Linnéuniversitetet
Sjöfartshögskolan

Advanced Shiphandling

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2012

Innehållsförteckning

Avsnitt	Innehåll	Sida

Per-Åke Kvick, nov 2002

"Manövern är en Vettenskap, som lär att, med eller utan seglens och vindens tillhjelp, med fördel regera ett ensamt skepp vid förefallande händelser till fart, vändningar eller stillaliggande; och förekomma härvid många handarbeten, hvilkas tillämpning inbegripes under namnet Sjömanskap.
Manöver kallas äfven hvar och en särskild rörelse som verkställes med ett skepp; manövrist är den som verkställer".
(Konungens stabsadjutants och riddarens Fabian Casimir Rosvalls försök till Hjelpreda för Nybegynnare i Skepps-manövern, Stockholm 1803)

Några visa ord på vägen

The six most common words when you are practicing ship handling:
- **Go Slow,**
- **Think Ahead,**
- **Be Patient**

Watch the grass…
To watch a ship manoeuvre, should be as interesting as watching the grass grow.
(Instructor MMA)

If there is nothing to do - Do nothing
(Instructor MMA)

The art of Shiphandling involves the effective use of forces under control to overcome forces not under control.
(Charles H. Cotter, The Master and His Ship)

The mark of a great ship handler is never getting into a situation that requires great ship handling
(Fleet Admiral Ernest King)

How to become a competent ship handler:
- **Understand forces that influence ship's movement**
- **Ability to use forces to your advantage**
- **Know the manoeuvring characteristics of your ship, effects of propellers and rudders, effects of various sea conditions**

Detta kompendium är avsett att användas i kursen "Avancerad fartygsmanöver" för SK och består av ett antal olika texter från olika källor, se källförteckning i slutet av materialet. Språket i materialet är till viss del blandat då både svenska och engelska källor har använts och där jag valt att behålla den engelska texten. Vissa texter har kompletterats med egna kommentarer och bilder för att ytterligare klargöra texterna.

P- Å Kvick

Inledning manövrering

Fartygsmanövrering handlar huvudsakligen om att ha kontroll på de krafter och moment som påverkar fartyget, i synnerhet vid manövrering i låga farter. Dessa krafter kan vara av oss kontrollerade eller externa - okontrollerade.

Av oss kontrollerade	**Okontrollerade**
Huvudmaskin Roder Förtöjningar Ankare Bogserbåtar Hjälputrustning, t ex bogpropeller	Vind Ström Is Hydrodynamiska effekter orsakade av grunt vatten Vågor dyning

En förståelse för dessa krafter och hur de verkar ger oss större möjligheter att lyckas med den manöver som vi avser göra. Nedanstående exempel är endast till för att belysa omfattning och storlek på dessa krafter.

Hur ett fartyg som ligger fritt uppför sig bestäms av de krafter som verkar på det. Några av dessa krafter kan kontrolleras av navigatören medan andra, yttre krafter, ej kan kontrolleras. För att uppnå en önskad manöver hos fartyget måste navigatören använda de, av honom, kontrollerbara krafterna på ett sådant sätt att de icke kontrollerbara krafterna övervinns och den önskade manövern kan genomföras.

Om de okontrollerade krafterna ej beaktas i tillräcklig grad eller att de verkar starkare på fartyget än de kontrollerbara, kan den önskade manövern ej genomföras eventuellt saboteras. Det är därför nödvändigt att navigatören beaktar dessa yttre okontrollerbara krafter så att man inte påbörjar en manöver som ej går att genomföra/fullfölja.

Den som manövrerar fartyget bedömer normalt verkningarna av de olika krafterna genom att iaktta fartygets rörelse, medan krafterna verkar. Blir manövern inte den förväntade genomförs lämpliga förändringar, t ex ökat varvtal, större rodervinkel etc, så att manövern kan genomföras. Antalet korrektioner under en manöver bestäms i hög grad av navigatörens erfarenhet- skicklighet. Emellertid är det som påpekats många krafter som samtidigt verkar på fartyget och det kan ta lång tid att erfarenhetsmässigt uppnå tillräcklig säkerhet i manövreringen. Det är därför önskvärt och nödvändigt att ha viss teoretisk kunskap om de relativa storleksförhållandena av dessa krafter och om det sätt som de verkar på fartyget.

