

# TANK CONTAINERS

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## 1 History of the Transport of Liquids

The transport of liquids has been important for mankind since people are travelling. Water was filled in leather bags to support people when crossing deserts, wine was filled in wooden barrels for transport on rivers or for crossing the Mediterranean Sea like people from Greece and Rome used to do.

These wooden barrels were multimodal as they could also be moved over-land by animals or carts drawn by horses or oxen.

Next step was the transport of barrels on railway cars, especially in North America for the transport of oil in the last century. During that time also riveting, bolting, welding of metal became more and more popular and so tanks for railway cars and tanks for steel ships were designed and built.

Traditionally, these tanks were tailor designed for their special purpose and fixed for their whole life on a railway car or on a ship. Liquids were also transported in cellular ships or tank ships.

“ISO Box containers” appeared during the 60ies and were a revolution as they allowed to load and unload ships much quicker than before with the result that the time which a ship spends in a harbour today has decreased from an average time of unloading reloading of 10 days to one or two days.

## 2 Todays Application

### 2.1 Cargo Tank – Family Tree

Iso Tank Containers today amongst all transport tanks have become more and more important.

The following diagram shows the different degrees of intermodality and ISO compatibility for a range of tank types and configurations.

### 2.2 Range of Transported Goods

Today, tank containers can carry a very wide range of different products like :

- \* non-hazardous liquid food products such as wine, fruit juices, oils, starch, milk, sugar and chocolates

- \* non-hazardous chemicals

- \* low hazard and hazardous, i.e. flammable, toxic and corrosive liquids

- \* liquefied and permanent gases

- \* bulk materials such as powdery or granular.

### 2.3 Capacities

In the early 70ies when tank containerization started, typical designs of tank containers had a capacity of about 20 m<sup>3</sup>. A typical design is shown on picture n° 82408.

Also non-cylindrical tank containers with capacities from 18 m<sup>3</sup> to 19 m<sup>3</sup> were built especially for the wine and liquor industry. A typical unit is shown on picture n° 83017.

Connected with today's regulations the pressure rates of these non-cylindrical containers are no longer in line with legal requirements, although a lot of these units which were built in the 70ies are still legally in operation.

So, today most of the tank containers are built as cylindrical tank containers with capacities from 21 m<sup>3</sup> up to somewhat more than 25 m<sup>3</sup> but – connected with the dimensions of ISO frames 20' x 8' x 8'6'' – the diameter/dimension of the cylindrical tank is limited and so far the capacity of these units.

Picture n° 1054-9-92 shows a typical unit which can carry 23 m<sup>3</sup>.

There are also designs available in line with today's requirements which can be transported as an IMO 1 unit with 6 bar test pressure, 30 m<sup>3</sup> in a 20' frame, which is shown on picture n° 877-11-89.

For the end-user this has the advantage of higher transport volume without paying any extra money for the transport itself which is always based on a unit price by the railway authorities or shipping lines.

Due to the different specific weight of the liquids these high volume units are especially interesting for very light liquids.

## **2.4 Design Developments**

Whilst during the 70ies the insulated and heated tank was an exemption and nearly 90% of the units were built bare like picture n° 82408 (DAL) shows, today the market asks more and more for special solutions for liquids which needed cooling or heating. So, manufacturers are offering semi and full tube heating systems or panel heating systems normally working with steam, also different glycol based or water based heating systems are offered.

Units with highly sophisticated electrical heating systems are also offered and there are products like MDI which require such heating systems. An example for a combination of steam and electrical heating shows picture n° 887-1-90. Damages through dynamic impact or salt water or combinations of both make electrical heating systems very expensive in maintaining and vulnerable.

Nearly all of these heated or cooled tanks need additionally an insulation. Used materials are :

- \* rockwool
- \* polyurethane

or combinations of both.

For the cladding aluminium, stainless steel and GRP are used.

## **2.5 Today's Production**

The world population of tank containers is estimated between 50,000 and 60,000 units. So, compared with box containers the tank container is and will be a niche market. But designing is complicated and also the prices compared with boxes are much higher.

