Informal meeting on Code of Practice for Packing of Cargo Transport Units

at the request of the United Nations Economic Commission for Europe Working Party on Intermodal Transport and Logistics

Geneva and virtual, 29-30 September 2021 (second meeting)
Item 4 of the provisional agenda
Updates to the CTU Code

Transport of liquids

Submitted by ETS Consulting, developed substantially from work commissioned by TT Club in compiling risk management guidance for flexitank operations. TT Club retains the right to use this material

This document proposes possible changes to Section 5.2 Flexitanks

The section 5.2 provides a very limited text regarding flexitanks. Since the publication, the use of flexitanks has increased and more cargoes are being carried. Therefore, the following amendments are recommended:

Amendment:

5.2 Liquids in flexitanks

5.2.1 Flexitank has been used to describe the bag in which the cargo is carried, but for the safe transport of bulk liquids in containers the whole system needs to be considered. A flexitank system refers to the whole installation including the container.

5.2.~~1~~2 Flexitanks used for the transport of bulk liquids by road, rail or sea should carry a label that confirms the type approval by a recognized consultative body. The flexitank manufacturer's fitting instructions should always be followed, and the cargo intended to be carried should be checked for compatibility with the material of the flexitank. The transport of dangerous goods in flexitanks is prohibited.

5.2.~~2~~3 During transport the contents of a flexitank will be subject to dynamic forces without significant retention from friction. These forces will act upon the boundaries of the CTU and may cause damage or complete failure.

5.2.~~3~~4 Therefore the payload of a CTU should be appropriately reduced, when it is used for carrying a loaded flexitank. The reduction depends on the type of CTU and on the mode of transport. When a flexitank is loaded into a general purpose CTU, the mass of the liquid in the flexitank should not exceed a value agreed with the CTU operator, to prevent the CTU from suffering bulging damages (see figure 7.50).

Figure 7.50 Damaged CTU side wall

5.2.45 Road vehicles intended to carry loaded flexitanks should have boundaries of a certified strength that is sufficient to confine the weight of the cargo under the accepted load assumptions. The certification of fitness of the vehicle should explicitly address the bulk transport of liquid under the assumption of zero-friction. Nevertheless, the lining of the bottom of the loading area with friction increasing material and the application of over-the-top fibre lashings every two metres is recommended for stabilizing the position and the strength of the flexitank.

5.2.6 Flextank operation

5.2.6.1 Commodity considerations

When considering whether a commodity is suitable for transport in a flexitank consider the following process:

