventilation is provided by ventilation openings in the top and bottom side rails. The openings do not let in spray, to prevent depreciation of the cargo by rain or spray, for example. Ventilated containers are used for cargoes that naturally contain and release moisture, such as coffee and cocoa beans. Nowadays, most of the containers are actively ventilated (with adjustable ventilation provided by temperature control unit), which simultaneously act as insulated or refrigerated containers.

1. Introduction

The characteristics of the product set the frame for transport and packing planning for products transported by sea. The weight, amount, dimensions, loadability and other key characteristics determine the choice of the transport unit and set the requirements for packing and product protection needs during the transport. As an example, fragile cargo (e.g. electronic devices or glassware) needs different protection and handling in comparison to a more robust product. Loadability must always be ensured especially with project cargo, such as large and heavy machinery or equipment (e.g. power plant components, cranes, machines). Ensuring loadability includes making sure the availability of suitable lifting, transport, cargo securing and lashing equipment, and that the product itself and its package have adequate lifting and lashing points. Different types of cargo transport units (CTUs) are presented in chapter 2 of this guide. The main focus in this guide is on the CTUs used in international maritime transport. *Railway wagons are not presented in this guide.* Regarding goods, the focus is on general goods and unitised cargo. *Therefore, dry, liquid and gaseous bulk are not dealt with in this guide.*

The transport of dangerous goods is subject to specific, detailed regulations and instructions. The website of the Finnish Transport and Communications Agency Traficom lists various national and international regulations and instructions concerning the transport of dangerous goods (Traficom 2022, 2023a and 2023b). The IMDG Code (The International Maritime Dangerous Goods Code) regulates the maritime transport of dangerous goods in packaged form and is updated every two years (IMDG Code 2022, incorporating amendment 41–22, obligatory as of 1 January 2024). The regulations and instructions for the transport of dangerous goods are not discussed in this guide. However, the markings, warning labels and placarding for the transport of dangerous goods, classes of dangerous goods (HAZMAT classes) and hazard pictograms for chemicals are presented in chapter 7.5 so that the operators in the transport chain can identify the shipments containing dangerous goods.

Besides the characteristics of the product, the destination where the product is going and when it should be there determine the choice of transport mode and route. Other key criteria for transport planning include costs, delivery time and the reliability of service. To save transport and delivery costs, it is economical to transport large batch/quantity of products. If the delivery time is short, goods must be delivered quickly and in a reliable manner, which usually raises costs. Air transport is the fastest freight delivery option but it is also the most expensive choice. Maritime transport is the cheapest option for transport of large quantities of goods overseas, and for heavy and oversized products it is often the only available choice. Due to Finland's geographical location, incoming imports and outgoing exports are always transported by the sea at some point of their journey. Often different transport modes (road + sea, road + air, rail + sea) are combined in cargo transports, so cargo is transported by multimodal transport. Thus, one should be aware of the conditions during transport as well as the terms and requirements of maritime and multimodal transport. A typical maritime transport chain and the different logistic parties of it are presented in chapter 3.

The chosen transport mode, route and the conditions at the site of origin and destination for cargo may set additional requirements for transport planning and for packing and protecting the product(s). The transport planner must be aware of the prevailing conditions at the country and site of origin/destination, along the selected route, ports and transshipment points. Climatic conditions and prevailing weather during the maritime transport directly influence cargo packing, protection, securing and lashing needs. The shipper/consignor must protect, lash and secure the cargo according to the worst conditions and stressors of the entire transport journey. Transshipment always poses a risk for cargo damage. The available loading equipment and efficiency of the ports determine how fast the cargo can be loaded and unloaded (which in turn influence the total lead time), and what type of vibration stresses the transported products may encounter. The conditions during sea transport and the different stressors therein and during loading and unloading are presented in chapter 5. Methods to prevent cargo damage (especially desiccation, moisture protection and anti-corrosion) are shown in chapter 6.

Even though a closed cargo transport unit, such as a container, is a protective package of a kind, most products need a separate (seaworthy) transport package (for the sea part of their journey) as well as securing and lashing the product itself and its transport package to the cargo transport unit (to a trailer, container, roll-trailer, or flat rack – depending on the product in question). The package

must withstand and enable adequate securing and lashing of the product. The package must also have openings required for securing and lashing and the product must have points from which the cargo can be lashed and secured without time-consuming additional work during the loading phase. An adequate transport package, sufficient product information and labelling on the transport package and in the transport documents, and securing and lashing ensure that the product reaches its destination in good condition, undamaged, appropriately, and safely without trouble. Insufficient securing and lashing inside the container may cause the goods to break, and incorrect weight distribution may lead to the container moving and hitting another container, for example. Seaworthy packing, package options suitable for different products, package labelling, cargo securing and lashing and related equipment, and safe CTU loading and unloading are discussed in chapters 7–11. The regulations governing cargo securing and lashing are presented in chapter 12.

Despite careful planning, something unexpected may always happen. Therefore, an essential part of transport planning is always the anticipation, assessment and management of different risks. Besides the changing climatic conditions during the sea journey and the physical stressors related to cargo handling (e.g. trembling and sudden movements), the socio-economic conditions in the country where the goods are going or coming from may differ significantly. Legislation, standards and other rules and regulations regarding transport and packing requirements may be different, or there might be differences in interpretation and application of the rules and regulations. These differences can directly determine how a product should be classified, packed (e.g. due to prohibited packing materials) and labelled (e.g. phytosanitary labels & measures), what certificates are needed, and what materials are chosen, etc. In addition, the available equipment at the transshipment points and in the final destination site and the knowledge level and experience of the personnel there should be taken into account. Typical risk factors and means to avoid and manage them are discussed in chapter 4.

2. Choosing a suitable cargo transport unit (CTU) for a product

Cargo transport units (CTUs) used for land and sea transport include containers (table 1 and figures 1–11), cargo spaces in vehicles, full trailers and semi-trailers and their different combinations (table 2 and figures 12–15). In Finland sc. module combinations are full trailer combinations exceeding 22 metres in (total) length and semi-trailer combinations exceeding 16.5 metres in length. Large and oversized cargo is also transported on flat racks (figures 9 and 10), container platforms or flatbeds (figure 11), and on extendable (telescopic) and flatbed trailers (figures 17–21). In cargo handling terminals in seaports, oversized and heavy cargo is loaded to Ro-Ro vessels by roll-trailers (or mafis) and Ro-Ro cassettes (table 3 and figures 22–23).

Choose a suitable CTU for your cargo by the amount and characteristics of cargo and its transport needs. Trailers, containers and other CTUs are available for different purposes (see tables 1,2 and 3). Containers are mainly used in maritime transport, and they are also suitable for road and rail transport. Advice for choosing the right CTU can be found from freight forwarders, port and terminal operators, shipping companies as well as companies that sell and lease containers and other CTUs.

Table 1. The dimensions, payload and typical use of different types of containers.

Container type	Internal dimensions: length, width, height (metres)	Door width and height (metres)	Cubic capacity and payload	Uses
Dry cargo container 20 ft	5.9 m x 2.35 m x 2.37–2.39 m	width: 2.32–2.34 m height: 2.28 m	32.5–33.2 m^3 21,750–25,000 kg	All types of dry cargo
Dry cargo container 20 ft, Pallet Wide	5.9 m x 2.44 m x 2.38–2.39 m	width: 2.4–2.44 m height: 2.2–2.28 m	34.0–34.5 m^3 27,860 kg	All types of dry cargo
Dry cargo container 40 ft	12.03 m x 2.35 m x 2.37–2.39 m	width: 2.34 m height: 2.28 m	67.7 m^3 27,600 kg	All types of dry cargo
Dry cargo container 45 ft (Pallet Wide High Cube)	13.56 m x 2.35 m x 2.9 m	width: 2.4 m height: 2.58	89.2 m^3 29,220–29,690 kg	All types of dry cargo
Refrigerated or reefer container 20 ft (normal height)	5.44 m x 2.29 m x 2.27 m	width: 2.23 m height: 2.10 m	28.3 m^3 27,400 kg	Temperature controlled and refrigerated products
Refrigerated or reefer container 40 ft (normal height)	11.56 m x 2.28 m x 2.25 m	width: 2.29 m height: 2.26 m	59.3 m^3 27,700 kg	Temperature controlled and refrigerated products
Tank container	6.05 m x 2.40 m x 2.40 m or 2.55 m		20–35 m^3 32,100–32,350 kg	Liquids and chemicals
Insulated container, 20 ft	5.7 m x 2.29 m x 2.16 m	width: 2.29 m height: 2.16 m	28.4 m^3 27,540 kg	Products requiring a constant temperature
Insulated container, 40 ft	11.59 m x 2.29 m x 2.5 m	width: 2.29 m height: 2.45 m	67.5 m^3 29,400 kg	Products requiring a constant temperature
Ventilated container 20 ft	5.9 m x 2.35 m x 2.39 m	width: 2.33 m height: 2.29 m	33 m^3 28,080 kg	Cargoes containing and releasing moisture
Open top container, 20 ft	5.9 m x 2.35 m x 2.38 m Roof opening width: 2.23 m length: 5.44 m	width: 2.34 m height: 2.28 m	32.5 m^3 28,130 kg	Oversized cargoes
Open top container 40 ft	12.03 m x 2.35 m x 2.38 m Roof opening width: 2.21 m length: 11.57 m	width: 2.34 m height: 2.29 m	66.4 m^3 26,630 kg	Oversized cargoes
Flat rack 20 ft	5.94 m x 2.35 m x 2.35 m		32.7 m^3 30,140 kg	Heavy and oversized cargoes, cargoes loaded from the above and side
Flat rack 40 ft	12.13 m x 2.40 m x 2.14 m		62.2 m^3 40,000 kg	Heavy and oversized cargoes, cargoes loaded from the above and side

Container type	Internal dimensions: length, width, height (metres)	Door width and height (metres)	Cubic capacity and payload	Uses
Platform (bolster) 20 ft	6.06 m x 2.44 m		31,260 kg	Heavy and oversized cargo which does not fit in any other container type
Platform (bolster) 40 ft, wooden floor	12.19 m x 2.44 m		39,300 kg	Heavy and oversized cargo which does not fit in any other container type

Data sources: DSV (2022a); ETS Logistica (2022a); Finnlines (2016); Maersk (2022); German Insurance Association (2022). Note! The dimensions and max payload may vary depending on the producer, age, characteristics and furnishing of the container.

Figure 1. 20-feet dry cargo container
Photo: Artic Containers Oy

Figure 2. 40-feet dry cargo container
Photo: Artic Containers Oy

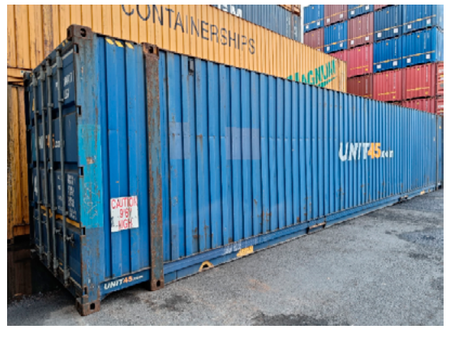

Figure 3. 45-feet dry cargo container
Photo: Artic Containers Oy

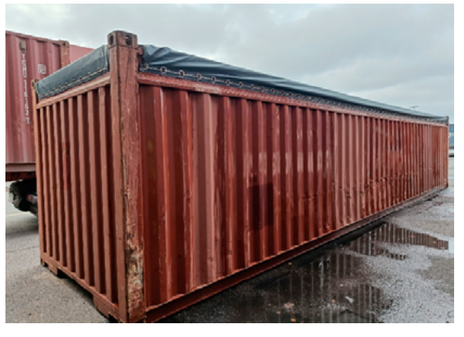

Figure 4. Open top container
Photo: Artic Containers Oy

Figure 5. Insulated container
Photo: Artic Containers Oy

Figure 6. Ventilated container, 40 ft

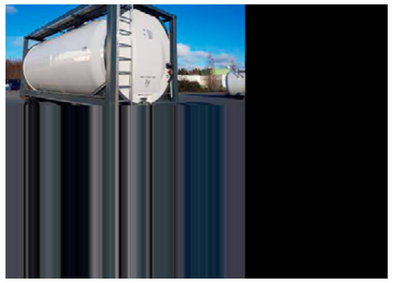

Figure 7. Reefer container
Photo: Artic Containers Oy

Figure 8. 20-feet tank container

Figure 9. 20-feet flat rack container

Figure 10. 40-feet flat rack container

Figure 11. Platform (bolster)

Table 2. Cargo transport units (CTUs) commonly used in international Ro-Ro transport