A standard IMO 1 unit regularly has 10<sup>th</sup> of the worth of a box container.

Tank container production started in Europe in countries like Great Britain, France and Germany. Especially, France used to be a country of the so called "mass builders", which are companies that build more than 500 tank containers per year.

Most of the units are built in stainless steel. Common material in the early days of the tank container was ASI

304, while today 316 l and 316 Ti are more popular.

Connected with lower wages, a very attractive finance system by government and so called “Investors”, today South Africa is the place where most of the tank containers are built. So, especially the French mass builders lost a lot of business to South Africa.

At the end of the 80ies several companies tried to jump in the market with rock bottom prices but as they offered designs which were not sophisticated, most of the companies disappeared after a period of two or three years from the market.

Also every year several companies announce that they will go in this market. Tank containers look very simple and similar, but the problems start if you really build the first unit and try to get the approvals. As tank containers are treated very rough in practice, it is difficult to build designs which are accepted by the market, also having in mind that today’s customers want :

- \* a high capacity
- \* a low tare
- \* a design which has no risks of fatigue and of course
- \* a long life time.

So it has become more and more popular in the industry to give a license to other companies as the range of designs is limited and in the market is only a number of designs available which have really proved in practice that they have no fatigue risks and a low tare weight.

As a lot of the developments of the tank container industry came from Europe today, based on European license partners there are tank containers built in Japan, New Zealand, South Africa and North America under license contracts.

## **2.6 Structure of Companies in the Tank Container Industry**

Today in Europe some companies are still in the business since more than 20 years while several of the companies that started early with the tank containers disappeared from the market place.

Additionally, in Europe some companies which came from the road tanker manufacturing, today have divisions, where they also build tank containers.

The typical mass business today is concentrated in South Africa, with presently 3 companies offering tank containers, most of them under license contract of European based companies.

In Asia since the mid-70ies under an European license one company is working in Japan, while several companies presently based in Singapore, Indonesia and India show interest and want to step in the market. As Asia has tremendous economic growth, this market seems to be very interesting for the rest of this century.

Unexpected and perhaps difficult to understand is that the box container business came from the United States but the tank container started its important role in Europe.

Since the late 80ies every year two exhibitions take place promoting the tank container on the North American market and several companies in North America are now starting to build tank containers, most of them based on designs which were developed in Europe.

Connected with new regulations for road transport, more and more hauliers in the States are investing in tank containers instead of new road tankers. Also pricewise –beside the intermodality of the tank containers - this has advantages.

### **3 Standards, Tests, Quality Requirements**

#### **3.1 ISO/CEN, UN-Recommendations**

Standards and regulations are one of the main problems for getting approvals for a tank container design which can be legally operated worldwide.

Different areas of the designs are defined in different regulations, different countries and for different traffic modes.

The problem for the designer is that there are sometimes discrepancies and problems which are difficult to solve, also, bearing in mind that the tradition of the different traffic modes vary.

The main codes, inspection and approval connected with tank containers shows the following table “Codes, Inspection, Approval”.

#### **3.2 Classification Societies**

One of the first classification societies inspecting tank containers was LLOYD’s LONDON and they still do a lot of tank container inspection worldwide.

In Europe also Bureau Veritas and Germanischer Lloyd have reasonable experience in inspecting tank containers while ABS is now very active in North America.

It also happens that the customer prefers to have two classification societies inspecting the units. Then it is typical that an inspection society which he knows and comes from his country is also involved.

### **3.3 Standards and Quality Requirements**

While a lot of the standards and quality requirements are defined in clear and strict regulations, the inner surface of the stainless steel tank containers and the different requirements for the quality of the welds still let room for a lot of discussions.

Traditionally hot rolled material was used and all the welds were done manual rod and later grinded.

Also grinding of the whole surface to get a smoother surface was popular.

In the 80ies then there was a trend to use cold rolled material and to automatize the welding and do as less grinding as possible which today is state of the art.

The European based manufacturers today prefer to use cold rolled material while most of the South African mass builders prefer in South Africa fabricated hot rolled material and so do more grinding inside the tank.

