

# CERTAIN FEATURES OF THE CARGO PLAN FOR OIL TANKER

## НЕКОТОРЫЕ ОСОБЕННОСТИ ГРУЗОВОГО ПЛАНА ТАНКЕРА-ХИМОВОЗА

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**Abstract:** Cargo ship plan represents the graphic display of disposition of each consignment in cargo tanks at the ship drawing for particular voyage. The cargo plan is designing, while respecting the conditions of the forthcoming voyage. Along with technical and organizational requirements there are taking into account in designing of cargo plan the need to achieve the highest economic efficiency of ship operation. In designing of cargo plan it is necessary to know all details on ship, cargo and voyage conditions. The cargo plan ensures the safety of voyage and crew as well as environmental protection. Significant features of cargo plan designing process for oil tanker consist in distribution of liquid cargoes among different cargo tanks on the ship, for what it is necessary to analyze and take into account all physical-mechanical, chemical and other properties of cargoes. In designing of ship cargo plan it is necessary to address an issue of maximal use of cargo capacity and bearing capacity.

**KEYWORDS:** CARGO SHIP PLAN; TRAFFIC CONDITIONS; CHEMICAL LOADS; CARGO CAPACITY; CARGO TANKS; STABILITY; CARGO SPACE; DRAUGHT

### 1. Introduction

Cargo ship plan represents the graphic display of disposition of each consignment in cargo tanks at the ship drawing for particular voyage. The cargo plan is designing based on general requirements for optimal positioning of different cargoes while respecting the conditions of the forthcoming voyage. In order to meet these requirements it is necessary to ensure the following conditions [1]:

- maintaining the required stability, durability and trim difference of ship;
- the most advantageous use of cargo capacity and bearing capacity of ship;
- compatibility of different chemical cargoes, oil products and various sorts of oils taking into account compatibility of chemical groups and temperature of loading, unloading and shipping;
- shipping terms and compatibility of previous sorts of cargoes;
- possibility of ensuring the loading and unloading of cargoes in time;
- safe navigation;
- safe and timely delivery of cargo;
- ensuring the consecution of loadings and unloading with computation of unshipping at the intermediate ports without additional transshipments;
- observance of safety measures and crew and terminal workers labor protection.

Along with technical and organizational requirements there are taking into account in designing of cargo plan the need to achieve the highest economic efficiency of ship operation

### 2. Preconditions and means for resolving the problem

In order to design the cargo ship plan it is necessary to know detailed data of the ship, cargo and voyage conditions. The cargo ship plan can be accepted only when it ensures the safety of voyage and crew as well as environmental protection, i.e.:

- the ship has sufficient stability, fore-and-aft durability, permissible list and trim difference;
- ensuring the appropriate distribution of the loads bearing over length;
- adequate supplies of void volumes inside cargo tanks;
- leak-tightness of tanks and suitable atmosphere and pressure inside cargo tanks;
- segregation of steam cylinder oils and load lines at least with two isolator valves.

The next most important stage of cargo ship plan designing is to distribute loads among different cargo tanks of the

ship, for which they study and take into consideration all physical-mechanical, chemical and other properties of loads. The correct distribution of loads into the tanks influences not only on safety of them, but on safety of ship navigation as well. Planning of the placement of corrosive, toxic and highly inflammable loads on the ship must be treated particularly sensitively and attentively. The simultaneous transportation of incompatible loads in the adjacent cargo tanks can lead to spoilage or inflammation because of harmful effect of them on each other. In designing of ship cargo plan it is necessary to address an issue of maximal use of cargo capacity and bearing capacity. This is achieved by the method of matching the appropriate combination of cargoes and ballasting taking into account a specific weight of each cargo. A quantity of cargo, which can accept ship for transportation is determined by its specific loading volume.

In maritime practice there are distinguished two forms of cargo ship plans – preliminary and executive ones.

The preliminary cargo ship plan can be designed by chief officer and approved by captain and operator. In designing and approving the cargo ship plan it is necessary to know the operating and spec characteristics of the ship as well as transport characteristics of cargo and its physical-chemical properties.

The operating and spec characteristics of ship include the following ones:

1. The linear parameters, such as length, width, the height of the ship board and its draught;
2. The weight parameters, such as light displacement tonnage, displacement tonnage to the load, cargo capacity (dead weight);
3. Volumetric characteristics of ship.