Examples of CTUs	Internal dimensions: length, width, height (metres)	Door width and height (metres)	Cubic capacity and payload	Uses
Semi-trailer TIR, 3-axled	13.62 m x 2.48 m x 2.68–2.71 m	Width: 2.45 m Height: 2.68–2.71 m	90 m^3 Max payload: 28,000 kg 33 euro pallets	Different loads loaded from the back or the side of the trailer
Curtain side trailer, 3-axled	13.62 m x 2.48 m x 2.68–2.72 m Gaps b/w poles 2.52 m	Width: 2.45 m Height: 2.67 m Side opening height: 2.65 m	90 m^3Max payload: 28,000–32,800 kg33 euro pallets	Products on pallets Loaded from the side
Mega trailer (Jumbo trailer), high model	13.62 m x 2.48 m x 2.94–3.00 mGaps b/w poles 2.52 m	Width: 2.45 m Height: 2.90 m Side opening height: 2.87 m	100 m^3Max payload: 32,800 kg33 euro pallets	Products on pallets
Refrigerated (reefer) semi-trailer	13.31 m x 2.48 m x 2.65–3.00 m	Width: 2.45 m Height: 2.6 m	85 m^3Max payload: 24,000–31,000 kg 33/66 euro pallets	Products requiring temperature control, e.g. food
Link trailer	7.74 m x 2.48 m x 2.8 m	Width: 2.45 m Height: 2.6 m	18 euro pallets	
Flatbed trailer	13.62 m x 2.48		31,900 kg	Oversized, over weight and/or wide load transport
Full trailer (towing vehicle + trailer)	7.3–8.1 x 2.45 m x 2.9–3.0 m	Width: 2.45 m Height: 2.7–3.0 Open body models are loadable from the back, side and/or top	110–120 m^3 Max payload: 24,000 kg 38 euro pallets	Different types of general cargo
Module Link (Nordic countries)	Length: 7.3–8.1 m + 13.6 m (trailer) max total length: 25.25 m width: 2.48–2.5 m height: 2.7–3.0 m	Width: 2.45 m Height: 2.7–3.0 m Open body models are loadable from the back, side and/or top	Max payload: 44,000 kg Please take country-specific payload restrictions into account	Different types of general cargo Transport of multiple containers
Link trailer combination	Length: 7.70 m (container) + 13.6 (trailer) max total length: 25.25 m width: 2.48–2.5 m height: 2.7–3.0 m	Loadable from the back, side and/or top	36,000–40,000 kg Please take country-specific payload restrictions into account	Different types of general cargo Transport of multiple containers

Examples of CTUs	Internal dimensions: length, width, height (metres)	Max payload	Uses
Low bed trailer (2+4-axled)	Load space max length: 13.25 m Loading height: 0.4 m	90,000 kg	Oversized, over weight and/or wide load transport
Semi low loader (3–4-axled)	Load space max length: 23 m Loading height: 0.85 m	Payload: 55,000 kg	Oversized, over weight and/or wide load transport
Open extendable trailer (4-axled)	Length: 17.3–51.3 m	Max payload: 56,000 kg	Oversized, over weight and/or wide load transport, e.g. pipes, conveyor, wind mill components

Data sources: DB Schenker (2022); DSV (2022b); DHL Freight (2022); ETS Logistika (2022b); Hyvönen Yhtiöt (2022); Kuljetus Tornikoski (2022). Note! Trailer dimensions and cubic capacities may vary depending on producer and production year.

Figure 12. 2-axled semi-trailer

Figure 13. Open body full truck combination

Figure 14. Curtain side trailer

Figure 15. Refrigerated semi-trailer

Figure 16. Flatbed trailer

Figure 17. 3+4+5-axled modular trailer.
Photo: Kuljetusliike Ville Silvasti Oy

Figure 18. Extendable semi low loader.
Photo: Kuljetusliike Ville Silvasti Oy

Figure 19. 4-axled (extendable) semi low loader.
Photo: Kuljetusliike Ville Silvasti Oy

Figure 20. 6-axled extendable semi low loader.
Photo: Kuljetusliike Ville Silvasti Oy

Figure 21. Extendable flatbed trailer. Photo: Kuljetusliike Ville Silvasti Oy

Table 3. CTUs used in the Ro-Ro terminals of ports

CTU	Dimensions: length, width, height	Payload	Uses
Cargo roll-trailer (mafi), 20–80 ft	6.0–25 m x 2.5–3.5 m x 0.58–1.0 m	25,000–160,000 kg	Loading, unloading and transfer of general cargo to/from a vessel
Ro-Ro cassette	12 m x 2.5 m x 0.85 m	50,000–130,000 kg	Loading, unloading and transfer of oversize cargo to/from a vessel

Data source: Euroports Rauma (2022); Finnlines (2022).

Figure 22. A pile of cargo roll-trailers.
Photo: Finnlines/Timo Vanhala

Figure 23. Ro-Ro cassette

3. Maritime transport chain

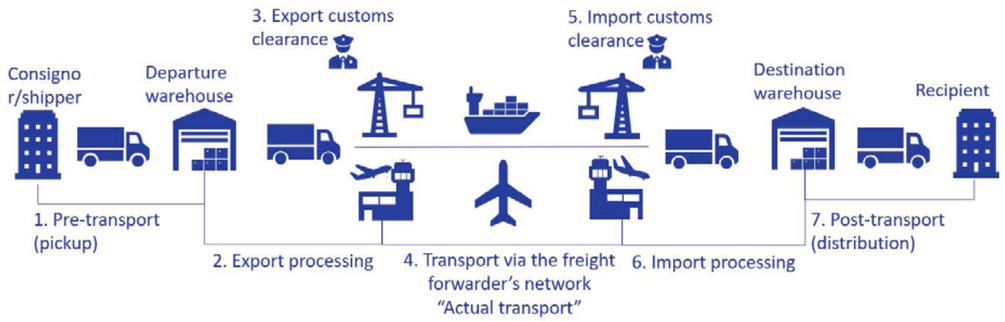

Figure 24. The typical stages and parties of the transport chain. Photo: Ojala et al. (2020), Traficom (2023c);

In Figure 24 (original source: Ojala et al. (2020), you can see a typical goods transport chain. The terms of delivery and shipping, contracts between seller and buyer, and international and national rules and regulations define responsibilities and obligations for different parties in different parts of the transport.

Cargo owner/consignor is usually either the producer or sender of the goods. His/her responsibility is to make the goods as loadable as possible into a container or other type of CTU. The consignor must ensure that the product (in itself) and the transport package covering and protecting it can together be lashed in the CTU so that they remain stable and endure the conventional stresses that take place during the transport. Consignor must also inform the other maritime transport chain parties about the essential characteristics of the cargo, so that lashing, cargo securing and loading operations can be planned adequately and carried out in a safe manner.

Shipper is (according to maritime law) a company or a private person who turns goods over to be transported by the sea. A shipper is usually either the consignor, or a party working under his/her behalf. The shipper makes the booking for the cargo space (in a vessel) and makes a contract with a shipping company or shipping agent.

Freight forwarder arranges transport of a cargo based on terms of delivery mentioned on the sales contract either on behalf of the seller or buyer (for more information about terms of delivery and INCOTERMS, see International Chamber of Commerce (ICC) 2020; Logistiikan maailma 2022). Freight forwarder plans the transport of goods on behalf of the customer, prepares the necessary contracts and documents, and informs the different parties of the transport chain. In addition to transport planning and organising services, freight forwarders also offer warehousing, logistics, packing and package planning services and consultation.

Container loading/stuffing: Goods that are exported from Finland are usually packed and loaded into a container either in the shipping department of the cargo owner/sender, inland terminal of the logistic party of the cargo owner, or in the cargo terminal of the port.

Port operator is responsible for loading of cargo into a ship or other means of transport at the port, and handling of goods while they stay in the port. Cargo loading operations include loading, securing and lashing of (non-unitised) cargo and cargo transport units (CTUs) of exported cargo into a vessel, and unloading of in-coming cargo, respectively. When goods are unitised in the port, port operator carries of the work. Typical cargo stuffed into a CTU in a port is break bulk.

Shipping company is responsible for the maritime transport of the goods and collaborates with port operator in loading of the vessel. Especially with demanding transports of project cargo, the cargo owner, freight forwarder, port operator and shipping company collaborate closely to ensure that the shipment can be loaded and transported safely.

Shipmaster is responsible for the seaworthiness of the vessel. His/her task is to make sure, that cargo is loaded properly and secured adequately on the vessel.

Land transport operator is responsible for transport of the cargo to and from the port. Depending on the terms of delivery included on the sales contract (see Finnish Customs 2021, INCOTERMS), making arrangements for the (land) transport can be either the duty of the seller, or the buyer and the owner of the goods may change already at the port (of origin/destination), depending on the chosen delivery clause. The seller or buyer can make a contract for land transport directly with the operator, or use the services of a freight forwarder, or other logistics service provider. With door-to-door transports the land transport is usually included in the transport contract and it is organised by a freight forwarder.

4. Transport and cargo handling risks

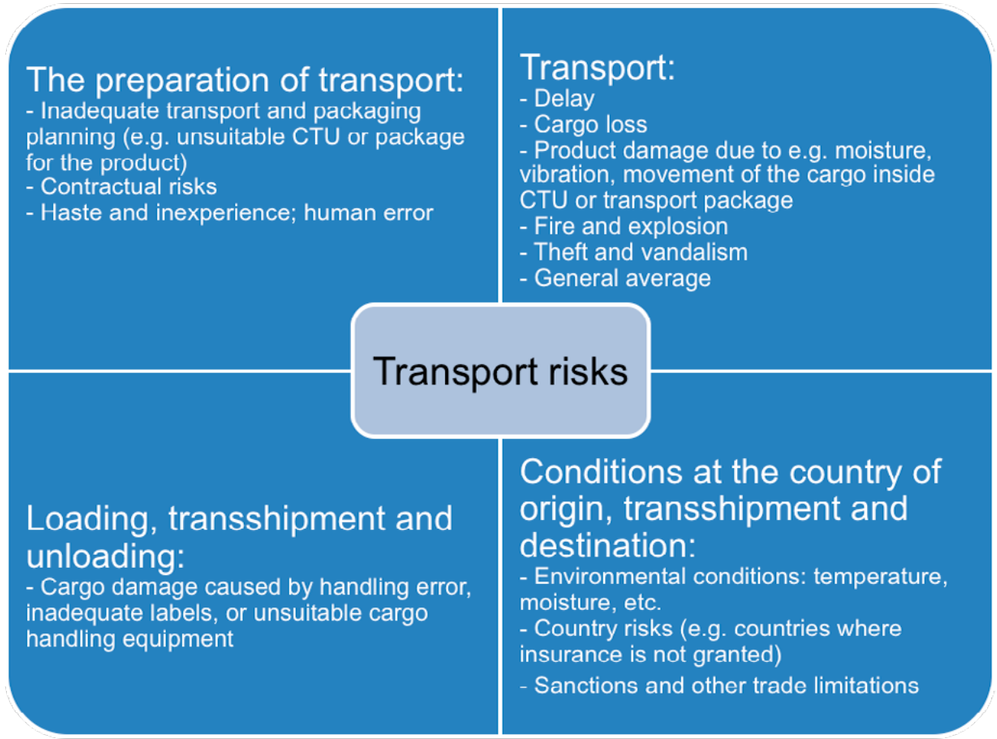

Figure 25. Typical risk factors in transport and cargo handling

4.1 Risks related to the preparation of transport

Inadequate transport and packaging planning is one of the most significant risks, having an effect to the transport as a whole. Unsuitable or inadequate (transport) package and cargo transport unit (CTU) may contribute to cargo damage during transport and/or cargo handling. Sender/cargo owner (consignor) is responsible for ensuring that the goods and their transport package can endure a drop from a common drop height, piling and stresses occurring during transport. The weight distribution inside both the transport package and the CTU must also be taken into account.

As a result of cargo damage, products may need to be re-produced and transported again to the receiver, which causes extra costs and non-wanted additional work in particular to the producer and/or shipper as well as to the receiver, who does not get the needed shipment on time. All this extra work results in environmental burden, too.

The sender of the goods (consignor/cargo owner) is responsible for taking care of packing of the goods and giving sufficient guidelines to carrier(s) on proper handling of the goods. The carrier is not responsible for cargo damage that occurred during transport, if there is proof that the cargo loss, reduction, damage or delay in cargo transfer is caused by a mistake or neglect by the sender or receiver, flawed guidelines by the sender, insufficient quality of the goods, or circumstances which the carrier cannot avoid or consequences he/she could not have prevented (see Carrier liability in the Road Transport Contract Act/Tiekuljetussopimuslaki 345/1979, section 28).

