



Interaction Risk in Narrow Channels



Written by
Captain John Taylor and
Taslim Imad of the
Loss Prevention Team



Background

The Marine Safety Investigation Unit (MSIU) of Transport Malta has published investigation reports for two accidents which took place in narrow channels. Details of the two events indicate that the accidents were caused by interaction.

The first incident, the grounding of *M.V. APL Danube*, took place in the Suez Canal, Egypt with a pilot on board. *The APL Danube* was approaching the km 133 mark in the canal when the vessel suddenly sheered to starboard. In an attempt to correct the heading the helm was ordered hard over to port and speed was increased, the vessel however continued to swing to starboard and ran aground. MSIU stated in their report, as an immediate safety factor, that “*The vessel suffered loss of directional power due to bank effect, since she was in close proximity to the Eastern bank of the Suez Canal*”.

The second incident, a collision, took place in the Ghent-Terneuzen Canal, Belgium, when the inward-bound *M.V. Klara* sheered to port across the canal, colliding with the tug *Braakman* that was assisting outward-bound *M.V. Posidana*, a vessel constrained by its draught. The *Klara* was originally navigating in the middle of the canal but had altered course slightly to starboard to provide more sea room to the *M.V. Posidana*. Just after passing the outbound barge *Imperial Gas*, that was ahead of *M.V. Posidana*, the pilot on the *Klara* started to very slowly alter course to port, to align the vessel's heading with the canal channel track of 168°, parallel to the shoreline. The manoeuvre was initially uneventful until, with the *M.V. Posidana* bow still about 450m away, the vessel started to turn quickly to port, eventually colliding with the tug *Braakman* and the *M.V. Posidana* then ramming the starboard side of *M.V. Klara*.

This Risk Alert draws Members' attention to the risks when vessels are navigating in narrow channels and highlights factors that give rise to this effect.

Introduction

In simple terms interaction takes place when a ship gets too close to another ship, when it gets too close to the seabed or riverbed, or when it gets too close to the bank of a channel or river.

Interaction can therefore be thought of as: –

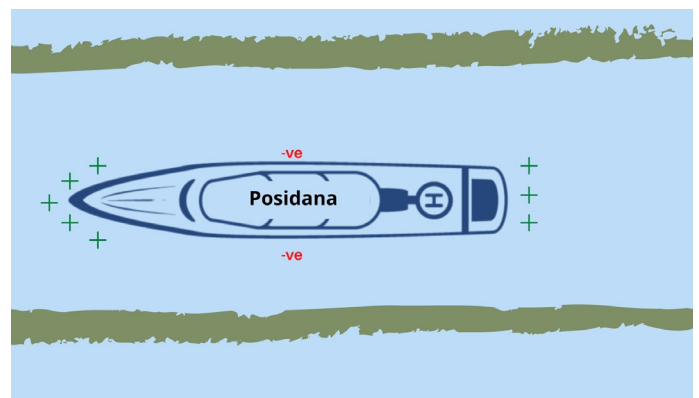
- Ship to Ship Interaction
- Ship to seabed (Squat); and
- Ship to riverbank (Bank Effect).

In both these accidents vessels were close to the riverbank, and this Risk Alert will examine these three features of Interaction in greater detail.

1. Ship to Ship Interaction:

To understand the cause of interaction it is important to appreciate the hydrodynamic effects associated with the movement of a ship's hull through the water.

As a ship moves ahead, there is a build-up of water pressure at the bow. As fluid moves and accelerates along the side of the hull, there is an associated fall in pressure at the side in line with the Bernoulli principle, concerning the relationship between fluid velocity and pressure. At the stern of a ship there is again an area of increased water pressure associated with the propulsive effect of the vessel's engine.



Posidana illustrating areas of positive and negative pressure around a vessel

These areas of high and low pressure are always present when a vessel is underway even in open water, but their interactive effect is much more noticeable when waterflow is accelerated. Such acceleration can result from either reduced lateral clearance from a bank, or another vessel, or reduced vertical clearance from a channel bed. There is also an interactive effect when vessels pass close to each other as the areas of high pressure at the bow and stern connect.

Consequently, where two vessels are navigating in a narrow channel, ship to ship interaction will be noticeable when they are either meeting in a head-on situation or



STEAMSHIP MUTUAL Risk Alert



where they are overtaking one another.