The basic transport characteristics of the filling load are the following ones: mass, specific loading volume, expansion coefficient with temperature rise, degree of corrosivity, toxicity and explosibility. For the solution of problems connected with possibility of transportation of different loads in adjacent cargo tanks, such properties as flammability, toxicity, corrosivity, radioactivity and other aggressive properties are important.

After the planned placement of loads in tanks the following parameters of ship are calculated: stability, list and different of ship; loads on ship designs; ship rocking elements.

The designed preliminary cargo plan must be approved by captain, agreed with local agent and terminal. During the process of shipment it is possible to make some adjustments to cargo plan, which must preliminary agreed with all interested parties.

In case transportation of uniform load of complete cargo capacity, the priority condition must be the maximal use of all cargo spaces, so, for instance, the loads from the CPP (Clean Petroleum Product) with a specific weight less than "1" must be distributed into all tanks filling the tank volume not more than to 98% with a glance of expansion coefficient with temperature rise in the

dependence of external climate and thermal conditions.

With the complete load of ship, a specific weight of which is over "1" (acid, caustic soda etc.) the priority is given to the height of the load's level inside the tanks in accordance with registered table of calculation for each tank, which is regulated by the degree of the strength of longitudinal and lateral assembly of ship's stiffening ribs in order to avoid an extrusion or damage of decks and bulkheads of cargo tank by load [2].

The oil products are unified in groups according to common features, to each of which the corresponding designation is given. In compliance with storage and transportation terms all kinds of oil products are divided into the following groups: light oil products, such as gasoline, kerosene, ligroin and some sorts of diesel fuel; dark oil products, such as black oil, engine fuel, crude oil; lube oils - all sorts of lube oils; other oil products – the rest of oil products, which did not enter the first three groups.

The basic properties of liquid cargoes, which are essential to know during transportation of them, are the following ones: density; flash temperature; viscosity; solidification and cloud temperatures; evaporability; thermal characteristics; specific (fire risk, adverse health effect and corrosivity).

Precise determination of the value of specific weight of liquid cargo taken by ship is one of the most important problems, which must be resolved by ship administration board during shipment process. The nonconformity of actually determined value of specific weight to data indicated in certificate of quality, can testify either replacement by sender of the declared sort of cargo, or about pollution, irrigation of it or other defects of loads made available for transportation.

Specific weight of load at the filling serves as a basis for calculation of voids in tanks envisaged for the case its expansion, which are occupied by liquid cargo, and by its specific weight it is possible to determine its weight quantity. By the same way there is determined the normal temperature at 20°C, which includes the variable quantities determining the properties of substances depending on the temperature. Specifically at this temperature the meters must provide correct indications.

The value of specific weight of liquid cargo varies with the dependence on its temperature. Taking into account of this variation is important as for determination of load quantity, since in the period filling its temperature can differ from standard rate, so for determination of sizes of voids, which must be left inside the tanks because of assumed expansion of cargo. The cargo density is inversely proportional to its temperature.

Method of direct measurement of density of liquid load can not always be used. For example, in designing of preliminary cargo plan, when there is no load in the tanks yet, it is necessary to use the calculation method, which enables to sufficiently rapidly and accurately a specific weight of cargo with any level of its temperature. This is of great particular importance during calculation of void values, which must be left for the possible expansion of cargo.

Loading of tanker is carried out on the basis of cargo plan agreed and approved by captain of ship and under the guidance of one of the captain's assistants.

A quantity of cargo taken by tank is limited to value of the reserve buoyancy, which must have ship by the moment of the end of loading.

Since the tank vessel in the loaded state has sag of ship's hull, it is immersed up to cargo stamp until using of its dead weight, i.e. the tanker is underloaded.

With incorrect loading of ship there can be created the bend with which the tanker is immersed up to cargo stamp already after complete using of its cargo capacity.

With normal loading of tanker it is necessary to envisage the following conditions [4]:

- 1) maximal use of cargo capacity as well as of bearing capacity on conditions of guaranteeing the safety of cargo during loading, transportation and unloading;
- 2) the best flow chart of loading process, which enables to reach considerable shortening of the duration of cargo operations to

the minimal level with the condition for providing the fire safety;

- 3) rational distribution of loads and variable reserves along the length of ship, preventing appearance of the excessive stresses of hull;
- 4) ensuring the normal stability, trim difference and draught of ship at the all stages of voyage, i.e. during the cargo operations and navigation.

