# CARRIAGE OF SCRAP METAL IN BULK A HIDDEN RISK SERIOUSLY AFFECTING THE SHIP STABILITY

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**ABSTRACT**

The present paper presents the problems which arise from the transport of scrap metal in bulk on board vessels. Risks and factors involved in such transports, as well as proprieties of cargo and assessment of ship's stability, have to be correctly evaluated by all parties involved. A recent maritime casualty, related to loss of stability and sinking of vessel, revealed the hidden risks in this matter.

**Keywords:** *scrap metal, ship stability, stowage factor, centre of gravity.*

## 1. INTRODUCTION

The maritime transport of scrap metal in bulk is growing up every year. Scrap is seen increasingly as a global commodity. It is a cargo that apparently is easy to load, stow and transport by ships. The reality proved the contrary. In the last years a number of ships, loaded with scrap metal, lost their intact stability and, furthermore, most of them capsized. The main objective of this article is to point out and raise an alarm about risks involved in such transport. The motivation came from the fact that, in a recent case, a vessel loaded with scrap metal in bulk capsized and sunk in doubtful conditions.

## 2. SCRAP METAL – A HOMOGENOUS OR BREAK BULK CARGO?

As a normal rule, in practice, the weight of bulk cargoes is determined by dividing the volume of cargo hold to the stowage factor. Of course, this rule applied as most of the bulk cargoes are homogenous cargoes. But what means homogenous cargoes? According to maritime publications, homogenous cargo is that stowed loose in the hold and is not enclosed in any container such as box, bale, bag, cask or the like. Bulk cargoes consist entirely of one commodity and are usually shipped without packing. Specifically, bulk cargo is composed of either:

- free flowing articles such as oil, grain, coal, ore and the like which can be pumped or run through a chute or handled by dumping, or
- uniform cargo that stows as solidly as bulk cargo and requires mechanical handling for landing and discharging.

An aspect of bulk cargoes which have to be taken into consideration is fungibility (goods that are identical with others for the same nature).

Under normal circumstances, break bulk cargoes means the cargo that is not containerized and thus cannot be classified as bulk cargo under the above definition. It is important to note that the difference between bulk and break bulk is based not only on the type of cargo, but also on the way in which the cargo is stowed or loaded.

The first problem which arises is where can be categorized the cargo of scrap metal in bulk: homogenous cargo or break bulk cargo. As per above mentioned definitions, we can conclude that this type of cargo is neither homogenous nor break bulk cargo. However, such cargo should be never considered as homogenous cargoes.

From the commercial point of view, such cargo is described as bulk freight. As a matter of loading on board vessel, being a relatively light weight cargo, in all situations, the total weight of cargo to be loaded is determined by vessel's Master in such a way, using in calculations the entire volume of cargo spaces, cargo being loaded by volume occupied.

A very important aspect is what volume of cargo holds have to be used in case where structural members, such as frames, are exposed inside the hold, with reference to bale or grain capacity. Scrap metal in bulk, loaded on board vessels, usually consists in pieces of metal of various sizes, shapes and weights and it is difficult to be stowed compactly and moreover to occupy the entire space between various structural members exposed inside cargo hold.

Of course, the commercial parties are using the volume of cargo holds which fulfil their interests in order to load cargo as maximum vessel's capacity. In such cases, vessel's master is between hammer and anvil and has to satisfy the commercial interest as well as vessel's safety (which in many cases was on the second plan).

## 3. PARTICULARITIES OF LOADING AND STOWAGE OF SCRAP METAL ON BOARD SHIPS

Such type of cargo is usually loaded by shore cranes using grabs, cargo being freely dropped into vessel's cargo holds. During loading, from time to time, Master requests that the cargo to be pressed, in order to compact the cargo stow and increase the remaining volume of cargo hold. This kind of operation consists in dropping of one "weight" from a high point above cargo hold.

