UK P&I CLUB

Carefully to Carry

Flexitanks

Introduction

What is a flexitank? A flexitank is a bladder that is designed to fit inside a 20ft general freight container and which converts that freight container into a non-hazardous bulk liquid transportation unit.

Flexitanks are not an approved form of packaging for the carriage by sea of dangerous goods classified under the International Maritime Dangerous Goods Code.

Flexitanks have been used for the carriage of bulk liquids for over twenty years. However, there has been unprecedented expansion since 2000 with the emergence of single-trip tanks.

In the early years, shipments amounted to around 5,000 per annum. In 2006 the total global market had increased to about 120,000 flexitank movements.

Annual growth is forecast at between 15% and 20%. Of the present trade, it is estimated that between 15% and 20% of global loads emanate from South America, with the movement of wine and fruit juices being particularly prominent.

The flexitank market is divided between equipment suppliers and equipment operators. A particularly dominant equipment manufacturer and operator is Trans Ocean Distribution Limited which has approximately 45% of the global market. Some of the newer entrants include a number of the conventional tanktainer operators, such as Stolt Nielsen Transportation Group and Hoyer Global.

There are more than 40 manufacturers of flexitanks worldwide. There is presently no agreed standard regarding

"The carrier shall properly and carefully load, handle, stow, carry, keep, care for and discharge the goods carried."

Hague Rules, Articles iii, Rule 2

Carefully to Carry Advisory Committee

This report was produced by the Carefully to Carry Committee – the UK P&I Club's advisory committee on cargo matters. The aim of the Carefully to Carry Committee is to reduce claims through contemporaneous advice to the Club's Members through the most efficient means available.

The committee was established in 1961 and has produced many articles on cargoes that cause claims and other cargo related issues such as hold washing, cargo securing, and ventilation.

The quality of advice given has established Carefully to Carry as a key source of guidance for shipowners and ships' officers. In addition, the articles have frequently been the source of expertise in negotiations over the settlement of claims and have also been relied on in court hearings.

In 2002 all articles were revised and published in book form as well as on disk. All articles are also available to Members on the Club website.

Visit the Carefully to Carry section in the Loss Prevention area of the Club website www.ukpandi.com for more information, or contact the Loss Prevention Department.

construction and operation. However, the Container Owners Association (COA) set up a flexitank working group with the inaugural meeting held in Paris on 28 June 2007. The aims include producing a 'Standard' and a 'Code of Practice' that flexitank manufacturers, operators and container operators can follow.

Container operators are concerned that the pressure placed on the sidewall panels can result in them bulging beyond accepted ISO external dimensions and tolerances and permanent deformation can occur. Some operators are so concerned that they will not accept the shipment of flexitanks. Many feel that there should be a limit on how much can be carried in a flexitank.

The International Standard Organisation (ISO) / Institute of International Container Lessors (IICL) deformation limit for sidewall panels is a maximum of 10mm beyond the plane of the side surfaces of the corner casting fittings.

Perceived advantages/disadvantages

In the non-hazardous markets, flexitanks are considered in some quarters to be effective substitutes for ISO tank containers and drums.

Reasons put forward to justify single-use flexitanks include:

- Product dedicated and therefore no risk of cross contamination;
- Relatively low positioning costs (in some areas 100 empty flexitanks can be positioned for the same cost as one tank container);
- Positioning a flexitank with a capacity of up to 24,000 litres inside a 20ft general freight container enables shippers to despatch about 40% more cargo per container than a drummed consignment, about 50% more than a bottled consignment and about 15% additional payload when compared to a container filled with intermediate bulk containers (IBCs);
- No return loads are required; and
- Loading rates are higher compared to drums and IBCs.

The disadvantages of flexitanks include:

- Products classified as Dangerous Goods under the IMDG Code are not permitted;
- Pumps are required for unloading;
- Greater preparation is required than for ISO tank containers, although ISO tanks require substantial cleaning, especially in food applications;
- Environmental issues arise in connection with the disposal of used single-trip flexitanks;
- The risk of leakage of the full contents;
- The potential of high costs to clean up spillages; and
- Dependant upon stowage on board, spillage resulting in the contamination of other cargo.