Med kunskap kan det vara möjligt att utnyttja de yttre krafterna, för den önskade manövern, istället för att kämpa mot dessa

1. Ship handling in heavy weather

Fig. 1 Ship in violent storm

QE2 Hit by Tidal Wave in Atlantic

London, September 15 -- The luxury line QE2 was hit by a 95-foot tidal wave while crossing the Atlantic Ocean last Monday night. The giant wave was the result of hurricane Luis' passage through the Atlantic.

As the QE2 hit the wave bow-on, most of its 1,200 passengers slept. The wave's crest was at the height of the bridge on the QE2. Nobody was injured as the ship plowed into the wave south of Newfoundland, near the Grand Banks.

The QE2 owners reported that the ship was in no danger at any time and only minor repairs were necessary when it arrived in New York 8 hours behind schedule.
MariNet News

Vågen hade tidigare passerat utanför USA´s ostkust och vågbojar hade registrerat våghöjden till 99-foot.

1.1 Seascape

The experienced seaman and ship designer know just what the sea at its worst can do to the structure of a ship. Overwhelmed by the sea is a warning to both seafarer and architect that such unforgiving force must never be underestimated, and may not yet be fully understood.

Let us look at a large cargo ship on a winter passage across the North Atlantic from Europe to North America. Her Master will have received regular weather reports and will have plotted his route in an effort to minimize the effects of heavy weather, but such is the depth and frequency of the giant depressions that remorselessly track across the Western Ocean in winter, that it is unlikely that he can avoid their effects entirely. Sooner or later the ship will find itself laboring against the worst that nature can throw at it. It is on such occasions that the complex structure of steel and systems which make up the modern ship will be tested to the limit. While the Master can adjust his speed and course to minimize the effects of the storm, his job is to get to his port of destination without too much delay, balancing the risk of damage against the cost of a late arrival, trusting in his skill as a ship handler and the strength of his ship.

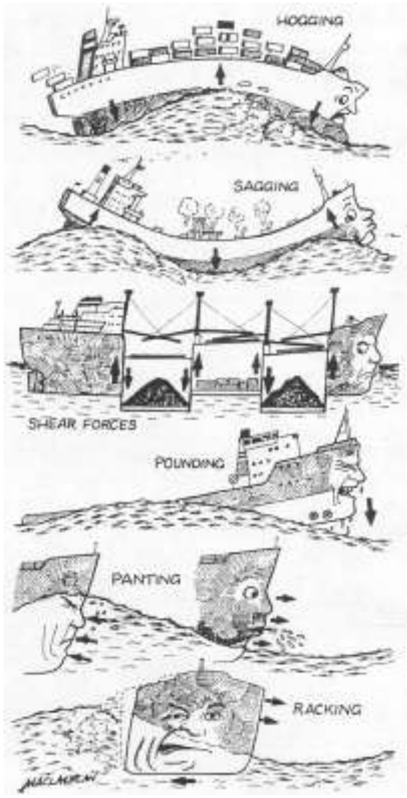


Fig. 2 Different influence of a ship in rough weather

1.2 Rough Weather

A ship encounters a storm with heavy winds and high waves. Some of the cargo is lost overboard and some sustains damage. Under these circumstances, the ship owner may feel that he should not be blamed for the damage, as his vessel was in good condition and the cargo was secured as well as it could be. As shall be shown below, he may find that he has a hard time succeeding in his efforts to avoid liability. However, it is not impossible, and, in certain legal systems, it is even quite feasible.