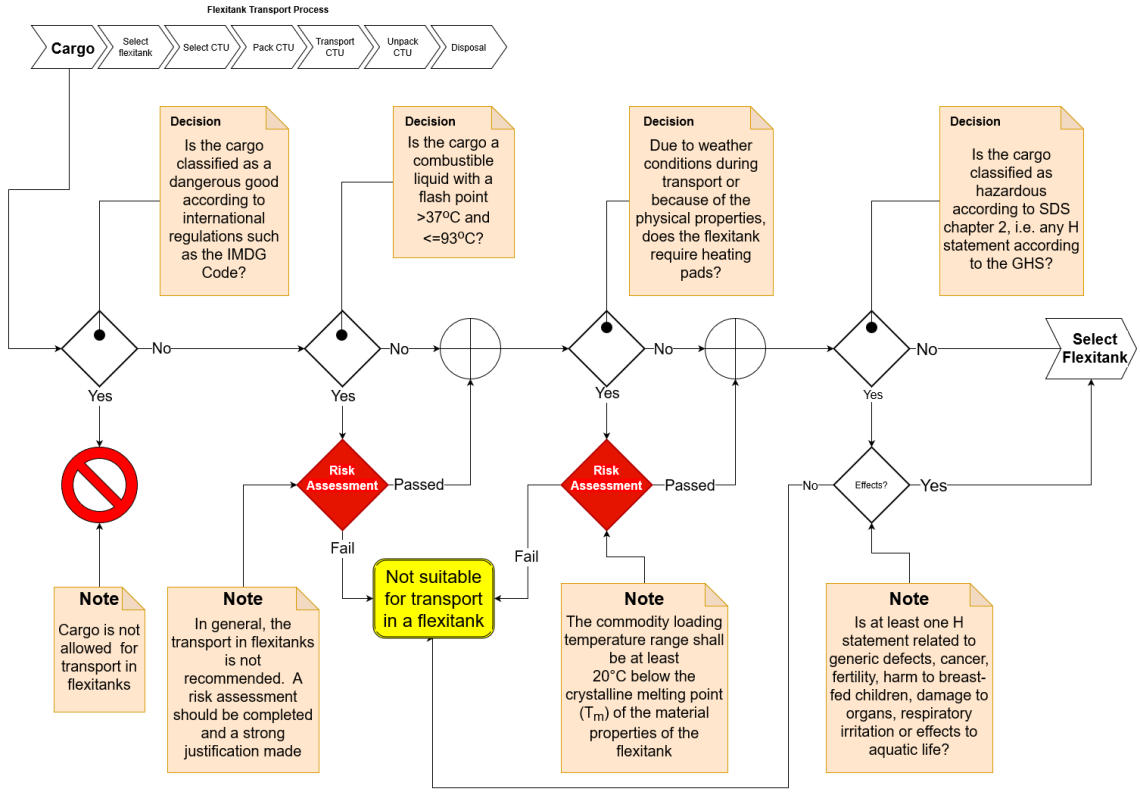

Figure 1 - Flexitank Transport Process – Cargo

5.2.6.2 The most common applications for flexitanks are:

- foodstuffs – molasses, glycerine, fruit juices, egg products
- wines and spirits – wine, beer, water
- chemicals – bio-diesel, glycol, polyol
- oils – base oils, edible oils
- industrial products – latex
- pharmaceutical products

Certain cargoes, such as wine, may be subject to fermentation during transport and the selection of the flexitank must be appropriate for the cargo carried. Improper selection may result in the flexitank expanding and damaging the container structure.

Many of the cargoes carried in flexitanks (such as foodstuffs, wines and spirits) present little risk to the infrastructure should there be a serious leak, while others (such as oils and latex) may severely impact the operation of a facility (ship, terminal, roadway etc.) should a similar leak occur. For these cargoes, a leak can result in roadways and terminal yards being closed or ships held in port while the leaked cargo is removed, and thorough cleaning undertaken. Such cleaning can take days especially if the cargo is particularly thick or solidifies when exposed to the air.

However, environmental controls may also mean that a leak of some easily disposed of cargoes, such as wine, beer and fruit juices, require containment, dilution or cleaning before it enters the waste water system.

5.2.6.3 Flexitank selection

Although the term flexitank is used in this document, it should be properly described as a flexitank system which refers to a system used for the transport of a liquid cargo and comprised of a flexitank, a restraining system , if used, a constraining system , if used, and a general purpose CTU.

When the system is used all parts of the tested and certified system should be operative. That means that restraining or constraining systems must be identical to that tested. Failure to do so nullifies the COA certification.

In order to meet the requirements of the latest edition of the COA CoP and the latest version of PAS1008, a flexitank needs to be manufactured out of virgin, high quality, food contact approved materials (not recycled).

The material used to construct the flexitank and valves etc. must be compatible with the intended cargo; the compatibility of new commodities must be tested in advance. Where a new commodity has similar chemical properties to other cargoes already being carried, further compatibility testing may not be required.