Types of flexitanks

The first flexitanks were designed on the basis that they would be for multi-trip use. This meant that cleaning and repositioning costs were incurred. However, these costs have been eliminated with the singletrip flexitank, the type now most commonly in use. The single-trip type now accounts for more than 95% of the global market.

The typical capacity of a flexitank is in the range of 10,000 to 24,000 litres. The weight carried will depend upon the density of the commodity. The permitted gross weight of a container should never be exceeded, however, current practice is not to load more than 24,000 kg of liquid in a 30 metric tonne gross weight rated freight container, although even this is considered too high by some container operators.

A major difference between the designs of the two types of flexitanks is that a restraining harness is used in the majority of multi-trip ones. Harnesses were, and still are, deemed to be dangerous as they create concentrated pressure points on the tank surface which can result in premature material failure. The use of a restraining harness has been dispensed with in the case of single-trip flexitanks.

If a flexitank is not filled to near its nominal capacity then a marked free surface effect and hydraulic surging of the liquid can occur, often resulting in damage to the container. A flow meter should be used to ensure that a flexitank has been filled to its correct capacity (+/-500 litres of its nominal capacity). A visual inspection alone is unlikely to be sufficient.

Use of flexitanks

A range of products are carried in flexitanks and include wine, fruit concentrate, animal fat, fish oil, base oil, detergents, non-hazardous chemicals, drilling mud additives, paint, lubricants, printing ink, latex and potable water.

Flexitanks are constructed in a number of different ways – singlelayered and multi-layered – and from different materials, but typically polyethylene. A shipper should discuss with a flexitank operator the most suitable type of flexitank that will be compatible with the product to be shipped. This may include giving consideration as to whether a flexitank should incorporate an impermeable barrier to prevent any tainting of the product being carried from external sources. For example, wine has been tainted by naphthalene, the origin of which has not always been clearly identified.

Single-layered flexitanks are constructed from 1mm thick polyethylene, whereas multi-layered flexitanks are constructed from a number of layers of plastic of which the inner surface at least should be polyethylene. Each layer may be about 125 microns thick. The outer layer of a multi-layered flexi-tank is normally of a woven type plastic material. With multi-layered flexitanks, the different layers may, during loading, get caught up and trapped resulting in a layer tearing.

Selection of freight container

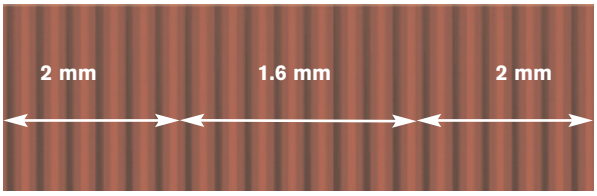
From discussions with a number of interested parties the general consensus is that a minimum 30 metric tonne gross weight rated container manufactured from Corten steel should be used, irrespective of the size of the flexitank. The actual sidewall strength is a function of a containers' permitted payload, i.e. 0.6 x payload (ISO 1496-1 Series 1 freight containers - specification and testing). Therefore, the sidewall panels of a 30 mt container will have been tested to a greater load bearing capability than, say, a 24 mt container.

The side wall test requires a general freight container to be subjected to an internal loading uniformly distributed and arranged to allow free deflection of the side wall and its longitudinal members. The ISO Standard requires that, upon completion of the test, the container exhibits neither permanent deformation which will render it unsuitable for use, nor any abnormality which will render it unsuitable for use and that the dimensional requirements governing handling, securing and interchange shall be satisfied. Therefore, for a 30 mt container the test load will be of the order of 16.8 mt. However, a flexitank does not place a uniform loading over the full area of a sidewall and a gross liquid cargo weight of 24,000 kgs is the recommended maximum by some flexitank operators. However, some container operators consider that there should be a lower limit. Containers are not specifically classified for the carriage of flexitanks.

