# AVOIDANCE OF COLLISION RISK

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**ABSTRACT**

Over the past decades there has been a continuous increase in the public concern about general risk issues. The consequence of this trend is that whenever a catastrophic accident occurs - and receives media coverage - there is an immediate political and public demand for actions to prevent the same type of catastrophe in the future. Many of the past improvements in safety of marine structure have been triggered by disasters but there is a change in this trend nowadays.

The maritime society is beginning, although slowly, to think and work in terms of safety assessment of individual ships instead of the much generalized prescriptive regulations which have evolved over the past 150 years.

In line of these aspects it is clear that rational procedures for evaluating the consequences of accidental loads are highly desirable, not to say necessary.

Collision risk or danger usually occurs in high sea, when navigation is led by Officer on Watch, as well as by traffic devices, when the breaking of rules is more significant: the rules have not been observed and/or efficient collision avoidance measures haven't been taken in due time.

Collision risk is an imminent risk, which requires immediate and firm measures for the re-establishment of the safety situation with respect to the collision with the target or other vessel that could bring about human accidents, serious damages to the vessel's hull, pollution, wrecking, scuttling, etc.

Collision risk is directly related to the „preventing method" of collision risk avoidance by assessing the collision probability together with the potential consequences. It is specific to „I" intersection angle of collision free courses.

**Keywords:** *ship, collision, avoidance, risk.*

## 1. INTRODUCTION

When talking about avoidance of collision risk, we mainly must refer to Rule 15 - „Crossing courses", when the determined **„**closest proximity of approach (CPA)**"** indicated an imminent collision and the burdened vessel shall insure the avoidance by increasing the CPA to the value of the nCPA, the value of the new closest proximity of approach, expressed in miles, established as such by the captain, which can occur in one of the situations described below. This situation covers any value of collision angle „C".

## 2. AVOIDANCE OF COLLISION RISK

At any moment, if OOW determines a slightly fluctuant bearing, almost constant, and a decreasing distance with respect to the target, it is possible to immediately calculate, in maximum 6 minutes, the distance at which the vessel will pass the target CPA, calculated through the distances „m" and the bow bearings „Ab" tangent to the circle with safety range to starboard or port, which means the necessary angular deviation.

In the case of collision danger, the data can be graphically calculated in a triangle with fixed angles or on the manoeuvring board, where the relative movement vector passes through the centre of the board - the target, meaning the CPA = zero.

All the information necessary to the avoidance is solely based on the own observations and is enough if properly used, which means that the determination of the elements regarding the target's movement is no longer strictly necessary. Currently, the AIS - Automatic Information System - device allows the electronic entry in the target's navigation system, thus obtaining information on its identity and elements of motion, which makes the precision of the OOW calculations beyond any doubt.

By seeing the distance and the bearing of the other vessel on radar, or by assessing it visually or by sound alerts, any OOW is able to establish the initial situation - first of all:

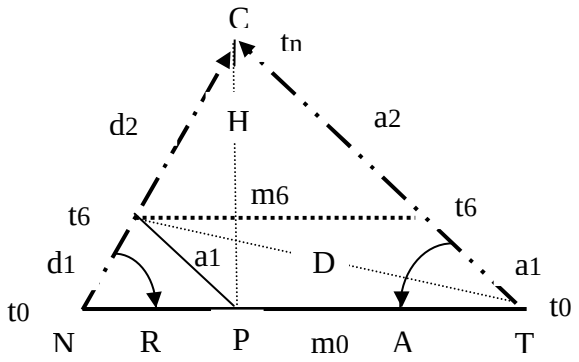
a. constant bow bearing or with an insignificant fluctuation, rapidly decreasing distance: it means imminent collision danger;
b. slight fluctuation of the bearing, decreasing distance - this means that one of the vessels:

(1) "gains" bearing – passes on the other vessel's bow side;
(2) „looses" bearing – passes on the other vessel's stern side;
(3) there is a risk and therefore it is highly important to check the real distance between the vessels
(4) the burdened vessel – mainly, and the privileged one secondarily –shall reach a new closest proximity of approach, both vessels having responsibilities clearly stipulated by COLREG, Rule2.
(5) constant bearing, constant distance – vessels on parallel courses on the sea;
(6) constant bearing, increasing distance – the vessels bear away one form the other, there is no risk.