Background

Historically, the ship owner was strictly liable for damage to the cargo. During the 19th century, they started to insert clauses into the contracts whereby they were relieved of liability to a large extent. 'The exclusions went so far as to make the ship owner liable only for the collection of freight', (SOU 1990:13). At this time, England had a strong ship owning community, whereas a large number of cargo owners were to be found in the U.S.

Possibly as a consequence of this, the matter of carrier liability came to be interpreted differently, with the U.S. courts being inclined to overrule the exclusion clauses inserted by the ship owners. This difference still exists to a certain extent.

A compromise was reached in the U.S. in 1893 with the introduction of the Harter Act.

The ship owner became liable for his negligence, but was not allowed to exclude liability. The act also gave the ship owner a defence against liability for damage caused by negligent navigation and management of the ship.

These regulations were further developed in the Hague and the Hague-Visby Rules, in which the ship owner was given a 'catalogue' of defences, one of them being 'Perils of the Sea'.

'Perils of the Sea'

The basic obligation for the carrier, according to the Hague and the Hague-Visby Rules, is to exercise due diligence in making his ship seaworthy, both before and at the beginning of the voyage. During carriage, he must also handle and care for the goods properly and carefully.

Provided that the carrier has been able to prove that he has fulfilled these obligations, the rules give him a catalogue of defences.

Assuming the carrier can prove that the vessel was seaworthy at the beginning of the voyage, neither the carrier nor the ship shall be responsible for loss or damage arising or resulting from perils, dangers and accidents of the sea or other navigable waters. In the
Inchmaree' case of 1887, it was clarified that this exception only covers liability for damage caused by dangers specific to the sea. This is an important distinction, since weather damage that could easily occur on land, such as rain or lightning, is not covered. The most common situation in which a carrier may be inclined to invoke the defence is when the vessel has encountered heavy weather during the voyage.
As shall be shown below, this is normally very difficult to prove. However, there are certain situations when the defence can be successfully invoked against a claimant. For example, it can be used to defend claims for damage caused by the vessel running aground in fog, or by collisions where the other vessel was negligent.
One should note that the carrier could also invoke this defence against damage resulting from actions taken to avoid a peril of the sea, but not against normal wear and tear.

Interpretations in certain legal systems
The interpretation of this defence differs in one important aspect between different jurisdictions and legal systems. The issue is whether this defence can be successfully used where the weather was harsh, but still foreseeable and expected under the circumstances of the voyage. In many countries, the weather needs to be exceptional and unexpected for the defence to be applicable.
"The exclusions went so far as to make the ship owners liable only for the collection of freight."
"It is not the level of harshness of the weather that sets the limit but rather the relation between the expected weather and the actions of the carrier."

Fig. 3 Shifting cargo on a ship in a storm

Since it is possible to forecast most weather situations, this will limit the scope of the defence quite substantially.
Very generally, it can be said that U.K. and Australian courts have tended to allow the owner to discharge liability in a wider range of circumstances.
German, Scandinavian and U.S. courts have only allowed the defence when the weather has been extreme and out of the ordinary for the specific circumstances.
An example of a more generous application of the defence can be found in the recent Australian case of the BUNGA SEROJA. The vessel experienced force 11 gales during a passage of the Great Australian Bight from Burnie to Fremantle. Because of the severe weather, she lost containers overboard and experienced damage to a cargo of steel coils. It was accepted that the vessel had been seaworthy before the voyage.
The gale was forecast, and could be considered normal in the circumstances. The court still allowed the carrier to invoke the defence and argued that in principle, the decisive factor is whether the carrier has exercised due diligence to avoid the consequences of the perils of the sea. In this way, it is not the level of harshness of the weather that sets the limit but rather the relation between the expected weather and the actions of the carrier.
The opposite approach was adopted in the U.S. in the case of Thyssen Inc. v. S.S. EUROUNITY. The vessel encountered Beaufort 10-11 winds and 10-11.5 metre waves during a winter crossing of the North