Another critical point is the number of damages to the surface during manufacturing. In this field all manufacturers try hard to avoid damages and most of them today use additionally foils during fabrication to protect the surface.

Another important point is the dimension of the stainless steel plates. To avoid expensive welding time and to avoid welds which have to be cleaned, ground, passivated, and pickled it is ideal to have big shell plates.

Several manufacturers also produce their dished ends from one piece of stainless steel while others still weld sections for the dished ends together from different smaller parts of stainless steel.

### **3.4 Welding Procedures**

While traditionally manual rod welding was important, today more and more welding is automatized or semi-automatized and so for the longitudinal seams Plasma-TIC welding is state of the art while for the circumferential seams plasma or submerged arc welding is state of the art.

Most of the flanges in the tank are TIG welded to avoid additional grinding inside the tank.

Several manufacturers have semi-automatized tank building capacities which are highly mechanized to avoid expensive hand labour work during tank fabrication.

Also such equipment has quality advantages.

Also it is meanwhile possible to weld the longitudinal seams outside for semi-tubes which are used for heating and cooling semi-automatically.

### **1.1 Additional Treatment**

To increase the inside surface quality the welds can be shot blasted with glass balls, pickling and passivation procedure of the welds or the whole surface is used and to get first class surface electro-polishing is possible. Combinations of these treatments are also popular.

## **4 Future Markets**

### **4.1 Barrels, IBCs, Tank Containers**

Main advantage of the tank containers is that they can be used intermodal.

Connected with its capacity between 15 to 25 m<sup>3</sup> there is worldwide the infrastructure to handle and to transport these units.

For smaller transport volumes middle-sized tanks are offered by some tank container manufacturers and also units of about 1m<sup>3</sup> so called “IBCs”, are still in operation.

And – like 1000 years –barrels are used to transport small volumes.

The main disadvantage of barrels and also IBCs is that they are presently not really intermodal and that connected with the smaller capacity the involved manpower for changing transported goods and as they are difficult to clean or it is expensive to clean them, the costs per transported liter or cubic meter are compared with tank containers higher, also bearing in mind that the production cost of barrels and IBCs are much lower.

Another problem is one way use of barrels becomes more and more difficult as if chemicals are transported the barrel cannot be disposed on like in earlier times without any cleaning.

Also, the tank container has proven over the last 25 years that it is very very safe. Only very few accidents where product went out of the tank containers were mentioned over the last years. The stainless steel tank withstands more impact and damages than aluminium tanks, IBCs or barrels.

### **4.2 Specials**

As tank containers have proven over the years that they are very safe, today more and more very special products that require special tank containers are manufactured, e.g. for gases and high toxic products which need additional cooling.

Picture n° 1056-12-92 shows a unit suited for the transport of Lithium Alcydes with an additional cooling unit while picture n° 1069-3-93 shows a unit only with top discharge for the transport of Anhydrous Amonia. This tank is also designed as an IMO 5 unit for the transport of gases.

While picture n° 1005-7-91 shows a non-iso container, so called “swap body” for inner European transport fitted for the transport of Carbon Dioxide.

There are only a few companies in the market offering a wide range of specials at competitive prices and reasonable engineering capabilities like computerized tank calculations and high speed CAD systems connected with computerized parts lists systems.

### **4.3 Potential in East Europe, South America, Asia**

With increase of industrialization in countries like East Europe, South America and Asia, the tank container will become more and more popular also there.

The next years will show whether also in these areas of the world new manufacturers of this interesting product will appear or whether the markets will be served from the traditional manufacturers.

## **5 Summary**

When the first tank container was presented at the late 60ies, nobody really knew whether they would be accepted by the market. Today the tank container has an important role for the safe and economic transport of liquids and gases.

Still a lot of tank containers are built in Europe and a lot of improvements and specials are still designed there.

Tremendous growth of tank containerization will take place on the Far East markets, probably also in East Europe and in some of the CIS states. As these countries have also a tradition in steel building there might appear new companies from the states offering tank containers.

In the future the tank containers will have an important role in the transport of liquids, gases and dry bulk worldwide.