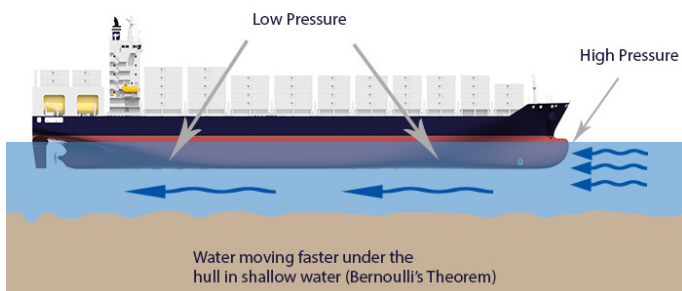
Interaction in a head-on situation involving vessels of a similar size is less likely to have a dangerous effect, as generally the bows of the two vessels, where there is a positive pressure, will repel each other and similarly, the positive pressure at the stern of each vessel will repel.

However, as the bow and stern of a vessel repel each other there could be a secondary ship to riverbank effect of which Mariners need to be aware, this is discussed in part 3. Interaction in a head-on situation could be much more critical when a smaller vessel is passing a larger vessel, as the bow of the smaller vessel could be attracted toward the low pressure at the side of the larger vessel and cause an accident. It is important therefore that bridge teams are alert to this potential situation.

Interaction between the vessels is expected to be stronger and more hazardous in an overtaking situation due to the pressure differences between the ships' sides. It is likely in this situation that the smaller vessel may take a sheer into the path of the large vessel. Another possibility is that when the vessels are abeam of one another the bow of each vessel may turn away from the bow of the other causing the respective sterns to swing towards each other.

2. Ship to seabed (Squat):

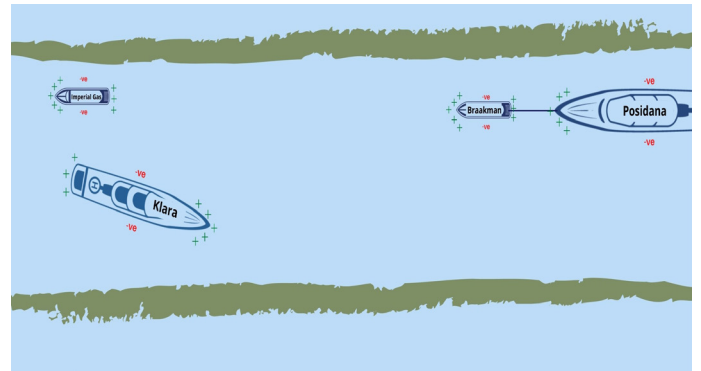
This occurs when a vessel proceeds too fast in shallow waters. In accordance with Bernoulli's principle, the increased flow between the vessel's keel and the seabed creates a low-pressure system beneath the vessel with a consequential change in the vessel's draught and trim, reducing the Under-Keel Clearance (UKC). In squat, the vessel's turning circle increases as the effectiveness of rudder helm decreases and stopping distances and stopping times increase.



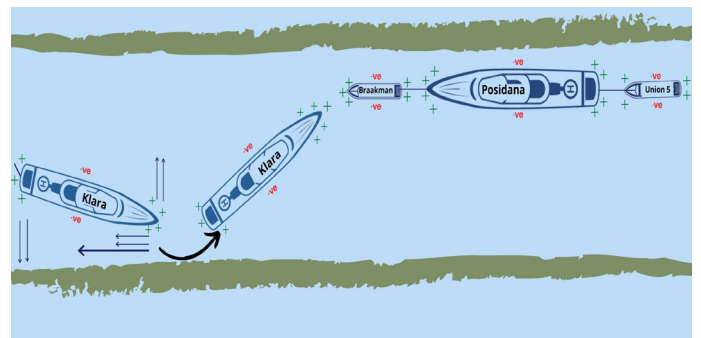
Source - <https://www.myseatime.com/discussion/squat>

3. Ship to riverbank (Bank Effects):

As the ship navigates in a narrow channel, the water between the bow and the nearer bank builds up a high pressure resulting in the bow being pushed away from the riverbank, the phenomenon is called Bank Cushion. Similarly, due to low pressure at the stern of the vessel the stern is sucked into the riverbank, explained by Bernoulli's principle, and this phenomenon is called Bank Suction. The combined effect of Bank Cushion and Bank Suction may cause the vessel to take a sudden and decided sheer towards the opposite bank as appears to have happened with the *M.V. APL Danube* in the Suez Canal and the *M.V. Klara* in the Ghent-Terneuzen Canal.