Atlantic and suffered damage to the cargo. The U.S. court did not accept that the carrier should avoid liability by invoking the perils of the sea defence. According to the court, one can only invoke a peril of the sea when the circumstances are of an extraordinary nature and cannot be avoided. The conditions in this case were not unforeseeable for this particular voyage.
The same thinking can be found in Germany. The courts focus on the question of predictability or what is foreseeable. The carrier may not invoke the defence against perils that can be expected on each particular voyage that a seaworthy and properly stowed vessel should be able to withstand. There is no comprehensive definition of the concept, since it depends heavily on the circumstances in each particular case.
However, it is not enough for the peril to be unusual. It must be impossible to foresee under the circumstances.
The phrase 'peril of the sea' has been removed from the Scandinavian Maritime Codes. The issue has, however, been raised in several recent cases when the carrier has tried to avoid liability by proving that he has not acted in a negligent manner. For the carrier to be able to succeed in invoking the perils of the sea defence, the weather must be extremely rough. The courts concentrate a great deal on the level of the wind and whether it was possible to foresee the conditions. From previous cases, one can draw the conclusion that there should be winds in the region of Beaufort 11-12 before the courts consider allowing the carrier to avoid liability.

Conclusion
In most legal systems, the carrier may be able to avoid liability for cargo damage caused by perils and dangers specific to transporting goods at sea. The idea behind this is that the owner of the cargo should carry some of the risk, as the shipowner is putting his vessel in jeopardy for the common good. In theory, this defence would seem to be quite extensive and to cover a large number of possible claims. In certain situations it will, in fact, allow the carrier to avoid liability. However, in most situations when a carrier might try to rely on this defence, it is of little or no value. In most legal systems, the courts focus on the level of heavy weather. They demand that the conditions have to have been exceptional and impossible to predict under the circumstances. For the carrier, it is almost always impossible to prove this. The position in the U.K. and Australia is different, allowing the defence to be invoked in a wider set of circumstances. The reason for this difference could possibly be traced back to the historic relations between ship owners and cargo interests on the Atlantic trade route during the 19th century.

"One can only invoke a peril of the sea when the circumstances are of an extraordinary nature and cannot be avoided."
(News, the Swedish club 2/2002)

1.3 Heavy weather damage – near casualty
Ship type: Tanker for Oil
Size (grt): 80000-90000
Year of build: 1992
Course of events
The ship was struck by a freak wave in a North Atlantic winter storm. It sustained substantial damage to the forward deck area and stores areas, leading to flooding of the forward compartments.
The vessel proceeded safely, but with a heavy forward trim, to a port of safe refuge for survey and repairs.

Extent of damage
The following damages were noted:

- The forward compartment access dog house had its watertight door torn off and washed overboard, resulting in flooding of the entire forward space from the keel and up to the main deck.
- The stores hatch cover was torn open, breaking the dogs and was "formed" around the hatch coaming by water pressure.
- The ventilator at the base of the forward mast was damaged beyond repair.
- Two small goose neck ventilators in the forward area were damaged by distortion.
- The starboard ballast tank vent head received minor damage.

- Below the deck, inside the stores area, all machinery and equipment were flooded. The paint locker fire door was badly distorted and torn off its hinges.
- The emergency fire pump diesel engine was damaged including its wiring harness, starting batteries, and various other accessories.

Probable cause
Under the extreme weather conditions extensive amounts of green sea hit the forecastle deck.
There are, however, indications that the condition of the equipment may have contributed significantly to the extent of damage and its consequences.
It is considered to be of utmost importance to provide regular and good maintenance, especially for vessels trading in these weather-exposed areas, in particular with respect to the maintenance of the cleats for the access hatches and the closing dogs for the watertight doors.
The forecastle, being the most weather and sea-exposed area on the ship, is hardly accessible under conditions as the above. The crew is often forced to wait until the weather has improved to carry out temporary remedial actions. This may result in extensive secondary damage, and even danger to the ship as the increased forward draft may become a critical factor when the vessel is in a fully loaded condition.

Lessons to be learned
The equipment on deck should be kept well maintained and in good working order so as to prevent water ingress in the foreship (forecastle, forepeak, hold no.1) following heavy weather damage to closing appliances and/or deck structures.