In many situations, this procedure proved to be dangerous for ship. During pressing of cargo, hard pieces of scrap metal penetrated the ship's structure resulted in damage to structural members, ballast tanks and even side shell plating. In normal conditions, these kinds of damage are difficult to be ascertained, having in view

that inspection inside cargo holds is practically impossible, particularly if such damage occurs over the night.

In the worst case scenario, we can presume, for example, that during pressing of cargo the side shell plating was penetrated at location below water line and water ingresses into cargo hold. The vessel could leave the port, without any knowledge about the damage, and the final result can be catastrophic. Such situations often happen.

Another problem which arises is related to cargo stowage factor. According to International Maritime Solid Bulk (IMSB) Code, shippers must provide the master with accurate stowage factors of different parcels of cargo loaded. Most of the shippers involved in such transports evaluate the stowage factor of the scrap metal between 60 and 90 cbf/t, but these values are extremely wide. It is hard to ascertain exactly the total weight of cargo to be loaded on board vessel when this kind of information is provided to ship's Master. The more precisely is determined the weight of cargo, the more precisely is assessed the intact stability of ship.

A high risk involved in the transport of scrap metal in bulk is shifting of cargo. Being a "mixed" type cargo of various irregular forms and weights, with large broken spaces, it is vulnerable to shift during transport. This can happen not only in rough seas, but also during a normal heeling of vessel, like for example turning.

## 4. ESTIMATING THE POSITION OF THE CARGO'S CENTER OF GRAVITY

The inaccurate determination of cargo weight is reflected in an erroneous assessment of the position of the cargo's vertical centre of gravity. Hence, as the weight of the cargo is the main element influencing the ship's stability, it is very clear that the calculation and assessment of ship's intact stability is affected from the beginning.

The problem is more complicated because scrap metal, stored at loading places, are a mixture of metal pieces with different densities, i.e. stowage factors, so a proper estimation of weights and positions of centre of gravity is very difficult. Incorrect estimates can have serious consequences as the voyage progresses with reducing stability margins. Again, vessel's Master is in a difficult situation.

Normally, shippers must advice vessel's masters when and where are loaded on board vessel cargoes of different densities. This is practically impossible, because since from the collecting and then discharging at storage places, scrap metal is not separated by weight due to insufficient storage place or time, facilities and expenses involved.

As the problem of cargo density is not solved from the beginning, due to inaccurate information provided by shippers, the only one solution is that to be ascertained during loading. The solution is that the weight of cargo to be determined on board vessel, at least every 12 hours, by draught survey method. In this way, master will not only know the weight of cargo but he will also be able to ascertain the correct stowage factor by measuring the volume occupied inside the cargo hold. Moreover, in this way he will have a control of the position on board vessel of the parcels of cargo with different densities and can stop the loading operations when, for example, heavy cargoes are loaded on top of light cargoes. So, the only method which can be used for the assessment of a close value of weight, and in this case of stowage factor, remains a method which is well known that give a lack of accuracy.

## 5. DISASTROUS ENDING OF A VESSEL LOADED WITH SCRAP METAL IN BULK

A general cargo ship loaded a cargo of scrap metal in bulk. Vessel cast off the lines around midnight and shortly upon pilot was disembarked and altered the heading the vessel start "flopping" from side to side and finally developed a list to portside. Even after ballasting of the tanks in opposite side, i.e. starboard side, the list increased more to portside. As the list continued to increase, Master decided to drop the anchor. When it became evident that the situation is not under control, i.e. why the list is continuously increasing, the crew abandoned the ship. After few hours the vessel capsized and finally sunk.

The cargo loaded on board vessel consisted in pieces of metal of various shapes, types and weight. As these pieces were mixed and loaded in the same time, it was difficult to obtain a stowage factor for such a cargo and moreover hard to estimate when and in what position inside vessel's cargo holds the heavy cargo or light cargo/pieces was loaded.