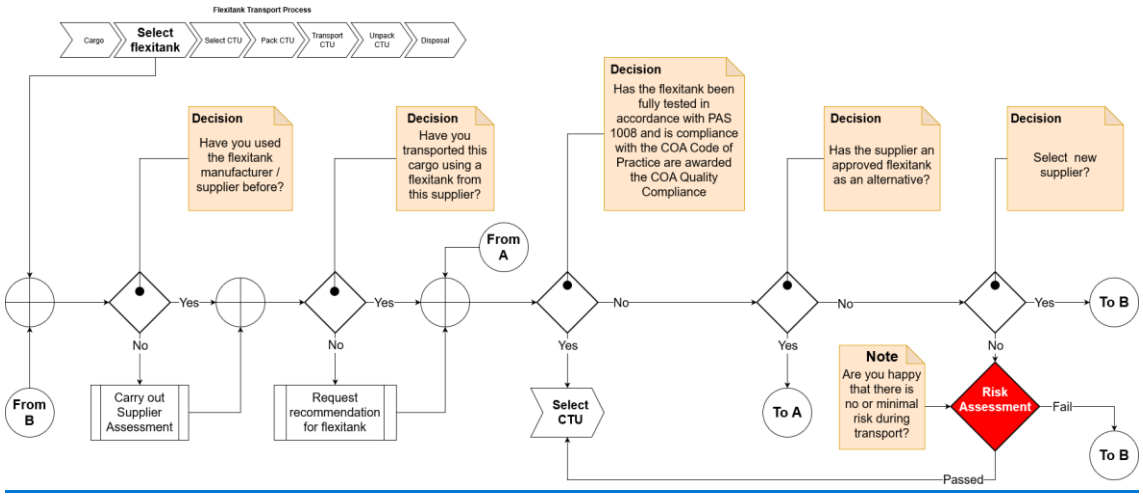

Figure 10 – Flexitank transport Process - Flexitank selection

Selecting a flexitank is more than just finding a flexitank and fitting it into a container.

Its starts with a partnership between the manufacturer and the operator or shipper. Manufacturers should provide:

- flexitanks that are fit for purpose.
- flexitanks that, as a minimum, meet the provisions of the COP.
- provide installation and operating instructions to the operator or shipper to ensure best practice and safe, reliable transport.

Operators and shippers should:

- select a flexitank manufacturer who has had their flexitank tested, certified and listed in the COA Flexitank Quality Management List – FQML with the status COA Member Certificate of Compliance.
- operate the flexitank system in accordance with the manufacturer's instructions and best practice to ensure safe and reliable outcome.
- carry out appropriate risk assessments of the flexitank system and the cargo to ensure safe and reliable processes.

- transport only cargoes that are classified as non-regulated (non-dangerous) and are compatible with the flexitank system.

Using a flexitank that has not been certified and listed in the COA FQML does not mean that it is not suitable for the cargo, however, the risk of an incident or damage to the CTU may be increased.

5.2.6.4 CTU Selection & checks

CTUs for the carriage of flexitanks must be in good serviceable condition and fit for purpose.