Noticing any kind of light on the sea or hearing the sound signals of a ship which is closer than the regular

distance but at least equal to the ship's turning range, allows the avoidance „in extremis" of any kind of collision, including by turning to stern.

If there is a better visibility or the radar devices are working, it is rather hard to find excuses for a collision in front of the juridical and insurance bodies, and the privileged party will bear at least 10% of the damages, even when the guilty captain was on duty.




Other graphical constructions of triangulation are also possible

**1. $c^2 = a^2 + b^2 - 2ab$** cosC

**2. Sin A/ a = sin B/b = sin C/ c**

Figure 1 Collision Triangle

*2.1 The case of reciprocal or nearly reciprocal courses*

The avoidance of collision in the case of reciprocal or nearly reciprocal courses is provisioned by Rule 14:

- When two vessels meet on reciprocal or directly reciprocal courses (the vessel's courses are marked on the map), each vessel shall alter its course to starboard, thereby keeping the other ship to the port side.

Such is the case of a vessel which sees the other ahead or nearly ahead, so that:

a. by night it will see the masthead lights of the other in a line and/or both sidelights;
b. by day, it will see the other vessel's corresponding bearing (estimated or provided by ARPA - NA).
c. If a vessel is in any doubt as to whether such situation exists, it shall assume that it does, and act accordingly.

*2.2 The case of almost reciprocal courses*

The situation of almost reciprocal courses could be met anywhere:

(1) in open sea – the target must be discovered in time and avoided;
(2) in narrow channels– according to Rule 9, see navigation in Bosporus, Dardanelles, English Channel and Dover narrow, etc., now with well established rules;
(3) on rivers – according to local regulations. In this case, it is worth noticing that the vessel's speed depends on the currents' velocity with their immersion and suction effects.

The maneuver recommended by COLREG is that each vessel should alter its course to the right, until it reaches the safety distance. When in doubt, alter the course a little more to starboard.

Given the vessel's bearing and the aspects of 0 - 4.5˚ the table for small angles shall be used for computations, when sine and tangent have approximately the same values, under 10% of the values of visibility distances.

*2.3 The case of overtake*

Collision avoidance when overtaking is provisioned by Rule 13 of COLREG and it states:

a) Notwithstanding any other provision contained in part B, the vessel overtaking on other one shall keep out of the way of the vessel it is overtaking (Rule 16 is not privileged).
b) The overtaking vessel is the one coming up with another vessel, from a direction (stern sector) more than 112.5 degrees, which means that it is in such position, that by night it could only be able to see the stern light of that vessel but neither of the sidelights.
c) If a vessel can't establish for certain whether it is overtaking another, it shall assume that it is and make a maneuver accordingly.
d) Any subsequent alteration of the bearing among the two vessels shall not make the overtaking vessel consider that it crosses the path of the latter vessel.

This situation has also led to various disputations regarding the real courses followed by the two vessels - and especially regarding the moment when each of them determined the relative position - distance bearing, as follows:

- by day, the situation depends on the interpretation of the situation by night, when the vessel is only able to see the stern light , but neither the masthead lights nor the sidelights, with their descending intensity, outside the angle of 112.5 degrees, as follows:

1) from the masthead: 112,5 + 5 = 117,5 degrees; this sector is larger than the one of the sidelights;
2) from the sidelights: 112,5 + 3 degrees = 115,5 degrees; not taken into consideration;
3) stern: 180 – 117,5 = 62,5 degrees in each of the sides.

The vessel which is only able to see the stern light+ / – 62,5º and by day– correspondingly, alters its course and overtakes, thus avoiding any risk of collision.

Since the masthead lights exceed more than the red lights towards stern, the invisible sector of the masthead lights is 2 x 117,5 + 235 degrees, which means that their invisible sector is 360- 235 = 125 degrees, which represents the stern sector, exclusively visible for stern lights, or 125 : 2 = 62,5 degrees stern bearing in both sideboards.