Good transport planning includes knowing and anticipating the circumstances, situations and possible problems that might occur during the transport, transmitting adequate information about the transported goods and their characteristics (esp. dimensions and lashing points), correct handling and other essential information to all collaborators and transport chain parties. The

sender/consignor must always inform the carrier if a shipment includes dangerous goods.

Contractual risks: In order to prevent risks related to contracts, it is vital that the responsibilities of different parties are clearly described in contracts and that the business partners are reliable. Carefully written and accurate call for tenders on transport service(s), understanding of the requirements of the product regarding transport, and knowing the contract party/parties help to diminish the contractual risks. If the call for tenders includes tight requirements e.g. on lead time, it may pose a risk for delay or error due to haste. The less freedom for action the provider of transport services has, the more responsibility (and thereby risk) the party asking for these services has.

When preparing and agreeing upon contracts, it is vital to make sure to understand correctly the meaning of the chosen term of delivery regarding responsibilities and liability and their consequences. Every mode of transport has its own regulations on liability that are based on international conventions. These regulations define carrier liability and disclaimer clauses. The carrier liability in maritime transport is usually limited (see the Maritime Act/Merilaki 674/1994). For this reason, it is wise to take an insurance for cargo damage.

When making the transport contract, one should make sure that the carrier or provider of the transport service takes responsibility of the whole transport operation, including sub-contractors. Making an insurance claim with one (already known) contract party is easier in the case of cargo damage, delay or other unexpected event, compared to dealing with an unknown freight carrier sub-contractor, or a port operator company located abroad.

Human error is a damage caused by a mistake of a single employee. Usually human error is a combination of different things: hurry caused by a lack of time, fatigue, thoughtlessness, multitasking, inexperience and a strong will to perform can contribute to accidents and near miss situations.

4.2 Risks during transport

Delay: The transfer of goods is delayed, when the goods are not delivered to the recipient by the time set in the transport contract. If a time for the point of transfer of the goods is not specified (in the contract), the delivery is delayed when the actual transport time exceeds the reasonable amount of time which a freight carrier would need to carry out the transport, considering the circumstances.

Follow-up effects of a delay can be significant if e.g. the transported product is a spare part or a component going to a production plant and the missing part causes a delay or an interruption to production. Contingent business interruption insurance (CBI) can help the recipient of the goods to cover these additional costs caused by the delay to his/her business operations.

The loss of goods: Freight carrier is responsible for the goods during transport until the goods is delivered to the recipient. The liability begins when the carrier has received the goods to be transported (see the Maritime Act/Merilaki 674/1994 and the Road Transport Contract Act/ Tiekuljetussopimuslaki 345/1979).

Due to the limited liability of the carrier, it is recommendable that the goods are insured to cover the loss off of cargo, damages etc. The loss of cargo during transport should be reported by making a written claim to the carrier.

Product damage during transport: In case goods are not properly lashed and secured, they may move within their transport package and/or inside the CTU and be damaged. Due to the movement of the vessel and waves, the cargo is always subject to vibrations (resonance). This movement may cause damage to the goods. Other factors causing cargo damage during sea journey include saline water (causing corrosion to e.g. metal products) and varying temperature and moisture conditions. The conditions existing during maritime transport and the different stressors caused to the cargo are described in more detail in the next chapter 5.

With project cargo, damages during transport cause extra trouble, since usually the transported product is custom made and a replacement for it does not exist. If the damage is so severe that the

product cannot be repaired, a new product must be produced and sent over to the customer. Since the production process may take several months or even a year, minimisation of cargo damage is profitable. Human errors, haste, and incomplete information are often the cause of accidents and near misses. In addition to cargo damage, it is important to avoid personal injuries.

Fire and explosions: Fires cause great damage on ships. Many of the cargo damages reported to the insurance companies are caused by fires or explosions. Among general cargo, especially electrical equipment and batteries (besides dangerous cargo) are prone to fire e.g. due to short circuit caused by moisture. Loading and transporting batteries safely is difficult, since they must always contain a small electrical current in order to remain operational.

Theft and vandalism: CTUs may be exposed to theft or vandalism during mandatory breaks at rest areas (Regulation (EC) No 561/2006 of the European Parliament and of the Council on driving times and rest periods). CTUs may also need to wait for loading or unloading e.g. in the cargo terminal, on board of a ship or in the cargo space of other vehicle. Even though the port or the terminal operator monitors the terminal area, shipping company is responsible for the safety and security on board of the vessel and drivers of the land transport carrier have regular security training, there is always a risk for theft and vandalism because there is a constant movement of cargo and people in the port areas, providing access for non-wanted. The risk may also come from the “inside” (own employees), or due to information leak to outsiders. The sender of the goods should therefore make sure that transport partners are reliable, that the information regarding e.g. valuable goods is not shared to outsiders and that the data security of one’s own company is protected.

General average is a principle of maritime law to define shares between the shipowner and cargo owners in a common loss during a maritime accident.

The general average is used only in maritime transport and in an event when cargo has to be jettisoned in order to save the ship, crew, or the remaining cargo. Costs may also be caused by salvage operations, e.g. firefighting and towage of the vessel.

When general average is declared, every cargo owner is responsible for taking part in sharing the costs to offset the common loss, in a part corresponding to the value of their goods, for the cargo of others, as well as the ship itself. These costs can be notable and also the owners of undamaged goods must take part. Therefore it is vital to make sure, that the transport insurance covers the costs of a general average.

4.3 Risks related to loading, transshipment and unloading

Cargo damage caused by handling error, inadequate labels or unsuitable cargo handling equipment are common risks during loading, transshipment and unloading operations. As described earlier in chapter 3, maritime transport may include several loading and transshipment points. Cargo(s) are delivered from sender to the recipient through many hands. Every transshipment adds the risk for cargo damage caused by error or missing information. Therefore, careful planning, packing, labelling and sharing information to the (trusted) parties is essential.

4.4 Risks related to the country of origin, transshipment and destination

Environmental conditions: Atypical weather conditions, such as strong storms and heavy rainfall, have increased due to climate change. Therefore, the stress to the cargo during the sea voyage and the risk for accidents at sea have increased.

The climatic conditions at the country of origin, transshipment and country of destination of the goods may be considerably different. At the country of origin in Finland the temperature may be 5 Celsius degrees above zero while at the country of destination it may be +25 Celsius or more. In a similar fashion, the relative humidity of the air at the point of origin and destination can differ. During maritime transport, goods are subject to salinity and variation of moisture which in turn can cause moisture and mould damage, and corrosion. More about these risks of damage in chapters 5.2 and 5.3.

Country risks are issues and changes related to a specific country or a part of it, and/or neighbouring countries with negative consequences to business activities, including transport. These risks can be caused by political, socio-economic or environmental changes. Examples include coup d’état, war or other armed conflict, corruption, natural disasters (e.g. floods or earthquakes), major accidents, or a pandemic. They often cause socio-economic instability and safety and security risk for transports. Normal transport insurance is not valid in countries of high risk, and due to e.g. a war or an armed conflict insurance is not provided at all.

Sanctions and other trade limitations: Sanctions and/or other trade limitations are often posed to countries that are at war or politically unstable. The sanctions and limitations can be e.g. restrictions to exports and/or imports, foreign payments and currency transfers. As an example, sanctions and trade limitations were set to Russia due to its attack to Ukraine in 2022.

Other recent risks limiting trade include COVID-19 pandemic and different measures to limit spreading the transmission of the virus. The containment measures (especially in countries with large amount of industrial production, e.g. China) have caused major delays and breaks in the global production and transport chain, resulting in e.g. difficulties in the availability of components and products during COVID-19 restrictions, and difficulties in the availability of maritime containers.

5. Conditions during maritime transport and cargo handling operations

5.1 Mechanical stresses

The cargo inside a CTU should be lashed and secured so that it does not move in any direction during transport and transshipment operations. Especially during loading and unloading, CTU and the cargo inside it face strong downward movement, vibrations and sudden drops. As a result of these movements, cargo can move or rub against the wall of the CTU if it is not properly packed, protected or lashed. The cargo must be lashed and secured so well that it bears the heaviest phases of the transport.

During transport cargo is always exposed to vibration stress (resonance). Vibration in maritime and rail transport can be so strong that it can break the goods. In road transport the condition of the road and the vehicle determine the level of vibration the cargo is exposed to.

During maritime transport waves and tides influence the movements of the vessel. The extent of the movements is dependent on the nautical features of the ship, how it is loaded as well as the prevailing weather conditions in the sea area where the vessel is sailing. Typical wave height varies significantly in different sea areas (table 4).

Table 4. Wave heights in different sea areas

Maritime area	Significant wave height	Highest individual waves
Baltic Sea (area A)	< 8 m	8–14 m
North Sea, Mediterranean (area B)	8–12 m	16–22 m
Bay of Biscay, Atlantic ocean (area C)	> 12 m	14–20 m

Data sources: Finnish Meteorological Institute (2022a & 2022b); NASA (2020); Sasmal et. al. (2021)

The greatest forces affecting the cargo during maritime transport are caused by wind and waves coming from the side of the ship and making the ship roll. If the ship starts listing, gravity makes objects slide on the deck. The longitudinal forces affecting the container and the cargo inside it can be strong. However, their effects are usually more minor than those of strong braking in road transport. Typical forces affecting the cargo in different sea areas are listed in table 5. (CTU Code 2014)

Table 5. Forces affecting the cargo in different sea areas

Maritime area	Forward	Backward	Sideways
A: Baltic Sea	0.3 g	0.3 g	0.5 g
B: North Sea	0.3 g	0.3 g	0.7 g
C: Unlimited	0.4 g	0.4 g	0.8 g

1 g = 9.81 m/s^2

The larger the movements of the ship, the greater the dynamic forces affecting the cargo on the board. The impact of the forces is greatest in the front and sides of the vessel and slightest in the middle. During the sea voyage, the CTU and cargo inside move along with the movements of the ship in six different directions (figure 26).

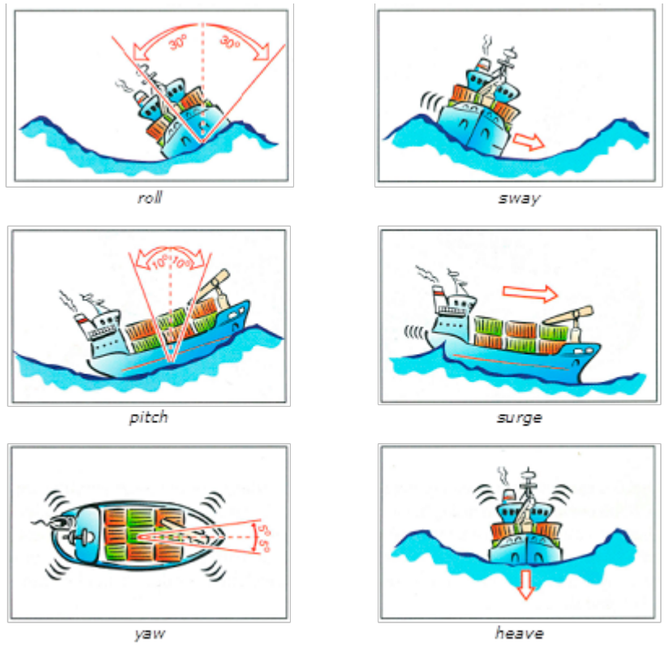

Figure 26. Data source: CARING project 2013.

Vessel movement sideways can be great due to rolling of the ship. Since intercontinental sea voyages are long, cargo, CTUs and their securing face dynamic stresses for a long time. As an example, the sea voyage from Europe to East Asia typically lasts 5 to 6 weeks, and crossing the Atlantic ca. 10–12 days.

Calculating the cargo securing and lashing stresses of maritime transport is described in the CTU Code. The cargo owner/consignor is responsible for securing and lashing the cargo to the CTU and must ensure that cargo securing and lashing withstand the stresses during transport.

5.2 Climatic stresses

Moisture and condensation: Ordinary CTUs (maritime containers, trailers and semi-trailers) have no air-conditioning and are never fully waterproof. During transport, the inner temperature of the CTU follows the temperature and moisture content of the air outside. Air always contains moisture (in the form of water vapour). The warmer the air, the more moisture it can contain. The relative moisture content of the air is given as percentage.
Dew point is the temperature in which the air cannot hold more moisture (as gas), and the excess moisture then condenses into liquid form as water droplets (dew) or frost if the temperature is below zero Celsius. Dew point calculator (http://kastepistelaskuri.fi/) helps to see, when condensation begins in different air temperatures. Condensation on top of products and inner surfaces of the CTU and cargo holds of the ship can harm goods. This phenomenon is also known as *cargo sweat* and *ship sweat*. Electrical equipment and their parts, metal products and goods that can soak moisture (e.g. clothes and insulation materials) are particularly vulnerable to condensation damage. Condensation can also foster mould growth on clothes and insulation materials. More about mould and other biological stressors in chapter 4.3.