The exposed forecastle deck, of course is especially vulnerable, where:

- All closing appliances for openings into the hull should be subject to regular inspection and maintenance, particularly when trading in waters where heavy weather may be expected.
- Locking devices for access hatches and doors should be kept in good working order so that unintended opening, due to green seas, is greatly reduced.
- Condition and clamping devices of air and sounding pipes should also be subject to regular follow-up by the ship's crew, as internal corrosion and inadequate clamping may turn out to be critical.

DNV has established a project to investigate classification requirements and survey methods for possible improvements. IACS is also investigating the issue.
For more information, see: www.dnv.com (Classification-DNV Exchange-General Information-Service Experience-Casualty Information)
(http://www.dnv.com/ 2002-11-05)

1.4 Why heavy weather is not like "Act of God" "Michael Grey" Lloyds list 1989-03-03

And never mind what the lawyers suggest, it stands to reason that any well practiced seamen looks upon the old excuse of "heavy weather" with a certain skepticism.. Of course it is sometimes possible to be hemmed in by land on one side, and bad weather to seaward, but a prudent master on a well-equipped ship in the open sea ought to be able to avoid heavy weather, particularly in the North Atlantic, where the forecasts are frequent and accurate.

Even if the master is not being weather routed, all he has to do is listen to the radio and draw rough weather maps to keep, a clear picture of the developing weather. His training as a seaman ought to tell him how to shape his course accordingly.

Then there is the suggestion that the heavy weather has been responsible for the carrying away of the hatches or the structural failure of the vessel. The ship-owner in the witness box spreads wide his hands in a gesture of resignation. "Nothing' the master could have-done," he recites. "Green seas damaged the forward hatches and the ship flooded." All shake their beads sagely at the inevitability of the accident and the general helplessness of the seafarer doomed by the forces of unforgiving nature.

A ship with sea room, even if she has not managed by judicious prior manoeuvring to avoid the storm, should not be sunk by the wildest of storm if she is properly handled.

A modern, well-found ship should be hove-to, rather than try to make headway into weather that is likely to push heavy weather over the forecastle. We hear a lot about freak waves, and there might be something in it, but in most cases damage could almost always have been avoided if the master had the sense to slow down enough.

Similarly a vessel is designed to cope whit the occasional pounding under her bow, but it is bad seamanship to persist in keeping the speed in circumstances where she is constantly slamming. It is not good enough to accept damage of this nature and underwriters should refuse to pay up when ships have been so damaged.

It is likewise no defence allege that the ship has been designed badly - in most cases, even that the ship is or weakened by poor maintenance. Certainly the ship ought not to be operated in this condition, but the master ought have been aware of the limitations of his craft and accordingly made allowances - always supposing that he himself was allowed to treat his ship gently.

1.5 Ships in rough weather, *"C.J Parker"* Seaways 1985 February,

What are the dangers?

The first strategy is to avoid known danger areas; where this has not been possible, it may be helpful to consider the effect of waves on ship stability. A number of naval architectures have argued that static calm water stability criteria is woefully inadequate for describing what happens to a ship in rough weather. However, at the moment ships do not carry their own dynamic wave interaction computer programmes and as seafarers we are only given the one basic measure.

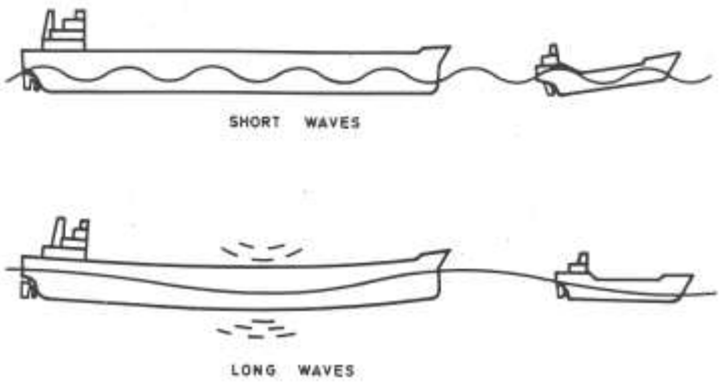


Fig. 4 Influence of the wavelength on different ship sizes.