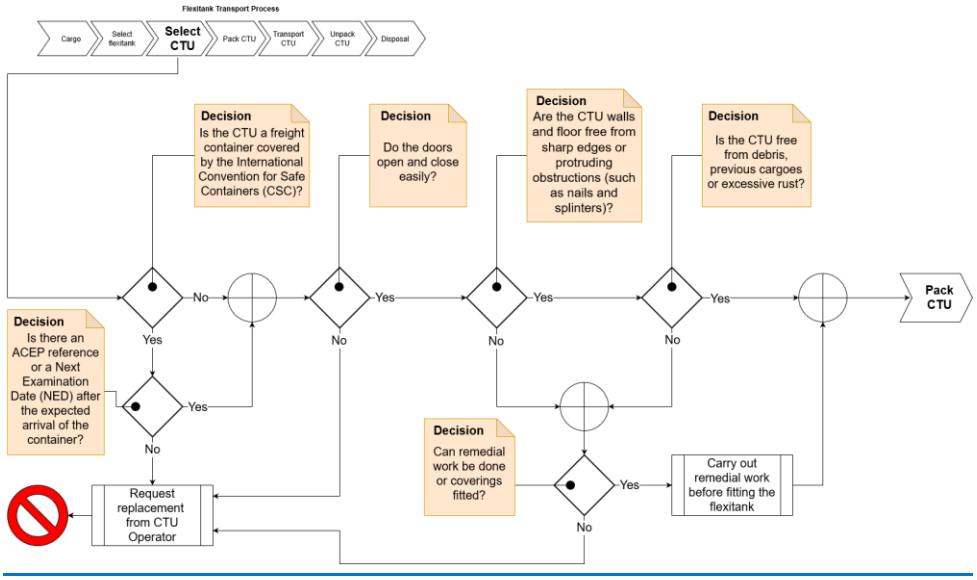

Figure 2 – Flexitank transport process - CTU Selection

On arrival the CTU should be checked in accordance with Chapter 8, sections 1 and 2 of the IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units (CTU Code)[1]. Deficiencies to the Safety Approval Plates, to the structural integrity of the CTU or its suitability for installing or transporting a flexitank should be notified to the CTU operator and returned for replacement.

While containers should be supplied that comply with industry repair standards, those to be used for transporting a flexitank should comply with the COA Code of Practice.

Of particular importance are:

Doors – these should operate easily and should not require forcing to turn the locking gear, or to open or close the doors. If there is concern about their operation, contact the CTU Operator and request remedial action or a replacement CTU.

Deficiencies that may puncture the flexitank – The CoP identifies a number of deficiencies that could damage the flexitank including:

nails and screws

splinters and broken flooring

gouges in the flooring

miss-aligned flooring or walls

sharp edges at welds and repairs

Sidewall corrugation creases

[1] https://www.unece.org/trans/wp24/guidelinespackingctus/intro.html

Where such deficiencies are found they should be rectified by repair or covering with a suitable protective lining.

5.2.6.5 CTU cleanliness – the CTU should be free of any debris, detritus, cargo residues, previous securing materials, significant rust, transferable stains or odours. If these deficiencies are found contact the CTU operator and request remedial action or a replacement CTU.