Rain, snow and temperature variations: When goods are transported by the sea, a part of the CTUs are always placed on the weather deck of the ship where they are exposed to rain, snow and temperature variations. In ocean trade between different continents, a consignor cannot know if his/her cargo units are loaded below the deck or on the weather deck. Therefore, the goods that are in the CTU must be protected to resist moisture and temperature variations.
When cargo is transported through different climatic zones, it is always subject to air temperature and moisture content variations. The climatic conditions and weather between the country of origin and the country of destination can vary markedly even inside Europe. When a closed CTU (e.g. a container) is waiting for loading on the terminal yard or container field, on a sunny and hot weather the inner temperature of the CTU may rise so high that the cargo inside may start to deteriorate. Food and other perishable and/or temperature sensitive products start to deteriorate if their storing temperature varies. Cold temperature in turn causes embrittlement of plastics and rubber, freezing and/or crystallisation of liquids and deterioration of food products that do not bear low temperatures (e.g. too low storing temperature cause blackening of bananas and freezing can damage water containing produce such as cucumbers).

Heavy rainfall or high air humidity can damage goods during transport, loading, unloading, and warehousing. In the monsoon zone, heavy rainfall is an annual phenomenon, in a similar fashion as variation between dry and rainy season in the sub-tropical climatic zone. In the northern temperate zone (where Finland is located), rainfall (in different forms) comes in all seasons, throughout the year. However, due to climate change, extremes of weather (strong wind and storms, heavy rainfall, draught) have increased. Heavy rainfall may cause e.g. floods on the ports areas and infiltration of water into warehouses.

5.3 Biological stresses

Biological stresses are damage caused by microbes (bacteria, viruses, mould and fungal spores) to goods and/or their package. The following materials are prone to biological stresses:

- Moulding: fabrics and textile materials, leather, wood materials
- Blue stain: timber
- Deterioration: fruit, vegetables, meat, grain
- Damage caused by insects and pests: food products, wooden materials
- Spread of invasive species in the goods and their packaging

Moist and warm conditions are ideal for the growth of bacteria and fungi. When microbe growth has started in the goods and/or in their package materials, it may cause damage also other goods that are transported within the same CTU.

Invasive species: The transport of goods from one continent to another always forms a risk for the spreading of invasive species. These species can spread as (adult) bio-individuals, spores, seeds, or other reproductive parts along goods and/or their packaging materials (see Regulation (EU) No 1143/2014 of the European Parliament and of the Council on the prevention and management of the introduction and spread of invasive alien species). The CTU Code includes a list and description of the most common (harmful) invasive species. The EU Invasive species regulation and species list include harmful species that are of concern in the EU. The list is updated as needed. Finnish Customs enforces the implementation of the EU invasive species regulation in Finland.

If goods or their package contains suspicious organisms, the Finnish Environment Institute (SYKE) can give guidance in identification of the harmful species and how to eradicate them. Only professional pest controllers can do eradication of the invasive species.

5.4 Container gases

Goods transported in closed CTUs, such as containers, can emit (volatile) chemical compounds that are harmful to health. The content of these compounds in the air inside the CTU can be high (Pitkänen et al. 2020; Kajolinna et al. 2016).

The goods may also be disinfected in the country of origin by fumigating them, in order to protect them from pesticides or mould. Outside the EU, methyl bromide may be used as a fumigant. Its use has been prohibited in the EU since 2010 (see Regulation (EC) No 1005/2009 of the European Parliament and of the Council on substances that deplete the ozone layer). If a container is fumigated, it must be notified on the container. However, sometimes the markings on container fumigation are either missing or may have come off during transport. Particular attention should be paid to safety if the container's ventilation openings are taped closed. For safety reasons, a container must always be ventilated before unloading the goods. Ventilation does not always guarantee safety, and the prevailing weather conditions influence the efficiency of ventilation.
The safety of working conditions can be ensured also by measuring, as long as it is known what substances to measure. The container may contain a large number of different compounds that are hazardous to health. (Pitkänen et al. 2020; Kajolinna et al. 2016; Pitkänen et al. 2017)

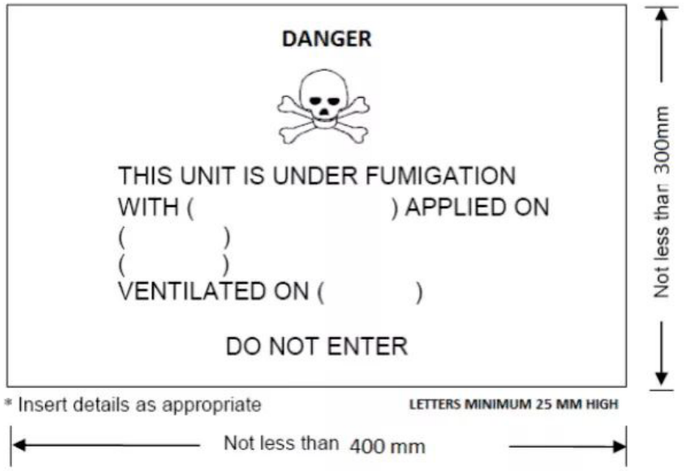

Figure 27. A warning label of container disinfection by fumigation (IMO 2022)

5.5 Chemical stresses

Corrosion: Rusting of metals takes place when goods made of metal are left unprotected outside, are exposed to rain and air humidity, and start to weather. Corrosion is a chemical reaction involving a reaction between the metal ions and oxygen in the air or water (oxygenation). As a result, the metal starts to weaken. Invisible corrosion is most detrimental, because the metal material can become unstable and break suddenly.

Corrosion begins when the relative humidity of the air exceeds 60%. In Finland this level of humidity prevails in the outdoor air throughout the year. In addition, metal surfaces always contain some impurities that keep the surface moist when the relative humidity is below 60%.

During maritime transport, seawater is a notable factor enabling corrosion. Waves bring seawater on the goods placed on the weather deck. The air and splashes of seawater are filled with oxygen, sea salt and moisture that are all accelerating factors for corrosion. In addition, wave activity creates micro droplets that are easily transmitted inside CTUs. The sea water contains salt (chlorides) that is very harmful to aluminium, steel, and even to stainless steel. Drops and splashes of seawater thus easily cause pitting on these metal materials. Therefore, metals transported by the sea must be protected from corrosion, also when transported in a CTU, e.g. regular container.

Project cargo, such as machinery, equipment and vehicles to be placed or used outdoors are weatherproof and corrosion protected (either galvanised, chromium plated, or painted).

In storage the greatest risk for corrosion is when a cold metal containing product is taken to a warm space after unloading in a cold weather. In the warm storage the goods are exposed to cargo sweating (see condensation in the chapter 5.2 climatic stresses).

5.6 Examples and pictures of the most common types of cargo damage

Figure 28. Corrosion damage

Figure 29. Damage on the exterior of a transport package

Figure 30. Insufficiently lashed and secured wood material load in a CTU

Figure 31. Examples of inadequate cargo securing. Photo: Helsinki Police Department/Iltasanomat (2015). https://www.is.fi/autot/art-2000000964731.html

Figure 32. Moisture damage

6. Methods to prevent cargo damage

6.1 Desiccation and moisture protection

Products that can easily absorb moisture, such as paper, insulating materials and textiles need to be protected from moisture during transport and warehousing. Moisture can easily damage electrical equipment, batteries, metal products and components and can cause corrosion (as described earlier in chapter 5.5). Methods to avoid moisture damage:

- If possible, arrange loading and unloading of the CTUs indoors. Make sure that the goods that are packed and the CTU are dry.
- Always use dry packing and support material for the cargo.
- If you use vapour barrier (an air-tight plastic around the good), place a drying/moisture absorbing substance (a dehydrant) inside the vapour barrier.
- If possible, send the goods in a season when the temperature in the country of origin and destination are close one another. Try to avoid rain and monsoon seasons when the humidity is at its height.
- There are different aids for moisture protection and dehydration (desiccants). Silica gel bags are available in smaller and larger bags (e.g. for 20-ft container, 15 pieces of larger 1 kg bags are recommended). There are also moisture absorbents that can be placed on the inner walls of a container.
- Use ventilated containers for goods that easily absorb moisture.
- Use corrosion protection for goods that prone to corrosion. This is described in more detail in chapter 6.2.
- Unload the cargo as soon as possible. Avoid long standing of the CTU outdoors.

6.2 Corrosion prevention methods

Goods are always subject to humidity and seawater during maritime transport. Management and removal of moisture (also inside the transport package) is thus vital. The transport package (and the CTU) can be ventilated or air-conditioned to avoid condensation. Another method is to use dehumidification (e.g. silica gel, calcium sulphate): substances which draw in moisture from their surrounding environment. When handling dehumidification agents, it should be noted that they may contain harmful substances.

All corrosion prevention methods are based on the same principle: avoiding oxidation and reduction of metal. The contact between oxygen and the metal surface must be prevented.

Note! Goods that are going for anti-corrosion treatment must always be handled with gloves, and they must be clean and dry before the treatment. The moisture and grease from uncovered hands can initiate corrosion. If someone has touched the product with bare hands, the product must be cleaned again before it can go to anti-corrosion treatment.

6.2.1 Anti-corrosion treatment with oil and wax

This treatment is very effective if done correctly. The product and the surfaces to be treated must be properly cleaned and dry before the treatment. One must carefully spread the oil or wax on the (metal) product to be protected, because even the smallest un-protected part can initiate corrosion also in the parts that are treated with oil or wax. Note that oils are not suitable for treatment of electronic equipment.

6.2.2 Anti-corrosion treatment by preservation

Preservation, or putting a product into an air-tight vacuum, is favoured as an anti-corrosion treatment in some market areas. In this method, an aluminium foil is seamed air-tight and placed around the product. Then air is either removed from this vacuum package, or it is replaced with nitrogen or inert gas (e.g. by helium or neon). These gases are hazardous to health and the requirements of the IMDG Code must be followed when they are used for anti-corrosion treatment.

The vacuum method has good anti-corrosion performance but it is relatively expensive. However – and especially with large-size goods – breaking the foil during transport, transshipment or unloading operations is the main disadvantage of this method. A broken vacuum package can foster corrosion of the product.

6.2.3 Anti-corrosion treatment by VCI (vapour corrosion inhibitor) method

The VCI (Volatile Corrosion Inhibitor) anti-corrosion substance is integrated into most commonly used packaging materials, such as polyethene (PE) films or kraft paper, or it can be released from a (separate) capsule. The corrosion inhibitors are released from the packaging materials and they give corrosion protection even up to several years.

VCI technology is easy to use and it is based on air movement triggered by temperature variations. The odourless, invisible and harmless chemical compound is released from the packaging materials or a separate capsule and sets on the surface of the protectable metal product and the surrounding air, preventing and slowing down oxidation process.

The VCI method is suitable for different types of metals and also for electronic equipment. Other advantages of the method are that it is easy to use, fast, and cost-effective, because it gives a long-term protection for goods during transport and warehousing. The method is safe: no personal protection equipment needed when used and the products (containing VCI) are recyclable.

7. Seaworthy packing and its characteristics

A seaworthy transport package is a package suitable for maritime transport which is capable of protecting the goods during the entire planned journey so that the goods can be safely delivered from the sender to the recipient in a good condition. The package must be able to protect the goods for several months (if necessary) for the different (dynamic and mechanical) stressors during transport, transshipment operations and warehousing. The transport package should also protect the goods inside for heat, frost, temperature variations, sunlight, moisture and humidity, and theft. Warehouses in many developing countries (located in tropical climate zone) can be inadequate, so goods may need to be stored outside (in their transport package) for a long time, and they are thus vulnerable to climatic and biological stressors.

Inadequate transport package (in itself) and insufficient or unclear labels often cause cargo damages. Therefore, the planning of the packaging in order to protect the goods during transport and cargo handling should be taken into account when designing the product. Poor or inadequate package may also hinder cargo securing and lashing of the goods to a CTU, ship or other vehicle. ***The goods must also be supported and lashed inside the transport package in such as fashion that they can bear the conventional transport stresses and be stationary. For goods with weight over 10 metric tonnes (10,000 kg), a direct lashing of the product is highly recommended. The lashing can be aided by making hatches to the transport package (see figure 33 below).***

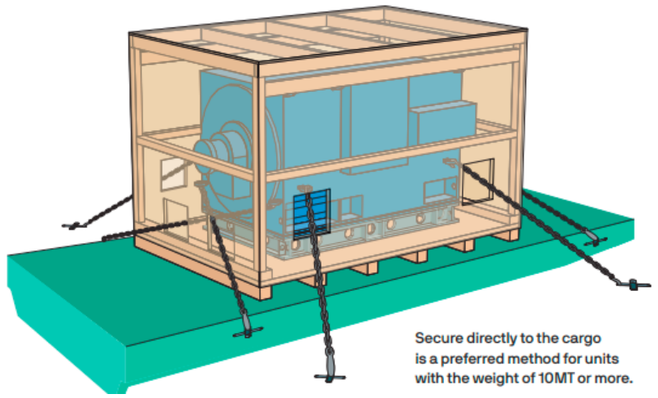

Figure 33. Transport package with hatches for securing the cargo directly from the product.