To minimise the stress upon the sidewalls of a freight container it is recommended that the height of the side of the flexitank in contact with the sidewall panel should be kept to a minimum. An optimum height of 1.3 metres has been suggested.

It is also recommended by flexitank operators that the sidewall panels are fully corrugated from end-to-end and that a container with sidewall decal panels is not acceptable.

One flexitank manufacturer/operator insists that container sidewall panels should be a minimum of 1.6 mm in thickness increasing to at least 2 mm at the extreme ends.



Some flexitank operators recommend that only containers five years old or less should be used. In the event that older containers have to be used then they must be in good condition. This means that no container should be used that already has signs of creasing or deformation to the sidewall panel corrugations and/or has had a partial replacement of a sidewall panel.

The container should be fitted with:

- Functioning dual locking bars for each door panel;
- Left-hand door handles must have a hole to accept a safety bolt seal
- Door recesses for bulkhead fixings.

Inspection of freight container prior to use

Irrespective of whether a single or multi-trip flexitank is being used, a freight container should be inspected to ensure the following:

- The container is structurally undamaged and free of sharp projections on internal side and end wall panels;

- The container is in a clean condition free from the residue of all previous cargoes;
- There are no floor imperfections:

  - Floorboards and their retaining bolts are flush;

  - There are no nails in the floor (nails/screws/fastenings should not be hammered into the floor);

  - The underside of the container floor should also be inspected to ensure that no nails are protruding and all cross-members are in place and firmly affixed to the floor and the side rails and do not show signs of excessive deformation and/or cracking;

  - Internal weld joints are smooth as rough weld joints can result in a flexitank being abraded (placing tape over the weld joints can provide extra protection);
- Cams on both doors position and lock correctly when the doors are closed;
- Handles position and lock fully in their hatches;
- Door recesses for bulkhead fixings are in good condition (note: containers are being built without door recess channels and therefore are unable to accommodate bulkhead fittings);
- Lashing fittings at bottom rails and corner posts should not be damaged as they could cause punctures; and
- Bolts affixing labels etc to the doors are not protruding through to inside of panels. If they are, they must be covered with foam or cardboard.

Some flexitank operators provide a standard practice check-list for container selection. If the container does not meet the criteria laid down the flexitank operators' technical department request that they be notified.

In order to ensure protection from the flexitank abrading against bare metal the normal practice is to line the inside of the container. Materials often used include corrugated cardboard, styrofoam sheets and kraft paper.

To prevent a loaded flexitank bulging outwards when the right-hand door is open, a false bulkhead is placed in the doorway.

In the early years these bulkheads were of a solid timber construction. Plastic panels are now used, held in place with horizontal steel bars that fit into the vertical corrugation in the door pillars.

Sturdier welded steel frame bulkheads such as those below are designed and constructed to withstand the rigors of rail operation.

To ensure that a flexitank does not bulge through the gaps in a steel framework bulkhead a sufficiently rigid sheet should be placed on the inside of the bulkhead. This prevents the flexitank chafing against the steelwork. The photograph below shows horizontal steel bars used with cardboard sheeting placed between the flexitank and the steel bars

Stowage of flexitanks

The stowage of flexitanks aboard a vessel needs to be considered in the context of two factors which may be conflicting.

To reduce forces acting upon the container and the flexitank, stowage low down in the hold and near to the ship's centre line is preferable. Such forces can be particularly high when the ship is partly loaded and/or has a large meta-centric height, resulting in a short rolling period. However, if the nature of the goods is such that they could solidify if they leaked (e.g. latex) and which could result in the ship's hold bilge lines becoming blocked, then on deck stowage is preferable.

Ship operators may wish to consider whether, due to the nature of the goods, a leak could result in tainting of the hold space and/or other container loads stowed in the same hold.

Accordingly, the information supplied by the shipper should include full details of the nature of the product and whether it could 'solidify', 'taint' or 'damage' the container in the event of a leakage.