Dangerous conditions

The means of avoiding the worst extremes the sea can provide are simply by the use of heading power and rudder. The sea acts on the hull producing hydrodynamic lift-forces which interact with the ship's drag. A rudder which is effective in calmer conditions can be both more and less efficient in a seaway.

A study of small cargo vessels which have capsized in heavy weather identified six causes.

- **Poor stability:** i.e., the vessel does not satisfy, from the start, the stability requirements currently laid down by the Maritime Directorate. The reason may be poor form stability and weight distribution.

- **Wave midship:** in this situation the vessel will lose waterline area, i.e., the initial stability and the curve of the righting lever (GZ value) will be reduced. The situation is characterised by the vessel having a following sea and sailing at approximately the same speed as the waves so that a wave crest may stabilize itself midship. Capsizing then occurs in the same way as for an unstable vessel in calm water.

- **The Mathieu effect:** When a vessel is moving in a following sea or a sea coming in abaft the beam, a special type of rolling movement which results in capsizing may occur. This involves a certain relation between the period of encounter and the rolling period of the vessel. The Mathieu effect will materialize as follows:

  When the crest of a wave is midship, the vessel loses stability and fails over, listing badly. The wave passes and if maximum rolling movement occurs at the moment when the vessel has the trough of the wave midship, the initial stability and the upward forces increase substantially. The vessel moves quickly back' towards an upright position. If the crest of the next wave is midship at this moment, this rolling movement continues towards the other side and towards a very low righting moment. As a series of waves with three to five choppy, but nearly regular waves, passes and the rolling amplitude continuously increases the vessel capsizes.

  Quite a number of prerequisites have to be met before this type of capsizing takes place. The vessel must be moving in choppy, nearly regular waves 1-2.5 times the length of the vessel. The rolling phenomenon is also connected with the natural rolling period of the vessel and the frequency of encounter of the waves coming in. In a given sea condition the speed and direction of the vessel in relation to the waves are therefore decisive.

  The most interesting unstable roll will occur when the period of encounter is equal to half the vessel's natural rolling period. Vessels with relatively low initial stability are most at risk.

- **Broaching:** This phenomenon occurs when a vessel is moving in a following sea and is overtaken by a forge wave. It may then happen that the wave transfers energy to the vessel and forces it to move at the some speed as the wave. The relative water speed past the rudder is reduced and the ability to maneuver is diminished. The vessel is 'lifted' off its course and swings into a turn, followed by a list towards the leeward side. This situation may occur when the length of the wave is much greater then that of the vessel and in steep waves. The swinging movement is created either by an initial roll movement, causing an unequal area on each side being submerged so that the resistance increases on the larger area, and the current of water in towards the bow becomes asymmetrical. Alternatively, the vessel's course may be slightly different from the wave direction and the movement of the water particles on the bow and stern may strongly increase the timing moment.

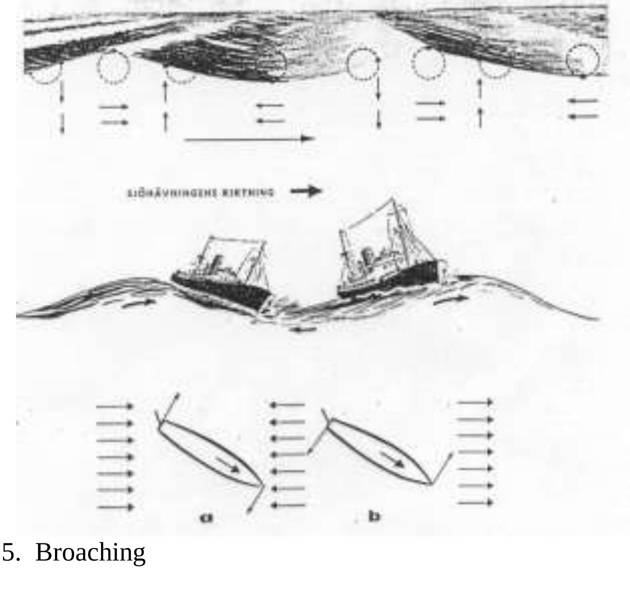


Fig 5. Broaching

- Breakers from the side: The vessel is moving in beam seas and a forge breaker with a steep front hits the vessel and knocks it over.