Given the above, COLREG strongly recommends that the vessel which is overtaking should be forced to bear away from the overtaken vessel. When in doubt, you should bear away even more. If you are an overtaken vessel and maneuver in order to bring the other vessel towards the stern, you will loose the quality of overtaken vessel!

*2.4 Crossing courses*

It is the most frequent situation, especially in high sea and Rule 15 of COLREG clearly stipulates that: if there is a risk of collision, the vessel which sees in its starboard other vessel must keep out of the way and, if possible, avoid the other vessel's stern side.

In this case, everything depends on the value of the first determination of CPA: is it or not safety CPA, in which situation only the captain can decide by Standing Order or, at the most, by Night Order.

In this situation, the vessel seeing the target in its starboard sector comprised between 3º bow (directly opposing) and 62.5º stern (can't be overtaken) must keep out of the target's way. Normally, one should pass on the target's stern side.

If there is a speed limit or the conditions allow the passing on the bow side, one should take into consideration the tension laid upon the target.

*2.5 Conduct of vessels in restricted visibility*

Rule 19 applies when the vessels „are not in sight of one another", when they are navigating near or in an area with restricted visibility, when the targets are to be discovered only with the radar.

Rule 3 stipulates that „restricted visibility" is that situation when the vessels are in sight of one another, although only one can be visually noticed by the other, if - according to the title of Rule 3, the context doesn't stipulate otherwise.

This situation has raised many disputes: the limits of the visual discovery distance and the reasons why „only one vessel could be visually noticed".

The judicial practice keeps record of such situations when the visibility was restricted to 2-3 miles, had an „internal gap", and the vessels could mutually see one another at several cables, thus being forced to maneuver as shown below and take more exigent measures than in the case of the first vessel which discovers the other. Therefore, as a rule, a vessel which sees a target only on radar, must navigate at the minimum velocity - so as to be able to immediately stop on a distance equal to half the visibility distance (counting on the fact that the other vessel shall act in the same manner).

This rule also introduces for the first time the notion and abbreviation „closest proximity of approach (CPA)" followed, after the avoidance calculus has been made, the notion and abbreviation of „new closest proximity of approach (nCPA)".

We get back to the correct understanding and application of Rule 2 - the collision shall be avoided, even at the risk of departing from the present rules"!

## 3. CONCLUSIONS

The avoidance maneuver shall be deemed to be concluded only when the target has been completely overtaken and the risk has been fully cleared.

One should bear in mind that, usually, if the maneuver is delayed, the privileged target could:

a. be hit in her starboard, if she wants to pass through the target's bow;
b. hit the target's port, if the vessel wants to pass through the target's stern.

Location of the impact spot depends on the vessels' lengths and the last minutes of the maneuver!

The most dangerous impact is the one which occurs in the area of the berths, the mess and the places where the crew fulfills its activities and leads to life loss or severe bodily harm, as well as the impact followed by the breaking of the skin of major compartments: engines, cargo tanks, or stores.

The bow - bow collision can also have serious consequences, especially on rivers, while the bow - stern collision occurs more seldom.

Any avoidance maneuver means - first of all, leaving the course marked on the map and marching on at least two segments (course lines, „CL").

Navigation occurs through map calculations, even electronic map, with courses determined with the use of the compass and subsequently turned into real courses and through covering the distances at high speeds.

The return on the course marked on the map (see the figure above) can also consist of one or more segments, a march for which everything is made based on reckoning graphical calculus.

The march on several course lines, outside the one marked on the map, represents a delay of the plan and therefore these maneuvers shall be briefly recorded in the sailor's book, as motivation for not fulfilling the marching plan during that watch, while the avoidance decisions shall be well grounded by the details recorded in the „OOW Register - scrab log". The return must occur during the own watch, by choosing a direction ahead the XTD beam.

It is worth reminding that the course marked on the map is the planned one, deemed by the captain as the safest from wrecking and other situations of this kind, as well as the shortest way to destination.

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