Note that the consignor usually cannot influence the stuffing and loading of the goods into a CTU, or where the CTU is placed on board of the ship.

7.1 Packaging types and the protection of the goods

Note the following when packing goods:

- Do not put things that do not suit together into a same transport package.
- If you put several goods with different sizes into a same transport package, always make sure they do not damage rub one another e.g. by rubbing on each other.
- Always pack the heaviest goods to the bottom.
- Do not pack heavy and light goods into a same package.

- Pack fragile goods separately.
- Make sure that all goods that need cover are inside a transport package (a box, case, crate, protective hood).
- Acknowledge the protection needs of the good(s): Is protection from moisture, dehydration, or anti-corrosion measures needed? How about protection from electromagnetic radiation or temperature variations?
- Make sure that the package is sealed properly and that joints do not open during transport.

7.1.1 Transport packages and platforms

Depending of the product, a suitable seaworthy transport package may be:

A light plywood case

- Can be handled mechanically, usually folded to size
- Stackability is limited
- **Suitable for** container and general cargo parcels that weigh less than 500 kg
- **Use:** Spare parts, electronic components, measuring equipment etc.

Figure 34. A light plywood case

A light wooden box

- Made of sawn timber, can be handled mechanically along long sides
- Stackable
- Rain cover can be made on top if needed
- **Suitable for** container and general cargo parcels that weigh less than 1,000 kg
- **Use:** Machinery, equipment, unitised components

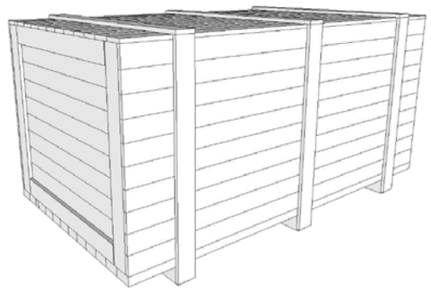

Figure 35. A light wooden box

- A heavy wooden box
- Made of sawn timber, can be handled mechanically from all sides
- Stackable
- Rain cover can be made on top if needed
- **Suitable for** goods that weigh more than 1,000 kg. Make sure the wood material is strong enough to bear the weight of the product
- **Use:** Machinery and equipment, metal and electronic products both in container and general cargo shipments

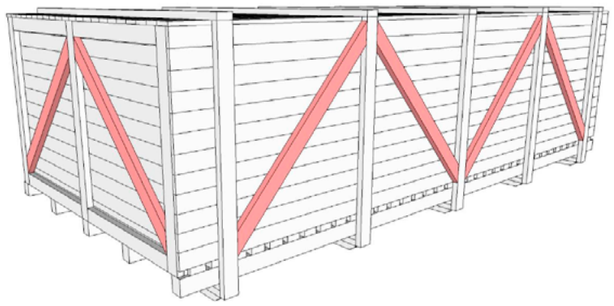

Figure 36. A heavy wooden box

A wooden frame (rack)

- Made of sawn timber, can be handled mechanically from either two or all sides
- Stackable
- Enables direct lashing of the good without separate hatches or openings on the package
- **Suitable for** goods that weigh more than 500 kg and that do not need weather protection
- Choose the material strength by the weight of the goods

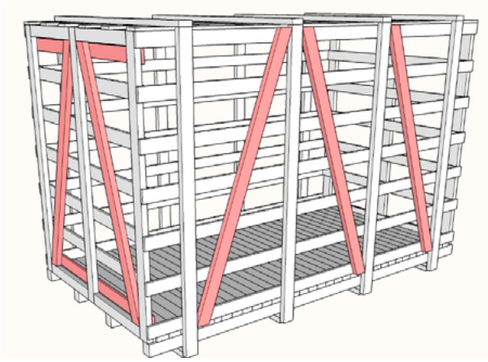

Figure 37. A wooden frame (rack)

Platforms

- Made of sawn timber, can be handled mechanically from either two or all sides
- **Not stackable**
- Enables direct lashing of the good without separate hatches or openings on the package
- Choose the material strength and platform type by the weight of the goods
- **Suitable for** goods that do not need weather protection, or in case weather protection is a plastic cover or a tarpaulin placed around the goods

Figure 38. Different types of wooden platforms

Product-specific special arrangements

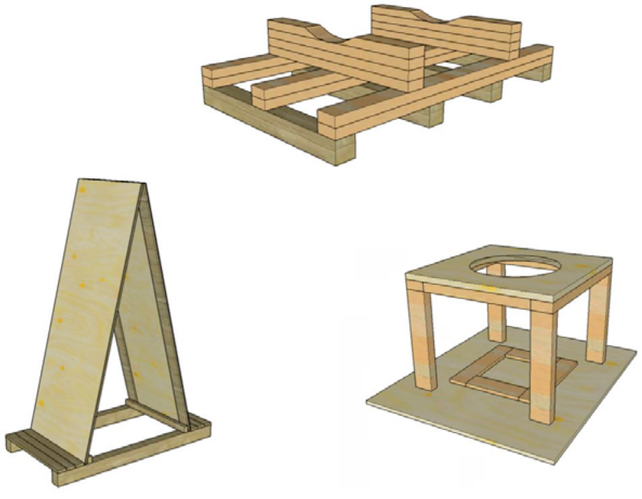

Figure 39. Special arrangements

More information about the dimensions and how to estimate the material strength by the weight of the product see e.g. Andritz Finland, seaworthy case design.

7.1.2 Interior Protective Packaging

Goods should be packed and protected adequately to bear the stresses of the transport. Therefore, support material is usually needed to make sure the goods stay in place inside the transport package. Wood, carton, sealing tape, plastic wrap, packing foam, air-bubble wrap, packing paper, dunnage bags and other stuffing materials can be used to support the cargo.

The aim of the support material is to:

- Abate trembling (vibrations) during transport and the impact of sudden movements during cargo loading and unloading
- Keep the goods in place so that they do not move inside the CTU (e.g. container or trailer) and/ or their own transport package
- Absorb the possible spill or leaks coming from the goods
- Prevent damages on the surfaces of the goods
- Protect goods from wet, moisture and corrosion
- Protect goods from temperature variations and sunlight (if needed)

Note!

- Whenever possible, bolt the product into the bottom structure of the transport package.
- Ensure that there is no empty space in between the goods and the transport package that can squeeze the goods due to a heavy knock or pressure.
- Ensure that the goods do not rub against the transport package and that there is protective material between them.
- Support the goods, so make sure the support material is attached to surfaces that are robust enough to enable adequate securing.

A separate transport package is not always needed if the product is robust and durable. In any case, make sure the following things:

- The platform of the product must be suitable for mechanical handling. A suitable platform is e.g. a standard size pallet. It is a simple type of transport package (in itself).
- The platform must be slightly bigger than the external dimensions of the goods/product so that in case of a sudden shock, the platform will hit the obstacle (e.g. CTU wall) before the goods.
- The goods should be lashed into their platform so that they stay in place during normal transport stresses. Use either binding straps, wedges, nets or bolts to secure the goods so that they are firmly in place.
- Handling markings, address details and other essential labels must be attached or painted to the good and/or its transport packages so that they are clearly visible.
- If the package and the product are not stackable, mark this information clearly.
- Make sure that the weight of the product or goods does not exceed the durability and load capacity of the platform or other loading base.

7.2 Suitable packing material and their environmental impacts

Unnecessary packing should be avoided for economic and environmental reasons. However, overpacking is generally less harmful than underpacking because proper packing helps to avoid cargo damages. Adequate, solid and good-looking transport package pays itself back by helping avoid reclamations and complaints from customers' side.

Environmental issues should be kept in mind when selecting packaging materials. To minimise environmental footprint, use recyclable packing and covering materials. Consider if the package (e.g. a wooden box) or cargo support materials can be reused. If the package materials cannot be reused, deliver them to recycling and advise your business partners to do so as well.

Wood materials, including timber, plywood, and wood-based boards and panels are durable and robust, have low carbon footprint and are widely available (at least in Nordic countries). Wood materials are reusable and recyclable, and are especially useful for packing and supporting heavy and large-size materials.

Wood materials are easy to work on. Timber, plywood and chipboard can be used for making boxes, crates, cases, platforms and other types of seaworthy packaging materials (see chapter 7.1). The packaging made of timber and other wood-based materials are durable, can be made stackable and can be used several times if needed. Wooden material can also be re-used for other purposes e.g. as construction and cover material.

When using wooden packaging materials, always make sure that they are certified and has labels showing accreditation.

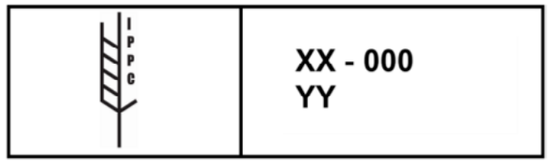

Figure 40. Model for a label compliant with the ISPM 15 standard for wooden packaging. In Finland, the use of the ISPM 15 label requires the approval of the Finnish Food Authority. (Finnish Food Authority 2023)

The label includes:

- IPPC logo
- XX = two-letter country code (FI for Finland)
- 000 = ID of the holder of the labelling right (given in the Finnish Food Authority's decision)
- YY = handling code
  - heat treatment = HT
  - methyl bromide fumigation = MB
  - dielectric treatment = DT
  - sulfuryl fumigation = SF

The wooden packaging materials used for the transport of products exported outside the EU must meet the ISPM 15 requirements. Wooden packaging materials imported into Finland from non-EU countries or from Portugal must also meet the requirements of the standard. Portugal is an exception in the EU due to the occurrence of pine wood nematode. Packaging materials imported into Finland from other EU countries do not need to comply with the standard. Most of the countries located outside the EU demand that the ISPM standard is obeyed. It should be remembered that the UK is a non-EU country, in terms of both imports and exports. The standard is developed and administered by the United Nations (UN) Food and Agriculture Organization FAO. The aim of the standard is to prevent the spreading of parasitic organisms in international trade. The parasitic organisms can harm plants, forests and plant-based products e.g. by eating or weakening them, or by spreading diseases. The ISPM 15 standard applies to all wooden packaging materials; however, its requirements do not apply to wood-based industrially manufactured materials, such as plywood, chipboard, fibreboard, and wooden materials that are less than 6 mm thick. The ISPM 15 requirements apply to both old and new wooden packaging materials: pallets, platforms, frames, boxes, crates, drums, dunnages, casks as well as plank and boards used as cargo support materials that are made of raw wood. Fumigation of these materials with methyl bromide or sulfuryl fluoride is prohibited in Finland, but importing fumigated wooden packaging materials is allowed. More information (in Finnish) on the website of the Finnish Food Authority: https://www.ruokavirasto.fi/yritykset/tuonti-ja-vienti/vienti-eun-ulkopuolelle/tuotekohtaista-vientitietoa/puinen-pakkausmateriaali/. (Finnish Food Authority 2023, FAO 2019)

Plastic is durable, light, inexpensive and easily workable material. As wrapping, film and cover material it is superior and hard to replace. In some applications bio-based wrapping and packaging materials are available. The negative side of plastic is its large carbon footprint, because plastic is made of crude oil. Other negative environmental impacts include plastic litter and harmful substances that dissolve from plastic materials when in contact with soil and water, and the breaking of plastic litter into microplastics. Recycling of plastic packaging materials is expanding in the EU but so far only part of the collected plastic materials are re-processed as raw material for products and majority is still ending up to power plants for energy recovery. In other continents waste management and recycling is less developed compared to Europe. Therefore, it is recommendable to avoid the use of plastic if other materials could be used instead.

Cardboard and paper-based products are recyclable and as cover and internal (primary) packing materials can replace plastics.

Roofing felt is commonly used in external and transport packing instead of plastic.

Dunnage bags are filled with air. They are available either as reusable or single-use models. A dunnage bag is easy to empty after use and then refill again. When using dunnage bags make sure to avoid damages caused by rubbing. Dunnage bags must not be used against doors, hard surfaces or partition walls. The producers of the bags can give recommendations and guidelines regarding the carrying and support capacity, durability and recommended air pressure.