Klara and Posidana Incident - Klara's pilot adjusted course to starboard towards the bank for Posidana after passing Barge Imperial Gas

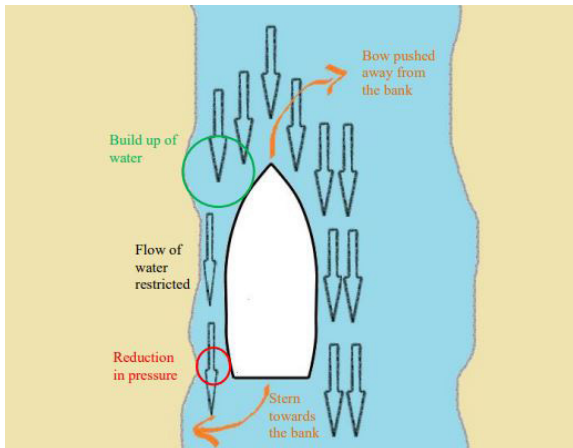


Klara and Posidana Incident - At Marker 9.6 kilometre, pilot started to turn vessel slowly to port to attain Canal course of 168° (parallel to the shoreline). Whilst initially uneventful the Klara continued to swing to port (possibly cause by "Bank Cushion Effect") and collided with tug Braakman, pushing her against the opposite bank.

In the case of *M.V. APL Danube*, she was close to the edge of the canal, and due to a negative pressure build-up at stern, caused by Bernoulli's principle, she took a sudden sheer to starboard before eventually grounding.



STEAMSHIP MUTUAL Risk Alert



Source – page 26 of MSIU report 08/2020 (M.V APL Danube)

In the case of *M.V. Klara*, navigating to starboard of the canal close to the riverbank, providing more sea room for the deep draught *M.V. Posidana*, when the pilot ordered helm to port, bringing the vessel parallel to the shoreline, the bow appears to have experienced Bank Cushion effect, pushing the bow to port, which, when combined with the port helm instruction resulted in the *M.V. Klara* quickly sheering off to port and the collision with the tug *Braakman*.



VTS image shortly before *M.V. Klara* takes the sheer to port.
Source – page 5 of MSIU report 09/2020

Possible Causes

Every vessel's manoeuvring characteristics are individual to itself. Every vessel also behaves differently in shallow waters and this can be dependent on the manoeuvring characteristics of the vessel and be affected by the design of the hull, her draught and trim in relation to the available depth of navigable water, type of equipment installed on board (overall engine power and rudder type), loading condition of vessel (i.e. ballast or laden) and whether the vessel has a list or is upright. All these

conditions can impact the vessel's manoeuvrability and the bridge team need to be aware of their vessel specific characteristics in order that they can take timely and appropriate actions to reduce the effect of interaction. For example, the deep draught vessel will have a slower response to speed reduction and to her rudder by comparison to a smaller vessel with a shallow draft, similarly a twin-screw ferry with backer rudder will behave differently to a single screw vessel with a normal rudder. In addition to the above vessel characteristics the width of channel, depth of water, local environmental conditions and the state of tide and current will also affect a vessel's manoeuvring capability.

Preventive Actions

The Club cannot over emphasise the importance of properly understanding and appreciating the phenomenon of Interaction when navigating in a narrow channel, and for the bridge team to be fully aware of their vessel's characteristics. Navigation in narrow channels should be carried out at slow speed with due regard to the local hydrographical conditions. A vessel's speed should be appropriate for the depth of water, such as to adequately maintain control, with sufficient contingent power available to aid the rudder if necessary. If a reduction in speed is required, it should be made in good time, in anticipation of the possible effects of interaction. A low speed will lessen the increase in draught due to squat as well as the sinkage and change of trim caused by interaction itself. Depending upon the dimensions of the vessels and the channel, speed may have to be restricted. When vessels approach each other at these limiting speeds, interaction effects may be magnified, and a further reduction in speed may be necessary. Those in charge of the handling of small vessels should understand that more action and greater vigilance may be required on their part, particularly when passing large vessels which may be severely limited in the actions that they can take in a narrow channel.

Regardless of the relative size of the vessels involved, an overtaking manoeuvre should only commence after the vessel to be overtaken has agreed to the manoeuvre.

Documentation & Reporting

[MSIU Report No. 08/2020 of Transport Malta – M.V. APL Danube](https://mtip.gov.mt/en/msiu/Documents/MV%20APL%20Danube_Final%20Safety%20Investigation%20Report.pdf) https://mtip.gov.mt/en/msiu/Documents/MV%20APL%20Danube_Final%20Safety%20Investigation%20Report.pdf

[MSIU Report No. 09/2020 of Transport Malta M.V. Klara](https://mtip.gov.mt/en/msiu/Documents/MV%20KLARA_Final%20Safety%20Investigation%20Report.pdf) https://mtip.gov.mt/en/msiu/Documents/MV%20KLARA_Final%20Safety%20Investigation%20Report.pdf

Suggested References

MGN 199 (M) Dangers of interaction
Ship Stability by Captain D.R. Derrett