  Two main factors cause the great angle of heeling: (a) the impact of the wave hitting the superstructure and hull; (b) the steep wave front which the vessel has to float on.

  The steep wave front is, however, the decisive factor as far as the angle of heeling of the vessel is concerned. We know from model tests that these large critical angles of heeling are on the whole independent of the stability of the vessel. It has also been shown that whether the vessel will remain in that position even after the wave has passed depends on whether the vessel still has a righting lever at the angle of heel in question.

- Icing down of vessel: It appears that many small vessels have got into great difficulties in areas where sea spray and rain or snow have collected on superstructure, masts and rigging in the form of ice. The weight of the ice results mainly in the vessel's centre of gravity being raised, thus reducing stability and the righting lever.

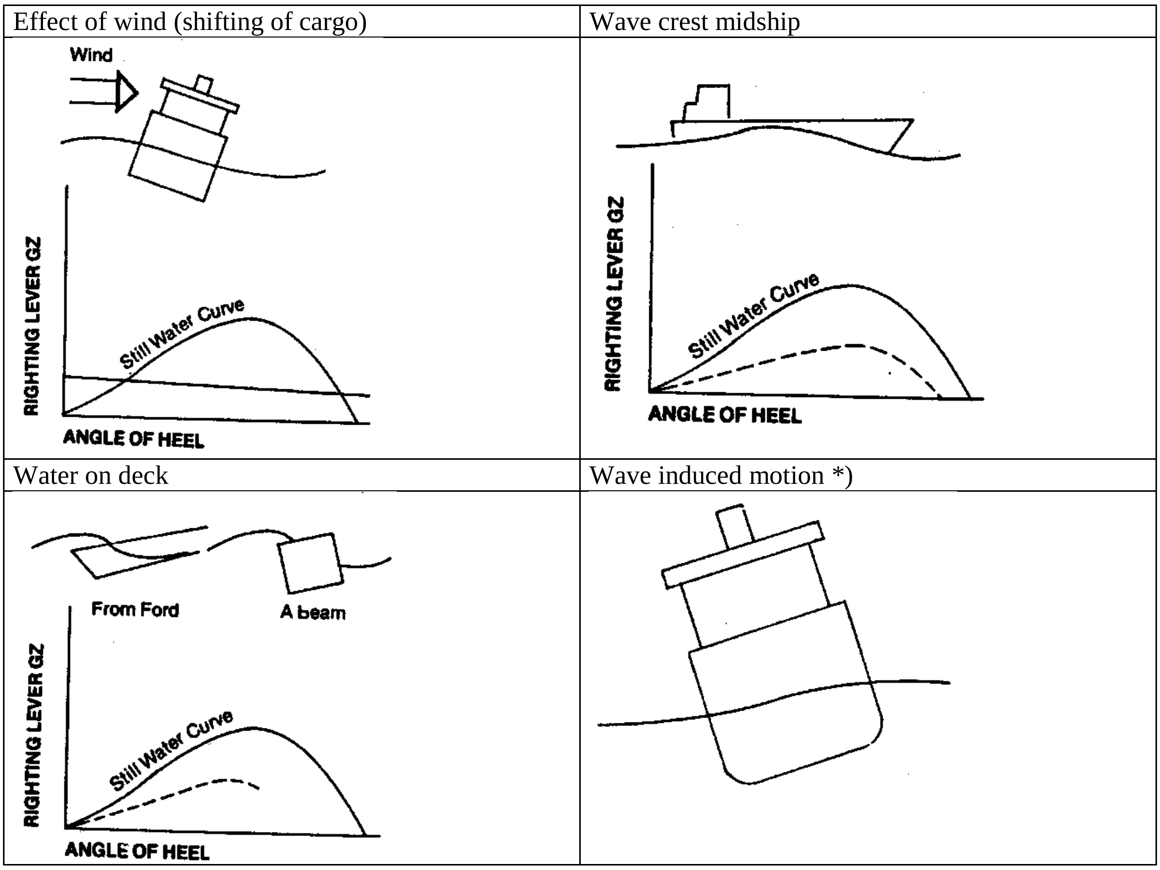


Fig. 6 Wind and wave effects on a ship

*) Approximated formula for calculating of resonance. If the ships rolling period is equal to the wave period the amplitude of the rolling will increase until the vessel will capsize.

$$T_{Roll} = 2\pi \frac{B/3}{\sqrt{gGM}}$$

$$T_{Roll} = \frac{c \times B}{\sqrt{GM}}$$

For larger ships, Robertsson and Lindemann point out that ship handling is dependent upon the type of ship and her cargo.

Tankers

- Roll. Little importance.
  Well-defined loading conditions with good stability range.
  Free surface effects small with full tanks. Cargo insensitive to roll.
- Motions and accelerations. Little importance.
  Some damages due to sloshing have been reported but are generally rare events.
- Shipping of water. Significant importance. A considerable part of damages in rough weather are reportedly caused to the superstructure including the forecastle by shipping of water on deck. The relative small freeboard when fully laden is the main reason for this.
- Slamming. Some importance. Small drought in some ballast conditions increases the risks for slamming, but the possibility of increasing the draught by increasing the ballast have led to few slamming damages. The introduction of segregated ballast tanks has limited this possibility so that slamming damages may be experienced more often in ballast.