On balance, the optimum stowage for flexitanks is probably the first tier, on deck.

Labelling of containers

The normal practice is to place a warning label on the left-hand door panel of the freight container. This label advises:

- Caution bulk liquid;
- Flexitank container;
- Do not open left-hand door until discharge completed; and
- Do not loose shunt.

These warnings are given in a number of languages on the same label. However, this single label presupposes that firstly it will be seen by the person handling the container, which may not be the case for the operator of the crane loading/discharging the vessel or the driver of the transport moving the container to/from the quayside to its storage location on the terminal. Also, it presupposes that the label is in a language understood by the person handling the container at any particular time in the transport chain.

A flexitank would be better marked with a suitable placard affixed to each of the four side panels and the roof panel. Accordingly, it would be very helpful if an internationally recognised symbol was agreed that could be seen at a distance by anyone handling the container.

How safe are flexitanks?

Certain types of flexitanks are accepted as providing a quality and economic containment system for non-hazardous bulk liquid products. However, no shipping method is without its weaknesses and accidents do occur. However, how high is the risk?

The flexitank industry is unregulated and is presently not represented by any central trade organisation. Therefore, incident statistics for the global market are not available.

Trans Ocean Distribution Limited has advised that only a small percentage of their loads give rise to incidents.

In 2005, only 35 of 31,052 (0.1%) loads were reported as bulging. Investigation of these incidents determined that either mishandling of the containers and/or pre-existing damage, weakening the panel, was the root cause.

For ease of discharge, bottom fittings adjacent to the doorway are generally preferred. However, this can result in a static head of pressure between the flexible body of the tank and the valve construction. Leaks can occur due to the detachment of the double patch around the valve opening of either the top or bottom fittings (see photo below).

The flexitank market is fragmented with more than 40 manufacturers worldwide. Shippers/container operators need to familiarise themselves with the equipment available in their locations, and its capability.

A damaged container does not automatically mean that a flexitank will leak. However, if a flexitank does leak and its full load is spilt then, dependant upon the commodity being carried, the clean-up costs may be considerable. Costs of the order of US$ 75,000 have been incurred for the clean-up of a single flexitank that has leaked on board a vessel.

A flexitank can sustain severe trauma without leaking. The following photographs show a flexitank stowed at the bottom of a flooded hold. The product was synthetic latex. There was no leakage and the product was later sampled, approved and discharged for its intended use.

As with the carriage of any cargo, problems can arise. With wine, fermentation can occur, which when carried in a flexitank can result in it expanding excessively. The following photographs illustrate such a case.

Whilst the sidewall and roof panels of the container were damaged there was no leakage of the wine. This is one reason why relief valves are not used on some designs. Whilst relief valves are suitable for the rigid design of tanktainers, there are complex problems in designing one suitable for a flexitank and there is not an ideal one on the market. The fitting of relief valves in the early flexitanks was one of the causes of criticism as there was frequently leakage of the contents during shipment.

Notwithstanding this example, to put the problem in perspective the number of similar incidents involving wine, for one flexitank operator has been three or four out of a total 28,000 carried.

Over the past few years, Trans Ocean Distribution Limited has undertaken a number of tests to demonstrate that side-wall panel integrity is not compromised by the fitting of their flexitanks in freight containers. These tests have included:

- Association of American Railroads (AAR) – Impact Test passed - February 2006; Field Test passed – June 2006
- Vertical Lift and Emergency Stop Test – Houston, - February 2006
- Testing with Railroad Academy of Science, Transportation and Economics Institute – Beijing, China, November 2004;
- Freightliner Rail Test, United Kingdom, July 2004

A computer model devised by a flexitank operator has predicted that sidewall panels in good condition will suffer no permanent damage from normal handling operations. This result is endorsed by the tests outlined above.