On completion of loading operation the vessel has a large angle of list to starboard side. To adjust the list, vessel was ballasted in a "randomly manner", port and starboard tanks, without filling completely any of the tanks. As soon as ballast operations completed in one side, vessel starts "flopping" to opposite side.

The fact that vessel started "flopping" from side to side and finally developed a list was a clear indication that the vessel started to gradually loose the stability, probably being in a unstable equilibrium condition. This might be the evidence that the cargo's centre of gravity was considerably higher than had been assumed, so high, that the vessel's initial metacentric height was negative. This leading to the idea that the scrap metal that was loaded initially was a lot lighter than that which was loaded later on top.

The fact that the vessel completed loading with a large angle of list revealed that loading operations were not under control, in order to load the cargo as to finally put the vessel in upright condition. Investigations revealed that no stability calculation was carried out on board vessel during and upon completion of loading operation according to actual loaded condition.

## 6. CONCLUSIONS

Shippers should inform the vessel the stowage factors of the cargoes that are to be loaded. Moreover, a vessel's officer should closely monitor the loading in order to check the accuracy of the information supplied. Cargo weights rely on the accuracy of the information provided by shippers, which can be very variable, whilst

the location of these weights within the spaces of cargo holds depends to a considerable extent on the judgement of the ship's staff.

Ship's officers who are responsible for loading should ensure that any assumption about cargo's centre of gravity is valid. Daily records of the loaded quantities should be kept in order to assess the weight and the position of the cargo loaded and furthermore the next sequences of loading. On completion of loading, the vessel must be, as much as possible, in upright position.

Ballast condition on board vessel should be checked regularly and soundings should be recorded. Preferably, the vessel to be, at the commencement of loading, either with ballast tanks pressed up or with ballast tanks empty. No slack tanks are allowed in order to avoid the negative influence of free surface effects on ship's stability. When correcting angles of heel, care is necessary to avoid the danger of inappropriate ballasting, especially when the vessel has an angle of loll caused by a negative metacentric height. The effect of free surface and the vertical transverse movement of the centre of gravity have to be taken into consideration. A wrong interpretation may lead to disastrous consequences.

Liquid weights, as fuel, ballast and water, are based on the tank soundings, which are affected by trim and list, and, although ships are supplied with sounding correction tables that take these factors into account, there is still scope fore some errors in the values.

Stability calculations should be carried out at the beginning, during and upon completion of loading operation to ensure all the time that vessels comply with stability criteria as stated in their "stability book".

It is very important to have in mind that the righting moment is the true measure of a vessel initial stability and not GM alone. Even so, complying with stability criteria does not ensure immunity against capsizing. Master should therefore take the appropriate actions and exercise prudence and good seamanship heaving regard to the season of the year, weather forecasts, navigational zone and cargo type. When the calculated final KG is close to minimum stability criteria to have in mind that the calculated GM and dynamic stability determined from GZ curve could be more in error.

The minimum stability criteria apply to the complete diverse range of commercial vessels may be inadequate for a particular ship in a particular situation. Smaller ships usually require a greater minimum GM for safety than larger vessels for the reason that even without taking the displacement into account, smaller ships are usually at risk of capsizing in heavy seas than larger ships with the same upright GM and hull form, as the resistance to increasing angles of heel increase with hull size.

The responsibility of the ship's officers is for understanding the behaviour of the vessel and they should always be ready to adjust its stability for the circumstances that the ship is in at the time. Appropriate values between calculated and observed drafts is an evidence that the estimated weight and its longitudinal distribution are reasonably accurate, but there is no check on the calculated KG, other than by any list due to a weight loaded off centre. If such list seems excessive for the estimated asymmetry in the athwartships weight distribution, then this would suggest that the ship is more tender than probably desirable.

An important aspect is also related to the lightship weight and its distribution which changes over years through important alterations to the ship construction, accumulation of paint, stores and steel wastage.

## 7. REFERENCES

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