Figure 41. Supporting light cargo parcels with dunnage bags: unsupported cargo on the left side, cargo supported with a dunnage bag on the right side

7.3 Packing labels and essential cargo information

Essential handling guidelines and other markings on a package need to be clear. It is recommended to use established international pictograms (see chapter 7.4). The symbols and other labels should be placed around the package so that they are clear and visible. Make sure the labels are firmly attached (e.g. as stickers, see figure 42) and stay in place throughout the journey. If the same transport package is used again, previous stickers and other labels must be removed.

Essential product information includes at least the following things:

- The type/class of product (e.g. its product code)? Does the shipment contain dangerous goods? Note! Do not give detailed information on goods that are prone to theft – just the product code is sufficient.
- Is the cargo fragile or perishable? Does the product need protection from moisture, temperature variations etc.?
- Information on the sender and the recipient of the goods.
- The weight, the centre of gravity, and dimensions (length, height, width) of the cargo.
- Lashing arrangements, support and securing of the cargo.
- Handling and lifting guidelines. Is the package stackable?
- Possible other guidelines and information on the cargo.

Packing labels must be so clear that the transshipment personnel (if any) do not need to guess what the contents are and how the contents and the package should be handled.

Packing labels and symbols related to the handling of goods should be large enough and placed on the side of the transport package. This makes them easy to see for the cargo handlers (see an example in figure 42).

Figure 42. An example of shipment labelling (HL Group Oy Pakkaus- ja kuljetusohjeet, 2022)

Keep a copy the above mentioned cargo/shipment information regarding every shipment lot. This information is vital if there are problems with e.g. customs clearance, or if a package or a shipment is damaged or is delayed.

If the same transport package is used again, always remove all previous stickers and other labels!

7.4 International symbols for packaging handling

The international packaging handling symbols shown in figures 43–59 can be found both in the ISO 780:2015 standard and on the pages 125–127 of the CTU Code (IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units (CTU Code), 2014). See also changes and amendments that have been suggested during updating.

Figure 43. Fragile

Figure 44. Use no hand hooks

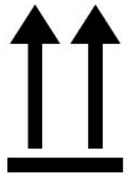

Figure 45. This way up

Figure 46. Keep away from sunlight

Figure 47. Protect from radioactive sources

Figure 48. Keep away from rain

Figure 49. Centre of

Figure 50. Do not roll gravity

Figure 51. Do not use hand truck here

Figure 52. Use no forks

Figure 53. Clamp as indicated

Figure 54. Do not clamp as indicated

Figure 55. Stacking limited by mass

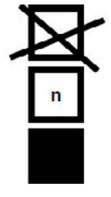

Figure 56. Stacking limited by number

Figure 567. Do not stack

Figure 58. Sling here

Figure 59. Temperature limit(s)

7.5 Markings, warning labels and placarding for the transport of dangerous goods, classes of dangerous goods, and hazard pictograms for chemicals

The shipper must be able to identify dangerous goods and IMDG cargo (e.g. supplies delivered with machinery, such as oils and various chemicals). The IMDG cargo must be clearly identified with information on the shipment and markings on the packaging so that everyone handling the cargo knows and can handle it with the required care and in accordance with the handling instructions.

The training regulations of the IMDG Code are compulsory for all employees involved in the maritime transport chain of the dangerous goods. The training consists of two parts: a general part on maritime transport of dangerous goods, and a task-specific part. The general part aims at raising awareness on dangerous goods and their transport classification, including labelling, packing, handling, carriage, stowage, segregation and compatibility as well as a description on the purpose and contents of transport documents regarding dangerous goods. The task-specific training involves a personalised programme meeting the needs of the employee's job duties. The employee and employer are obliged to maintain the information on IMDG Code training. The information on training must also be available for the competent authority. (IMDG Code 2020)

The presence of IMDG cargo in a non-dangerous shipment may cause serious hazards to cargo handlers, bystanders, the environment, and means of transport.

7.5.1 Markings, warning labels and placarding for the transport of dangerous goods

The rules concerning the markings and warning labels to be placed on parcels in the transport of dangerous goods are set out in appendix A, chapter 5.2 of the Finnish Transport and Communications Agency Traficom's regulation on the road transport of dangerous goods (TRAFICOM/473662/03.04.03.00/2022). The rules concerning the placarding, markings and orange sign for containers, break bulk containers, MEG containers, MEMUs, tank containers, portable tanks and vehicles used in the transport of dangerous goods are set out in appendix A, chapter 5.3 of Traficom's regulation on the road transport of dangerous goods. Placarding is larger than warning labels. In addition, the markings on the packaging and CTUs are discussed in the IMDG Code under 5.2 and 5.3. Some labels can be seen in figure 60. (Tieliikenne: Vaarallisten aineiden kuljetus tiellä 2022; IMDG Code 2020; Storck Guide, Stowage & Segregation to IMDG Code 2023).

Figure 60. Illustration of warning labels (Storck Guide, Stowage & Segregation to IMDG Code 2023)

The warning labels and placarding used in the transport of dangerous goods are different from the hazard pictograms of the CLP Regulation, i.e. the EU's Regulation on classification, labelling and packaging of substances and mixtures. (Tukes 2022a and 2022c).

7.5.2 Classes of dangerous goods and UN numbers

Substances and objects that are dangerous when transported are classified into different classes of dangerous goods (HAZMAT classes). The transport packaging must bear the UN number of the HAZMAT class according to the classification, and the corresponding warning label. The appendix A, chapter 3.2, table A of the Finnish Transport and Communications Agency Traficom's regulation on the road transport of dangerous goods (TRAFICOM/473662/03.04.03.00/2022), starting from page 272 of the regulation, has a list of dangerous goods ordered by their UN number. In addition, Traficom's website has a regulation-based search for transport of dangerous goods: https://www.traficom.fi/fi/liikenne/liikennejarjestelma/vak-haku. (Traficom 2023b, 2023d; Tieliikenne: Vaarallisten aineiden kuljetus tiellä 2022; Tukes 2023).

Table 6. HAZMAT classes and examples (Tukes 2023)

Class	Class name	Examples
1	Explosives	Mining explosives, fireworks, emergency and other flares, gunpowder, ammunition, detonators, fuses, sparklers
2	Gases	Pressurised gases (e.g. argon, acetylene, helium, carbon dioxide), LPG, camping gases, lighter gas, aerosols (e.g. hair spray, paints, deodorants), fire extinguishers
3	Flammable liquids	Petrol, diesel, acetone, alcohols, turpentine, paints, glues, glass cleaners, perfumes, many cosmetic products, alcohol-based hand sanitisers and many other disinfectants
4.1	Flammable solids, self-reactive substances, and desensitised solid explosives	Naphthalene, sulphur, matches, flint, table tennis balls (celluloid)
4.2	Spontaneously combustible solids	Phosphorus, calcium sulphide, BBQ charcoal
4.3	Substances that emit a flammable gas when in contact with water	Sodium, potassium, calcium hydride, aluminium powder, lithium
5.1	Oxidising agents	Bleaches, sodium chlorite, sodium peroxide, hydrogen peroxide
5.2	Organic peroxides	Peracetic acid
6.1	Poisonous substances	Cyanide, arsenic compounds, lead acetate, some mercury compounds, some herbicides and pesticides
6.2	Biohazardous substances	Bacteria, viruses, medical waste, samples considered infectious, some vaccines
7	Radioactive substances	Uranium, plutonium, smoke detectors with radiation source, certain pharmaceuticals
8	Corrosive substances	Acids and bases, acid batteries, formic acid, sulphuric acid, lye, mercury, some cleaning agents
9	Miscellaneous substances and objects	Lithium batteries, dry ice (solid carbon dioxide), magnetised materials (strong magnets), airbags, seat belt pretensioners, asbestos, environmentally hazardous substances, high-temperature substances and objects, internal combustion engines (with combustible gas or liquid as fuel).

7.5.3 Hazard pictograms for chemicals

The CLP Regulation applies to substances, mixtures and certain explosive articles in all industrial sectors. It does not apply to the transport of dangerous goods by air, sea, road, rail or inland waterway. The website of the Finnish Safety and Chemicals Agency (Tukes) presents the hazard pictograms for chemicals. They are in diamond shape, with a black symbol on a white background and a red frame. Figure 61 shows an example of a hazard pictogram for chemicals. The requirements for the hazard pictograms are laid down in Annexes I and V of the CPL regulation. The CLP Regulation is the Regulation 1272/2008 of the European Parliament and of the Council on the classification, labelling and packaging of chemicals. (Tukes 2022a and 2022b)

Figure 61. A hazard pictogram for chemicals: GHS06 – acute toxicity, symbol: skull and crossbones

8. Loading planning, loading, and securing of cargo in the CTU

A loading plan is a plan for the shipments to be loaded into the CTU. The aim of planning is to ensure that the cargo space is used and the loading event is carried out as efficiently as possible. Good advance planning ensures safe and cost-effective delivery of the goods. It helps in avoiding unnecessary complaints and the consequent loss of time, money and reputation. Good planning is of great economic importance. The key is to avoid personal, property, and environmental damage.

Cargo should be loaded and secured to a CTU so that it is stable and does not move or fall down inside the CTU during transport. Cargo lashing must not cause damage to the goods, their transport package, or the CTU. The cargo must remain in good condition all the way to the end customer.

An essential part of loading planning is cargo securing and lashing: securing and lashing the cargo to the CTU so that it remains in place and can withstand the stresses of the transport journey. When loading goods into the CTU, it is important to ensure that the load is evenly distributed within the CTU.

Inadequate advance planning of loading may create hazards when handling goods and CTUs: injuries, cargo damage, and negative environmental impacts. During a sea voyage, poorly secured and lashed cargo may move inside the container and be damaged. In the worst case, a container that has become unbalanced due to the movement of cargo may also detach from its securing and lashing equipment and fall into the sea or cause the ship to list.

Before loading the goods into a CTU, make sure that the total weight of the cargo and the needed packaging and cargo securing material (+ the weight of the forklift truck loading the cargo) does not exceed the net payload of the CTU. Therefore, always check beforehand the maximum payload of the CTU where the goods/shipment is to be loaded as well as country specific restrictions concerning trailers. The maximum payload of a container is marked on its CSC plate. The load carrying capacity and strength of the container floor and walls are specified and regulated by the ISO 1496-1:2013 standard and the Convention for Safe Containers (CSC code).

When loading heavy cargo, make sure that the concentrated (point) load (metric tonnes per running metre) on the floor of the CTU does not exceed the maximum payload. If the concentrated weight of the product exceeds the maximum payload of a regular container, transport the product on a flat rack (or platform). Flat racks are specifically designed for transports of heavy and oversized cargo and their floor is strengthened.

Oversized and esp. very wide cargo is difficult to secure and lash. They must be secured at least from both sides to the flat rack or the bolster, so that cargo handling is safe. Thereby it is vital to make sure the cargo has enough suitable lashing points. If needed, an additional securing is made on the board of a ship and the cargo is secured directly to the cargo deck.

Typically, the CTU loading process includes the following phases (Finncontainers Oy Konttiblogi):

1. Inspection of the condition of the CTU
2. Loading
3. Distribution of weight
4. Distribution of the concentrated (point) load
5. Selection of protection, securing and lashing materials
6. Cargo securing and lashing
7. Recording of cargo
8. Reporting

When loading the cargo into the CTU, maximise the cargo space and remember the following:

- Leave small spaces between different loading units to help loading and unloading.
- Use stuffing materials between loading units and the walls and ceiling of the CTU to ”cushion” cargo movements and to prevent cargo from rubbing against each other and the CTU walls.
- If the consignment includes many different types of cargo, always make sure that the goods are packed so that the packages or pallet loads are stackable and can also be safely unloaded. When stacking, put the heavier goods on the bottom and lighter goods on top.
- Form the cargo stacks so that the top layers reach the top of the cargo space. If this is not possible, the upper layers need to be secured.
- Make sure the weight of the cargo is evenly distributed. Do not exceed the maximum (concentrated) payload of the CTU! When loading heavy goods, the goods can be loaded on supporting timber in order to distribute the weight of the cargo more evenly and to prevent exceeding the concentrated weight. The supporting timber boards must be wide and thick enough.

If supporting the cargo is not enough to keep it in place, the goods need to be lashed with appropriate equipment (e.g. lifting slings) to the cargo lashing points of the CTU. When lashing, check and remember the following:

- Every parcel that is placed separately from other parcels must be lashed.
- In order to prevent a movement forward, cargo must be adequately secured and lashed (with a sufficient amount of lashing equipment). Note! Always use similar devices for the same direction in order to block the movement.
- Use blocking materials, such as front wall, wedges, friction mats, dunnage bags, chocks and beams to increase friction between the cargo and the floor and walls of the CTU.
- Tie lashing equipment (e.g. chains, lashing straps or hooks) only to the lashing points of the CTU.
- Do not tie lashing equipment to the CTU fastening points with a knot because that would reduce its lashing capacity.
- Lashing equipment may not be extended by knotting it with another equipment because that would reduce its lashing capacity.
- If nails are struck on the CTU floor or platform in the lashing phase, they must be removed in the unloading phase.
- Use only undamaged securing and lashing devices that are in good condition.