5.2.6.6 Fitting, filling & securing

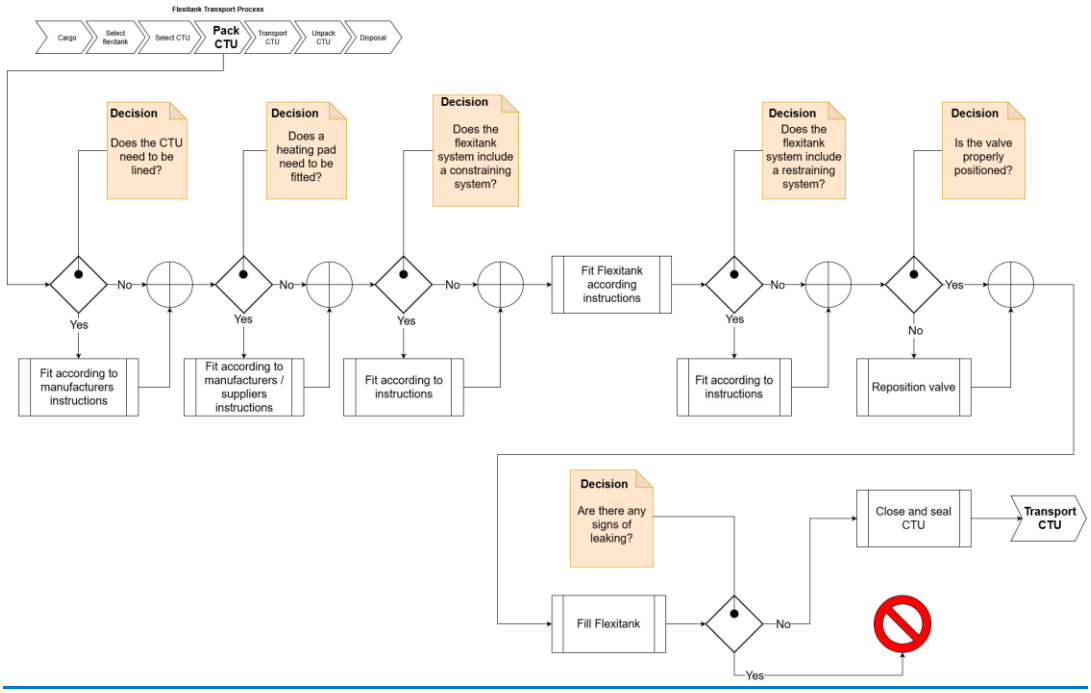

Figure 3 - Flexitank transport process – Packing

5.2.6.6.1 Preparation

Before the flexitank is filled, the CTU must be prepared:

If required, the inner walls of the CTU may be lined with a protective covering (normally corrugated cardboard) that provides protection against abrasion and that extends to the full height of the filled flexitank.

If the cargo has a thick consistency and requires heating to improve unpacking then the heating pads (water or electric) should be installed underneath or to the sides of the flexitank.

If the certified flexitank system includes a constraint system[2] as a constituent part, this should be installed in accordance with the manufacturer's installation instructions.

The flexitank itself should be installed according to the manufacturer's installation instructions using trained personnel.

If the certified flexitank system includes a restraint system[3] as a constituent part, this should be installed in line with the manufacturer's installation instructions. The restraint system may be in the form of a solid or semi-solid bulkhead or webbing straps separate to, or attached to, the flexitank.

[2] structure that is used to reduce the pressure of the flexitank on the walls of the CTU.
[3] structure that is used to prevent the flexitank from making contact with the door of the CTU

The filling / discharge valve should not obstruct the operation of the door and the door should not be displaced by the closing of the doors.

Vent tubes and other pipework should be positioned so that they are not trapped during the filling process.

During the preparatory stage shoe covers should be worn inside the container to protect the flexitank material from damage and to guarantee a clean surface. It is preferable that installers should not physically step on the flexitank in order to minimise the risk of damage.

Before filling starts, the installation should be checked to ensure the system has been fitted in accordance with the manufacturer's instructions and that there are no signs of damage to any constituent part of the flexitank system.

Furthermore, the CTU should be prevented from unexpected movement during the filling process. For example, the vehicle may need to be secured with wheel chocks.

5.2.6.6.2 Filling

Filling must be done exclusively with tested, dedicated hoses that are stored in an appropriate manner by the Packer. The filling hose should be connected and secured to reduce the stress on the valve and must be secured by using a hose support at the level of the valve to prevent stress on the hose and coupling.

For filling an empty flexitank the left hand door of the CTU should be firmly closed so that the inserted barrier is appropriately supported (see figure 7.51). ~~The flexitank should be filled at a controlled rate. The use of spill protection devices like collecting bag or drip tray is recommended. After filling and sealing the tank the door of the CTU should be closed and a warning label should be attached on the left hand door panel (see figure 7.52). No part of the flexitank or retaining battens or bulkhead should touch either door when fully loaded.~~

Figure 7.51 Container fitted with flexitank

~~**Figure 7.52 Flexitank warning label**~~

Spill protection devices like a collecting bag or drip tray should be placed into position to collect any cargo that may leak during the filling process.

During filling it is important that unexpected gases (air, nitrogen) do not enter the flexitank and blow down of lines and hoses before or after filling should not be allowed unless a pressure relief valve is part of the certified flexitank system.

After starting the pump, the tightness of the connections of pump and hoses should be checked.

It is recommended to start the filling process with a lower filling rate (recommendation: 200 litres per minute until 2.000 litres has been loaded) and to increase the filling rate to the standard recommended flow rate. A standard filling rate of 500-700 litres per minute is recommended. The maximum filling rate for flexitanks

should not exceed 1000 litres per minute. The product flow rate must accordingly be gradually lowered before completion, to avoid overfilling.