Trans Ocean Distribution Limited are willing to discuss with interested parties the findings of these tests on freight containers, Rhinobulk flexitanks and the steel bulkhead assembly. In an effort to obtain an acceptable industry standard in this growing market sector, TOD is a lead player in the formation of a working group on Flexitanks being co-ordinated by the COA (Container Owners Association) –www.containerownersassociation.org.

The inaugural Flexitank Working Group meeting was held in Paris in June 2007. The issues considered included 'container bulging or damage to containers' and a 'Code of Practice'. The latter covered guidance under the headings: safe operations, testing, training, safety and the environment.

Shippers and container operators need to understand the significant difference between equipment types. Discussions amongst the various flexitank suppliers and operators and getting to know the equipment and service being offered can best achieve this.

Charterparty contracts

In charterparty contracts, owners and charterers should identify who will be responsible for costs and damages consequent upon a leakage from a flexitank while on board.

In addition, when bills of lading are issued they should be claused to identify the party responsible for positioning and loading the flexitank in the container.

Summary

- Certain flexitank types are widely accepted as providing a quality and economic containment system for non-hazardous products. The entry of tanktainer operators into this market suggests that flexitanks may now be seen as a more credible form of transportation.
- Damage to containers can occur either as a consequence of improper handling or from pre-existing damage undermining the structural integrity of the freight container.
- During transportation the contents of a flexitank will be subject to dynamic forces that will act upon the structure of the container which could cause damage as well as possibly affecting its stability.
- A damaged container does not automatically mean that there has been leakage of the product from the flexitank.
- To minimise the possibility of a flexitank tank being damaged, careful selection of the appropriate freight container is required. A detailed inspection should be undertaken by the container operator before releasing to the flexitank operator, who must in turn undertake its own inspection before fitting their equipment.
- Flexitank operators should provide clear written advice regarding container selection and the loading of their flexitanks. This guidance should be fully understood and followed.
- A container carrying a flexitank should be properly labelled to indicate that the contents are a bulk liquid and caution should be exercised in its handling.
- Information should be passed along the transport chain, including details of the nature of the contents. This should include, in the event of a leakage, whether the product will 'solidify','taint' or 'damage', the container.
- Freight containers should be checked to ensure:
- The container is fitted with:
  - Functioning dual locking bars for each door panel;
  - Left-hand door handles must have a hole to accept a safety bolt seal;
  - Door recesses for bulkhead fixings.
- The container is structurally undamaged and free of sharp projections on internal side and end wall panels.
- The container is in a clean condition free from the residue of all previous cargoes.
- There are no floor imperfections:
  - Floorboards and their retaining bolts are flush;
  - There are no nails in the floor (nails/screws/fastenings should not be hammered into the floor);
  - The underside of the container floor should also be inspected to ensure that no nails are protruding and all cross-members are in place and firmly affixed to the floor and the side rails and do not show signs of excessive deformation and/or cracking;
  - Internal weld joints are smooth as rough weld joints can result in a flexitank being abraded (placing tape over the weld joints can provide extra protection).
- Cams on both doors position and lock correctly when the doors are closed.
- Handles position and lock fully in their hatches.
- Door recesses for bulkhead fixings are in good condition (note: containers are being built without door recess channels and therefore are unable to accommodate bulkhead fittings).
- Lashing fittings at bottom rails and corner posts should not be damaged as they could cause punctures.
- Bolts affixing labels etc to the doors are not protruding through to inside of panels. If they are, they must be covered with foam or cardboard.
- There is a warning label on the left-hand door panel of the freight container, advising:
  - Caution bulk liquid;
  - Flexitank container;
  - Do not open left-hand door until discharge completed;
  - Do not loose shunt.

This article is a review of current trade practice only. Presently there is no container type specifically constructed to carry flexitanks, nor any international rules governing their use. Container operators offering containers for flexitank use should therefore ensure that shippers are fully aware of the issues surrounding the carriage of flexitanks by sea in containers, as mentioned in the article, especially their responsibility should the container, flexitank, contents, or third party property be damaged.

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