9. Container loading planning instructions

9.1 Container transport checklists

In container transport, the container should be inspected before and after loading to avoid cargo damage.

Before loading, check the following in container transport (see Finncontainers Oy Konttiblogi):

1. Ther are no holes in the container ceiling or walls.
2. The doors are working.
3. The locking latches are working.
4. The container does not have any stickers related to the previous shipment. If it has, remove them.
5. If the container is an open top container, it has enough roof arches and they are properly attached.
6. If the container is an open top container, its tarpaulin is intact and fits well, and the wire rope ends are undamaged.
7. The container is waterproof. This can be tested easily: go to the container, close both doors and see if you can see any light leaking in.
8. The container is dry. Wipe off moisture or white frost. This enables you to prevent cargo deterioration due to moisture and corrosion.
9. The container is clean: there are no cargo debris, nails, or disturbing smells.

After loading the container, check the following (see Finncontainers Oy Konttiblogi):

1. The container is loaded appropriately, taking into account the contents of the cargo and the movement of the container during transport.
2. The packing list is in a visible place inside the container (for customs inspection, etc.).
3. When using wooden packaging, it must be taken into account that in some circumstances, there are separate rules for the use of wood.
4. The doors (and in some containers the roof) are carefully closed. For example, in open top containers, the wire ropes are securely attached and sealed.
5. In locking, durable seals have been used to avoid theft.
6. The container does not have any extra stickers.
7. The correct temperature required for the cargo has been set in reefer and heated containers.

The 7-point container inspection checklist, used by the U.S. Customs and Border Protection and intended for the prevention of terrorism and smuggling, is worth reading, especially if it is a question of container transport to the United States (CTPAT 7-Point Container Inspection Checklist, 2021).

9.2 Cargo lashing and handling in the container

The size, shape, weight (and centre of gravity) of the cargo to be loaded into the container and the conditions of the transport journey influence the securing and lashing requirements. Cargo securing and lashing is usually based on three things: securing, friction between the cargo and the cargo space, and lashing. The key is their combined ability to hold the cargo in place. Cargo should be loaded and secured to a container so that it is stable and does not move or fall down inside the container during transport. Cargo lashing must not cause damage to the goods, their transport package, or the container.

Before loading the goods into a container, make sure that the total weight of the cargo and the needed packaging and cargo securing material (+ the weight of the forklift truck loading the cargo)

does not exceed the net payload of the container. Therefore, always check the maximum payload of the container from the CSC plate on the container. The load carrying capacity and strength of the container floor and walls are specified and regulated by the ISO 1496 standard and the Convention for Safe Containers (CSC code).

The concentrated (point) load on the floor may not exceed 4.5 metric tonnes per running metre in most 20-foot containers or 3 metric tonnes per running metre in 40-foot containers. If the concentrated weight of the product exceeds the maximum payload of a regular container, transport the product on a flat rack (or platform). Flat racks are specifically designed for transports of heavy and oversized cargo and their floor is strengthened.

The joint centre of gravity of the cargo must be located on the line where the longitudinal and transverse symmetry planes of the container cross each other (close to the mid-length and mid-width of the container). If it is not possible to comply with this requirement, the joint centre of gravity of the cargo may be moved in the longitudinal direction as follows (see the CTU Code):

- in 40-foot and 45-foot containers, at the maximum 1,200 mm
- in 30-foot containers, at the maximum 900 mm
- in 20-foot containers, at the maximum 600 mm.

The joint centre of gravity of the cargo may be moved at the maximum 100 mm in the transverse direction. If the container is designed according to the ISO 1496–1 standard, the cargo can be evenly supported on the side and end walls of the container.

When loading the cargo into the container, maximise the use of the interior space and remember the following:

- Leave small spaces between different loading units to help loading and unloading. Horizontal gaps may be 150 mm in total.
- If the consignment includes many different types of cargo, always make sure that the goods are packed so that the packages or pallet loads are stackable and can also be safely unloaded. When stacking, put the heavier goods on the bottom and lighter goods on top.
- Form the cargo stacks so that the top layers reach the top of the cargo space. If this is not possible, the upper layers need to be secured.
- When loading heavy goods, the goods can be loaded on supporting timber in order to distribute the weight of the cargo more evenly and to prevent exceeding the concentrated weight. The supporting timber boards must be wide and thick enough.
- Use stuffing materials between the cargo and the container to ”cushion” cargo movements and to prevent cargo from rubbing against each other and the container.

If supporting the cargo is not enough to keep it in place, the goods need to be lashed inside the container (e.g. with lifting slings) to the cargo lashing points on the sides and ceiling of the container. When lashing cargo to the container, check and remember the following:

- Every parcel that is placed separately from other parcels must be lashed.
- In order to prevent movement, cargo must be adequately secured and lashed with one kind of lashing equipment. If different kinds of lashing equipment need to be used in the same direction, their elastic properties must be similar.
- Use blocking materials, such as front wall, wedges, friction mats, dunnage bags, chocks and beams to increase friction between the cargo and the floor and walls of the container and (or) the cargo layers.
- Strap and tie-down lashing equipment can only be attached to the lashing equipment of the container intended for this purpose.

- Do not tie lashing straps or stripes to the container fastening points with a knot because that would reduce the lashing capacity of the lashing equipment.
- If nails are struck on the container floor in the lashing phase, they must be removed in the unloading phase.

9.3 Safe unloading of cargo from the container

It is important to pay special attention to the order of unloading and safe working with the container. Priority must be given to safety when unloading cargo from the container. Unloading can be dangerous if the cargo has moved in the CTU. Especially the moment when the door of the CTU is opened entails hazards. This is a common cause of injury due to inadequate cargo securing and lashing. Consequently, when loading, it must be ensured that the cargo is secured and lashed appropriately so that when unloading begins, the cargo does not fall on the worker when the door is opened. The cargo on the back of the container can be secured with wooden structures, boards or empty pallets, for example.

Before unloading the container, ensure the following:

- The unloading site is safe, and there is sufficient space for unloading. Pay attention to people and vehicles that may be moving around. Rope or fence off the unloading site, if necessary.
- Ensure that suitable lifting equipment (e.g. forklift) and accessories are available for unloading.
- Check the container information, sealing and condition. If the seal is broken or the container is not in good condition, take photos and make a complaint. The seal can be a customs or commercial seal. Check that the transport document has the same container number and the same seal number.
- Goods inside the container may have moved during transport. Therefore, open the container doors carefully (ask for a photo from Tuomas, for example).
- Always before you start unloading, ventilate the container by opening the doors.
- Check the condition of the cargo inside the container. If there is damage to the cargo, document it by taking photos, for example, and make the necessary notifications.
- Check the packaging for any markings concerning lifting, the weight of the parcels, and the centre of gravity.
- Start unloading from the top. Remove cargo securing and lashing equipment.
- If unloading is carried out manually, pay attention to ergonomics, such as correct lifting positions.
- Clean the container and remove all the markings related to the unloaded cargo.

Do not lift poorly loaded cargo. Goods may become damaged.

9.4 Container ventilation

For safety reasons, a container must always be ventilated before unloading the goods, to be on the safe side. Safety can be ensured also by measuring, as long as it is known what substances to measure. The cargo and the protective packaging emit compounds into the container. These compounds are harmful to health, and their concentrations may be high. The goods in the container may also be fumigated in the country of origin, in order to protect them from pesticides, for example. If a container is fumigated, it must be notified on the container. However, sometimes the markings on container fumigation are either missing or may have come off during transport. (See 5.4 Container gases)

10. Cargo securing and lashing and its methods

Different cargo securing and lashing methods – locking, blocking, lashing and friction – can secure the cargo and prevent it from sliding, falling and tipping over, transferring, rolling, and/or moving sideways (CARING 2013, CTU Code 2014, Traficom 2021a, Cargo securing for road transport 2014).

10.1 Locking

Locking (figure 62) is the most efficient and safest way to secure a cargo. Locking and locking equipment are most commonly used when lashing a swap body or a container to a vehicle (Traficom 2021a).

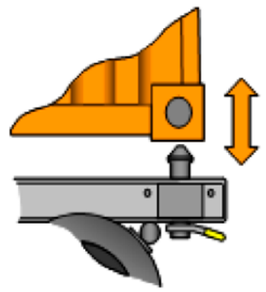

Figure 62. Locking a container to a truck chassis

10.2 Blocking

Blocking (figures 63–64) means placing and supporting the goods against the front and/or side walls of the CTU and using friction to keep the cargo in place. In case the cargo consist of several loading units or pallets, they must be loaded as close to one another as possible. Some empty can be left in between due to the shape of the goods. Horizontal gaps may be 150 mm in total. The empty space should be filled with stuffing and support materials, e.g. dunnage bags. Blocking is the primary method to prevent the cargo from sliding and it should be used whenever possible. If blocking structures are placed above the centre of gravity of the product, then blocking prevents the cargo from falling and tipping over. Thus, blocking is recommendable.

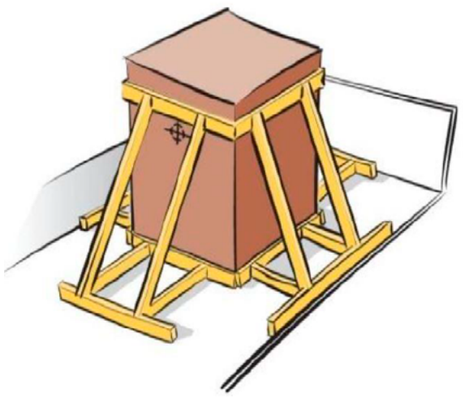

Figure 63. Blocking a regular shaped piece of good inside of a transport package or a CTU. Note also that the centre of gravity of this product is on the upper part of the product.

Figure 64. Example images of blocking inside of a CTU
Photo: Valmet Technologies, Inc.

10.3 Lashing

When ***lashing*** is used, a product must have fixing/lashing points where lashing equipment can be placed. Lashing equipment may never be tied with a knot or extended by knotting it with another equipment because that would reduce its lashing capacity. Lashing equipment must be in a good condition. Note also that lashing points in conventional containers can be rather weak and there is no specific information about them without checking the details from the shipping company in question. Remember the following:

- Use only standardised lashing equipment.
- Anchor points need to be planned and placed so that they can safely last a weight of 1,000 kg in every direction.
- Lashing points must be planned and placed so that they can safely last a weight of 500 kg in every direction.

In ***top-over lashing*** (figure 65), lashings run from side to side over the product or cargo load. Top-over lashing is also called friction lashing. Placing the lashing straps is critical in top-over lashing. This method presses the product item or package against the floor of the CTU and adds frictional force. The friction prevents the cargo from sliding and falling over. In order to prevent also longitudinal tipping, the lashings should be placed symmetrically. Top-over lashing prevents the item from sliding and tipping. Depending on the angle between the cargo lashing point and the floor lashing point, the effect of the prevention of tipping is different from the effect of the prevention of sliding. This method is most common when lashing cargo to a CTU and CTUs on board of a ship.

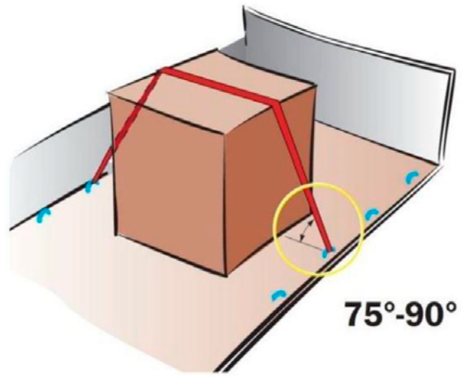

Figure 65. Top-over lashing of a product to a pallet or a flat rack

The top-over lashing is most efficient if the angle between the loading platform and the upright part of the lashing is close to 90°. When this angle diminishes, the lashing loses effect. If the angle is in 30–75°, the number of lashings must be doubled. If the angle is below 30°, top-over lashing has no effect and another lashing method must be chosen instead.

Loop lashing (figure 66) prevents cargo from sliding sideways and tipping. A loop is made by using first two lashing straps just like in top-over lashing, at least one pair per load block. Then, the rest of the strap is pulled under the cargo and tensioned to the same side where the loop was started. With loop lashing, remember always to make another loop from the other side. By using four lashing straps, twisting of the cargo can be prevented.