Therefore, the payload of a CTU should be appropriately reduced when it is used for carrying a loaded flexitank. The reduction depends on the type of CTU and on the mode of transport. When a flexitank is loaded into a general purpose CTU, the mass of the liquid in the flexitank should not exceed a value agreed with the CTU operator, to prevent the CTU from suffering bulging damage."

The PAS 1008 state that:

"The flexitank is required to be filled to the manufacturer's specified filling capacity and a tolerance of +/- 3% of the nominal capacity.

Overfilling a flexitank can result in damage to the CTU and loss of cargo.

Stop filling:

once the target volume has been reached,

if the flexitank or any constituent parts becomes trapped,

there are signs of the flexitank or the valve leaking.

Do not restart filling until the deficiency has been rectified.

Once filling has been completed remove the filling hose and check if there are any visually detectable leakages from the flexitank. No part of the flexitank or restraining system should touch the doors when fully loaded.

Check if there are any visible deformations of the CTU after filling.

5.2.6.6.3 Closing

On completion of filling the flexitank the CTU should be closed and marked and the transport documentation prepared by the Shipper according to the CTU Code Chapter 11.

Additionally:

the valve should not obstruct the door operation or be forced out of position when closing the door.

The CTU should be weighed after the doors have been closed so that an accurate gross mass can be determined.

Transport documents should be prepared by the Shipper and submitted to the Carrier in a timely manner. Such documents may be in hard copy or by electronic data interchange (EDI) or by electronic data processing (EDP).

5.2.6.7 Container Markings

the CTU should be marked with a Container flexitank warning mark on outside of the rear left-hand door, a warning triangle should be applied to the remaining three sides of the CTU (see Figure 4) and both ends of the roof.

Figure 7.52 Flexitank warning label

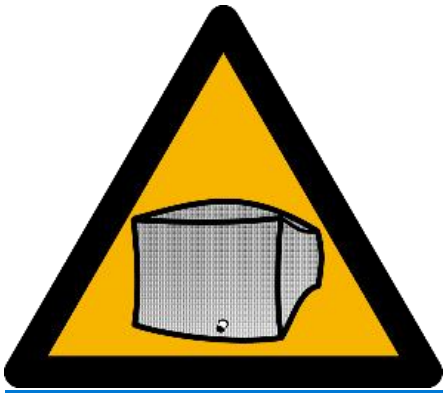

Figure 4 - Flexitank warning triangle

5.2.5 Before being fitted with a flexitank, the CTU should be carefully inspected for structural integrity and fully functional locking bars for each door panel. The CTU should then be prepared by thorough cleaning, removing of all obstacles like protruding nails and by lining the bottom and walls with cardboard. In 40-foot containers plywood should be used for lining of the side walls in order to avoid bulging damage. The door end of the CTU should be reinforced by battens, fitted into suitable recesses, and by a strong lining of cardboard or plywood. If the flexitank is equipped with a bottom connection tube, this lining should have an aperture matching with the position of the tube in way of the right hand door. The empty flexitank should be unfolded and laid out accurately to facilitate a smooth filling process.

5.2.6 For filling an empty flexitank the left hand door of the CTU should be firmly closed so that the inserted barrier is appropriately supported (see figure 7.51). The flexitank should be filled at a controlled rate. The use of spill protection devices like collecting bag or drip tray is recommended. After filling and sealing the tank the door of the CTU should be closed and a warning label should be attached on the left hand door panel (see figure 7.52). No part of the flexitank or retaining battens or bulkhead should touch either door when fully loaded.

Figure 7.51 Container fitted with flexitank

Figure 7.52 Flexitank warning label

5.2.7 Transporting Flexitank Systems

5.2.7.1 Road transport

Caution! – The contents of the flexitank are unhampered, and the flexitank material is flexible. The load moves heavily and unpredictably. All movements during haulage must be very gentle and abrupt braking should be avoided.

The driver should be made aware that the container is carrying a filled flexitank as the handling characteristics for the container may be different, especially if the flexitank is not correctly filled. Where possible, only use experienced drivers accustomed to handling bulk liquids in tank containers or within containers.