During transportation of cargo of first category it is necessary to fill the cofferdams with water or inert gases, to ground the hull for the period cargo operations, to ensure connection of flexible hoses preventing the damage or break of them, to make sure of respecting the preventive-fire-fighting regulations during the period of cargo operations. During the loading and unloading, for the correct connection of hoses are responsible the coast or ship hose workers, each for connection on his own section. The notice about the readiness is given to consignor after acceptance of cargo tanks and connection of hoses. Filling and emptying of tanks must be carried out in the sequence provided by instruction. Through the cargo main there are giving and handed out the oil products of I and II categories, the loads of II category can be filled through the top. Reserve for the expansion during the heating of load is no less than 2% of capacity of tank. During the placement of different sorts of cargo inside the adjacent tanks it is necessary that the level of load in the tank, which is sensitive to admixture of another load, must be higher; the level of load sensitive to supplying with water must be higher the load-line.

For quality control of the oil products and for the purpose of protection of their rights in case possible complaints of consignors, the captain of ship organizes the sampling of loads.

The sampling of loads is carried out in compliance with standards and technical terms in force [3].

Order of the selection from the top to bottom from three levels is as follows: one part is 200 mm lower than load surface, three parts from the middle of the oil product's level, one part at the level, which is distant from the bottom of tank at 250 mm. If required to determine quality of oil product at the very lower level. They select the bottom sample, which they analyze separately.

Sampling from the shore pipeline (pipeline sample) is carried out from control cock located at the end of the shore pipeline on the dock. Sample is taken at the beginning of loading (from the first jet), then periodically after certain time intervals.

The samples are selected by special representative of inspection with participation of crew member. The selected samples are stored on the tanker until the end of loading under observation of watchstanding and then they compose of them the mixture. The obtained mean sample they fill into to two 1-liter bottles, one of which, sealed up by sealing-wax press of sender, they transfer to the second captain's mate for storage. the pipeline sample is the arbitral one. The samples are stored for 2 months during transportation in local shipping and for 6 months during transportation in coasting trade and oversea transportation.

### 3. Conclusion

**The cargo ship plan for oil tanker must include at least the following information:**

1. Name, number and flag of the ship;
2. Voyage number and date;
3. Draughts - with bow, stem and midship section before loading and after loading of each consignment separately, as well as final draughts;
4. The name of loads – there are allowed the abbreviated names with necessary footnote to directory, where is possible to find full commercial name of cargo in compliance with MSDS (Material Safety Data Sheet);
5. Port of loading and port of unloading, name of terminals as well as their priority;
6. Loading temperature – sometimes there is required information about transportation temperature and unloading

temperature that must be reflected in cargo documentation of transportation;

7. A quantity of cargo by volumes inside each tank in cubic meters at the temperature 15°C;
8. A quantity of cargo inside each tank in metric tons with loading temperature, in some case there are required a quantity of cargo in barrels and in other measuring units required for particular voyage;
9. A specific weight of each load by tanks, in some cases it is necessary to add information on the correction of a specific weight to the temperature;
10. The level of filling of cargo tank with load in the percent relationship to the complete loading of cargo tank;
11. Full volume of each cargo tank in cubic meters with complete 100% filling of volume;
12. Category of cargo in compliance with MARPOL according to danger level of the environmental pollution;
13. Brief information about coating of cargo tank;
14. A quantity of each load by number of bill of lading and ship number at the end of the calculation of cargo, In the preliminary cargo plan the ship number of a quantity of cargo is planning-nominated by consignor;
15. Total quantity of cargo at the end of loading, dead weight and displacement.

In addition to above listed requirements, complete cargo plan requires information about calculation of stability and loads on the hull of ship, wherein are counted: the moment of fracture, the moment of bend/buckling and stresses

along the longitudinal and transverse set of stiffening ribs. This information is obtained directly from the shipment program, which is individually computed and approved by register for each kind of ship separately. The chemical loads, which are not lube oils and oil products must be distributed in accordance with US Compatibility Chart, wherein are taking into account compatibility of chemical origins of loads with a maximal use of cargo spaces.

One of the priority factors in designing of cargo ship plan for oil tanker is the planning of consecution of loadings and unloadings in accordance with stability, maximum allowed draught, ballasting possibility and requirements of consignor/consignee, agent and terminal's specificity. All required information must be obtained before preparing the cargo plan.

#### **4. Literature**

1. IBC Code 2007 Edition – International Code For the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk .
2. USCG Chemical Data Guide for Bulk Shipment by Water
3. IMDG Code - Internation Maritime Dangerous Good.
4. MARPOL 73/78 (2006 edition).