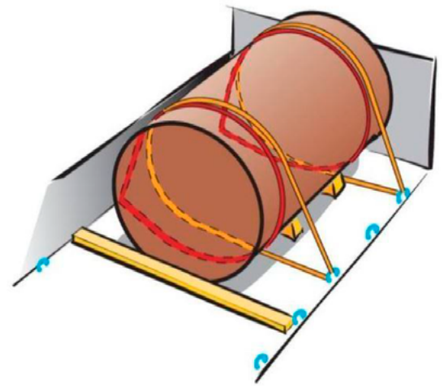

Figure 66. A cargo item with loop on a flat rack

Spring lashing (figure 67) is one of the most effective ways to prevent an item from sliding or tipping in the same direction as the lashing, i.e. forward movement is prevented by a lashing in front. This lashing method can solve many loading problems, especially when the cargo is placed on the second layer and blocking cannot be used. The spring lashing can be done in several ways. The common factor in all methods is that the angle between the lashing point and the floor is small. Spring lashing loses effect if the angle is great. The values in the tables of the CARING quick guide are for angles smaller than 45°.

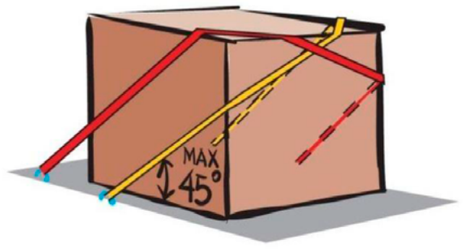

Figure 67. Spring lashing

In spring lashing, the lashing system leaves from a lashing point on one side of the CTU, runs behind or from the front of the cargo and is attached to a lashing point on the other side of the CTU that is opposite or nearly opposite to the first lashing point. Spring lashing can be done either by using spring lashing traps made for this purpose or by combining ordinary lashing straps into a loop that goes over the corner of the cargo and connecting it, on both sides of the cargo, with cargo straps that pull diagonally away from the lashing direction and that are attached to cargo lashing points. In lashing, empty pallets can also be used in the placement of the lifting slings. Alternatively, spring lashing can be done with two lifting slings so that the sling is run over the upper edge of the cargo to the cargo space lashing point and then via the end of the cargo to another lashing point. In lashing, empty pallets can also be used in the placement of the lifting slings (Ruotsalainen 2020).

Spring lashing is well suited for cargo that is as wide as possible, as well as for low cargo, because then the angle between the loading platform and the lashing is small and efficient at the same time.

Direct lashing (cross lashing) (see figure 33) is primarily used for lashing of single large items (e.g. large machinery) or parcels that allow straps to be placed around or directly to them so that the straps can also be tightened. Direct lashing prevents the item from sliding and tipping. Depending on the angle between the cargo lashing point and the floor lashing point, the effect of the prevention of tipping is different from the effect of the prevention of sliding.

10.4 Cargo securing and lashing calculation and calculation examples

To simplify the calculation, the additional materials of the CTU Code include a quick-calculation guide for road, combined rail and maritime transport in different sea areas (CTU Code 2014): QUICK LASHING GUIDE, Cargo securing on CTUs for transports on Road, Combined Rail and in Sea Area A, B & C:

https://wwwcdn.imo.org/localresources/en/OurWork/Safety/Documents/1498.pdf.

The CARING project (2013) created an Excel tool to calculate cargo securing and lashing, available in Finnish and English: https://blogit.utu.fi/cargosecuring/material-in-finnish/. Based on the initial values, the calculator provides tables for different modes of transport in different sea areas for different securing and lashing methods.

The separate appendix 1, Kuormanvarmistuksen laskenta ja esimerkit (Cargo securing and lashing calculation and examples, only in Finnish), has been created by Jamk University of Applied Sciences (2022).

11. Calculated load of cargo securing and lashing equipment

Different securing and lashing materials have different calculated maximum safe loads. Therefore, cargo securing and lashing equipment must be selected according to their intended use. The maximum securing load of securing and lashing equipment is always indicated either on the equipment itself or in its product description (available from the manufacturer and the seller).

11.1 Cargo securing and lashing equipment

Equipment that can be used in cargo securing and lashing include, for example, lashing straps (single or multiple use), wires, chains, dunnage bags, and timber.

The separate appendix 2, Kuormanvarmistus- ja sidontavälineet (Cargo securing and lashing equipment, only in Finnish), has been created by Haklift Oy (2023).

12. Regulations and standards concerning cargo securing and lashing

12.1 CTU Code

The CTU Code of the United Nations' International Maritime Organization (IMO), the International Labour Organization (ILO) and the United Nations Economic Commission for Europe (UNECE) (IMO/ILO/UNECE Code of Practice for Packing of Cargo Units) is a recommendation-like code, which comprehensively incorporates the international packing guidelines for the safe maritime and land (road and rail) transport of cargo transport units. The latest update of the CTU Code was approved for maritime transport in 2014. The Code provides comprehensive instructions for securing and lashing cargo in a CTU (container, cargo space, railway wagon, or another similar CTU). Updating the Code is currently being prepared.

12.2 CSS Code

The CSS Code (the Code of Safe Practice for Cargo Stowage and Securing) of the United Nations' International Maritime Organization (IMO), which entered into force in 1991, is an international code on securing cargo to a ship so that the ship's seaworthiness can be ensured.

12.3 SOLAS Convention

The United Nations' Convention for the Safety of Life at Sea (SOLAS) stipulates that there must be a Cargo Securing Manual on every cargo ship. The manual contains information on the ship's cargo securing and lashing system and fixed cargo lashing points, the amounts of securing and lashing equipment on board, as well as their strengths and storage places.

12.4 European Standard EN 12195-1:2010 Load restraining on road vehicles. Safety. Part 1: Calculation of securing forces

The purpose of the standard on the best European practices is to provide practical basic instructions for all those involved in cargo loading, unloading, securing and lashing, such as carriers, shippers, and technical roadside inspection authorities operating in the EU. The document is not legally binding in the same manner as legislation or other EU legal acts. The standard contains instructions for adequate cargo securing and lashing in all situations that occur under normal traffic conditions. The guidelines are also intended to serve as a common basis for the practical application and supervision of matters related to cargo securing and lashing.

12.5 Finnish legislation

12.5.1 Cargo bodies and cargo securing and lashing

The Finnish Transport and Communications Agency Traficom has issued a regulation on cargo bodies and cargo securing and lashing (TRAFICOM/149639/03.04.03.00/2019). The regulation entered into force on 1 April 2021. The regulation lays down the provisions referred to in the Vehicles Act (Ajoneuvolaki) and the Road Traffic Act (Tieliikennelaki): 1) with regard to vehicle approval: a. the requirements for the cargo bodies and cargo spaces of the vehicles used for the transport of goods and b. the lashing points and protective structures used for cargo securing and lashing; 2) the lashing and securing devices used for cargo securing and lashing; 3) the methods used for cargo securing and lashing, and deceleration threshold values related to driving situations. The regulation also includes coefficients applicable to the friction force that holds the cargo in place. The regulation takes into account the guidelines of the standard on the best European practices for cargo securing and lashing (European Standard EN 12195-1:2010). (Vehicles Act/Ajoneuvolaki 2023; Road Traffic Act/Tieliikennelaki 2018)

12.5.2 Road Traffic Act and Act on the Transport of Dangerous Goods

Section 114 of the Road Traffic Act (Tieliikennelaki) contains provisions on liability regarding the loading of vehicles in commercial transport. Liability regarding the loading of dangerous goods is regulated by the Act on the Transport of Dangerous Goods (Laki vaarallisten aineiden kuljetuksesta). However, the provisions of the Road Traffic Act concerning the obligation to declare the weight of the container and the swap body and to ensure that the supervisory authority has access to information also apply to the transport of dangerous goods. (Road Traffic Act/Tieliikennelaki 2018; Act on the Transport of Dangerous Goods/Laki vaarallisten aineiden kuljetuksesta 2023)

The party who has carried out the placement, securing and lashing of the cargo to a vehicle, a container or other cargo space, and the party who, due to their position, has given instructions for the placement, securing and lashing of the cargo is responsible for ensuring that the cargo is correctly placed, secured and lashed and otherwise meets the transport requirements. No responsibility arises for assisting in loading, but the party who has made changes to the loading is responsible for ensuring that the placement, securing and lashing of the cargo continue to be compliant with rules and regulations. However, the party loading the cargo may be released from liability if the party carrying out the transport has not provided correct and sufficient information about the vehicle. The sender of the goods and the party who has assigned the transport to be carried out are, in turn, responsible for ensuring that the party loading the cargo has sufficient and correct information about the goods being transported and that the party carrying out the transport has been notified of the weight of the transported container and swap body. Responsibility and its determination are therefore not unambiguous but case-by-case assessments.

Before the start of the journey, the driver must ensure that the vehicle has been loaded in accordance with rules and regulations, unless this causes unreasonable inconvenience and delay due to the sealing of the cargo space, unloading or other similar reasons. In addition, during the transport, the driver must ensure that the placement, securing and lashing of the cargo continue to comply with the provisions of the Road Traffic Act.

12.5.3 Road Transport Contract Act

The Road Transport Contract Act (Tiekuljetussopimuslaki) applies to a contract for the carriage of goods by motor vehicle for consideration in Finland or between Finland and a foreign country.

12.5.4 Maritime Act

According to the Maritime Act (Merilaki), the cargo owner/consignor is responsible for providing sufficient information about the cargo for loading and unloading. The cargo owner/consignor is responsible for securing and lashing the cargo to the CTU and must ensure that cargo securing and lashing withstand the stresses during transport. On the basis of the Maritime Act, the shipmaster may refuse to transport CTUs that are not in appropriate condition.

13. Checklist for a consignor/shipper

Table 7. Checklist for a consignor/shipper

CHECKLIST FOR A CONSIGNOR/SHIPPER
FAMILIARISE YOURSELF WITH THE PRODUCT AND MAKE SURE THE PRODUCT INFORMATION IS CORRECT
FAMILIARISE YOURSELF WITH THE GUIDELINES: HANDLING OF THE GOOD AND INSTRUCTIONS GIVEN BY THE CUSTOMER
MAKE SURE THAT A SHIPMENT DOES NOT CONTAIN DANGEROUS GOODS IF IT IS CLASSIFIED AS NON-HAZARDOUS CARGO
SELECT THE APROPRIATE PACKING METHOD AND MAKE SURE THE PRODUCT IS PROPERLY SECURED AND LASHED, ALSO INSIDE THE TRANSPORT PACKAGE
TAKE INTO ACCOUNT SPECIAL NEEDS OF THE CARGO, SUCH AS CORROSION PROTECTION
MARK THE DIMENSIONS OF THE PRODUCT (LENGTH x WIDTH x HEIGHT) AND WEIGHT (THE PRODUCT + TRANSPORT PACKAGE = GROSS WEIGHT) CORRECTLY IN EVERY PARCEL AND SHIPMENT DOCUMENTATION
MAKE SURE THE LABELS ARE CORRECT AND CLEARLY VISIBLE
MAKE SURE THE HANDLING GUIDELINES ARE CORRECT AND CLEARLY VISIBLE
TAKE INTO ACOUNT FURTHER HANDLING OF THE CARGO PARCER/SHIPMENT
MAKE SURE THAT THE NEXT HANDLER OF THE PRODUCT/SHIPMENT GETS ALL THE INFORMATION HE/SHE NEEDS

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14. Checklist for a recipient

Table 8. Checklist for a recipient

CHECKLIST FOR A RECIPIENT
CHECK THE GOODS WHEN YOU RECEIVE THEM!
CHECK THE INFORMATION RECORDED IN THE TRANSPORT DOCUMENTS.
CHECK THE CTU FROM THE OUTSIDE. IF YOU SEE DAMAGE, TAKE A PHOTO AND REPORT THE DAMAGE IMMEDIATELY.
CHECK THE CTU FOR DANGEROUS GOODS WARNING LABELS.
Ensure safety when opening the CTU. There is a risk of things falling on the person opening the door.
PAY ATTENTION TO POSSIBLE CONTAINER GASES IN CONTAINER TRANSPORT: VENTILATE THE CONTAINER OR MEASURE THE GAS CONCENTRATION ALWAYS BEFORE ENTERING THE CONTAINER AND UNLOADING THE GOODS.
CHECK IF THE SHIPMENT MAY CONTAIN UNDECLARED OR INCORRECTLY DECLARED DANGEROUS GOODS. REPORT ANY SUSPICIONS AND, IF NECESSARY, ASK FOR HELP.
CHECK IF ALL THE PACKAGES ARE IN GOOD CONDITION. IF NOT, TAKE PHOTOS AND MAKE A COMPLAINT.
PAY PARTICULAR ATTENTION TO COMPLAINT DEADLINES!

15. Links and sources of further information

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