The driver should inspect the container for signs of leakage prior to starting and periodically during the journey to the destination. If there are signs of leakage, then the driver should park the container in a position that will not cause a hazard or undue traffic congestion and away from any drains, rivers or waterways, and notify the shipper / consignee.

If the route should take the container over / through a bridge / tunnel where leaked material may cause a major disruption to transport, then the driver should check the container for leakage before crossing / entering. The container should not be opened.

Care should be taken when approaching and negotiating roundabouts, sharp corners, sudden changes in carriageway or uneven surfaces which may cause the liquid within the flexitank to swill from side to side causing the container and chassis / trailer to overturn.

When braking, the driver may experience a sudden forward force as the liquid within the flexitank moves within the container. This can be disconcerting when experienced for the first time.

Uneven surfaces and twisting roads can cause the cargo to move within the flexitank. Abrupt movements could cause an internal wave that could result in the end, or side walls being damaged (see picture 10). If the driver notices such damage it should be reported when the load is dropped at its destination.

Figure 5 - Damaged side wall following road transport

5.2.7.2 Rail transport

Some flexitank operators may not recommend railway transport due to high stress on flexitank and container. Different railway lines and different operation systems are reported to cause different levels of stress.

The container should be inspected for signs of leakage prior to starting and periodically during the journey to the destination. If there are signs of leakage, then the shipper / consignee should be notified.

Shunting wagons with containers carrying loaded flexitanks should be only carried out with caution.

If the route should take the container over / through a bridge / tunnel where leaked material may cause a major disruption to transport, then the train crew should check the container for leakage before crossing / entering. The container should not be opened.

5.2.7.3 Terminal handling

Many 20 ft containers are fitted with fork pockets which would allow the packed container to be lifted with a suitable fork lift truck. When the container is packed with a flexitank containing bulk liquids the container is subject to dynamic forces associated with liquids and similar to those experienced by tank containers.

Therefore, lifting packed containers with a filled flexitank with a fork lift truck should not be permitted.

When handling a flexitank system:

- the container doors should be closed, and the lock rod handles secured in their retainers.

- When lifting and lowering it is important to recognise that the liquid within the freight container will continue to move even though the container has stopped.
- Lifting and lowering speeds should be restricted so that the static / accelerated liquid can make a smooth transition without damaging the container or the lifting equipment.
- When swinging or moving a flexitank system transversely care should be taken when attempting to position the unit within a slot or on a chassis / trailer.

5.2.7.4 Marine transport

Avoid routings with transhipments – particularly in tropical regions where heat exposure is much higher on land than on the sea. If transhipment is inevitable, any stop-over should be very brief.

Containers packed with a flexitank can be loaded on ships and ship planners would normally place containers with a heavy gross mass as low as possible, however when positioning these containers, the planner should consider that: How does the operator ensure this with carriers?

- Temperature sensitive cargoes should not be placed on or near heated bunker tanks, the elevated temperature required to keep the fuel viscosity low may heat or otherwise damage the cargo (red slots below deck in Figure 1). Note the height up the side will depend on the ship's design and may be higher or lower than shown in the figure. Containers carrying flexitanks should not be stowed adjacent to the engine room bulkhead.
- Above deck, containers with flexitanks should not be stowed in the outer and upper most slots as or at the edges of deck covers (red slots above deck in Figure 6) as.
  - Containers in the top slot can be subjected to high temperatures from the sun's radiation.
  - Containers in the outer slots can be subjected to high acceleration loads and there is anecdotal evidence that flexitanks may burst through the side wall.
  - Containers placed at the edge of the deck covers may have slightly wider separation and there is an increase in the risk of the side walls being bowed outwards.

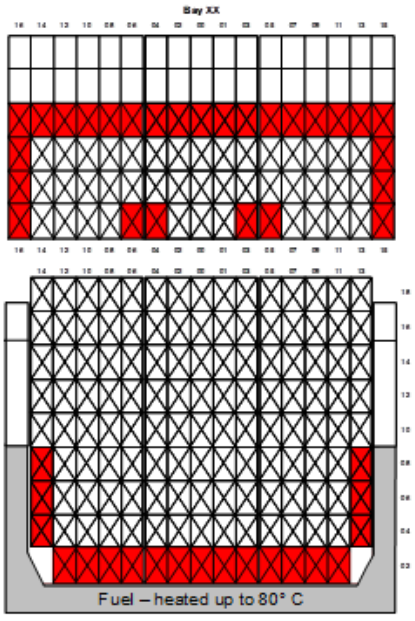

Figure 6 - Positioning flexitanks

Figure 7 shows an example of a container vessel capable of carrying 8750 teu. Because of the layout of the lashing bridges, the majority of the slots above deck are allocated to 40 ft containers with very limited slots for 20 ft units. Additionally, the forward bay and those astern of the superstructure are generally unsuitable for stowing containers with loaded flexitanks due to the dynamic forces that the containers in these bays are subjected to.

Figure 7 - 20ft container slots

Containers carrying products that are viscous or that solidify or which become more viscous when released from the containment of the flexitank should not be stowed below deck where a failure of the flexitank container combination may result in the product clogging the bilge pumps.

Water polluting and oily products on the other hand should be stowed below decks where any leakage can be captured within the ship's bilge.

5.2.8 Discharging cargo

Only the right-hand door should be opened until the majority of the cargo has been emptied from the flexitank.

The discharge hose can be connected to the valve and spill protection devices like a collecting bag or drip tray should be placed into position to collect any cargo that may leak during the emptying process.

If heating pads have been requested and fitted, then these should be activated before the emptying process starts.

It is recommended to consider (but not limited to) the following elements:

- the capability of the heating system to raise the cargo temperature should be taken into account, considering ambient cargo temperature and environmental temperature,
- ensure that only trained and competent personnel conduct the heating,
- avoid localised hot spots and potential loss of integrity due to thinning
- the cargo should remain static during heating,
- heating should be carried out close to the unpacking point.

The internal pressure of the flexitank will force the majority of the cargo out of the flexitank, but additional procedures may be required to fully empty the flexitank.

It is probable that a small amount of ullage will remain in the flexitank once the emptying process has been completed.

5.2.9 Environment: disposal & recycling

After discharge of the flexitank cargo, the flexitank, linings and all equipment should be completely removed from the CTU and safely disposed of or recycled for other use as agreed between the Shipper and the Consignee.

Wherever possible those items that can be recycled should be so processed. However, ullage left within the flexitank or the construction of the flexitank itself may render it un-recyclable.

In all cases the flexitank and constituent parts shall be removed from the CTU and safely disposed or recycled in accordance with local regulations.

The CTU should be cleaned and any marks fitted to the exterior removed. The empty CTU should then be returned to the CTU Operator notifying them of any deficiencies or damage that occurred during the flexitank transport process.

~~For unloading a flexitank, the right hand door of the CTU should be opened carefully for getting access to the top or bottom connection tube of the flexitank. The left hand door should be kept closed until the flexitank is substantially empty. The use of spill protection devices like collecting bag or drip tray is recommended. The empty flexitank should be disposed according to applicable regulations.~~

Consequential changes

1. Add new definitions

Flexitank	~~Bladder used for the transport and/or storage of a non-regulated liquid inside a CTU~~ Bladder with a loading/discharging valve which is installed inside a GP freight container as part of a flexitank system and is used for holding the commodity NOTE 1 The flexitank is usually constructed from polyethylene and polyethylene blends, but other materials (such as PVC) can also be used. NOTE 2 Other equipment is necessary for the filling and discharge of liquids from the flexitank, such as pumps and hoses.
Flexitank system	system used for the transport of a liquid commodity, which comprises a flexitank, a restraining system, if used, constraining equipment, if used, and a GP freight container