- Vertical bending moment. Some importance. Although scantling requirements make fatal damages due to large bending moments unlikely, keeping the wave bending moments down minimizes the risks for fatigue cracks developing.
- Torsional moment. Little importance. The closed cell systems formed by the hull and bulkheads give a high resistance to torsion.

Bulk carriers. including OBO and OO

- Roll. Little importance.
  In severe cases some shifting of cargo may occur, but generally the stability is well controlled.
- Motions and accelerations. Some importance.
  Damages to tanks, holds, and bulkheads due to sloshing have been reported, and the complex structure is comparatively sensitive to cracks developing. Shipping of water and slamming. Some importance. Damages to the superstructure deck and hatches due to shipping of water have been reported as well as bottom impact damages.
- Vertical bending moment. Some importance. See 'Tankers'.
- Torsional moment. Some importance.
  The structures resistance to torsion is generally good but very large hatch openings on some bulk carriers increase the risk of stress concentrations.

General-cargo carriers

- Roll, motions and accelerations. Some importance.
  Cargo displacements causing loss of stability in rough weather have been reported.
- Shipping of water and slamming. Significant importance.
  A significant part of rough weather damages are caused by these events. Superstructures, deck hatches and bottom are at risk.
- Vertical and torsional moments. Some importance.
  The size and shape of hatch openings affects the tendencies to stress concentrations, but fatal damages due to forge moments are unlikely.

Ro-Ro ships

- Roll, motions and accelerations. Significant importance.. The wide variety of cargo shipped put great demand on, secure fastening of the cargo. Large forces on the lashings may be experienced.
- Shipping of water. Some importance.
  The large bow flare common on many ships of this type reduces the deck wetness, but instances where deck containers have been washed over board have been reported.
- Slamming. Significant importance.
  The generally high speed of operation and the large bow flare make- them receptive to high impact pressures on the bow.
- Vertical bending moment. Some importance.
  Even though the construction is not very sensitive to vertical bending moments large magnitudes may be experienced when the large bow flare enters the water.
- Torsional moment. Little importance.
  The construction is not very sensitive to torsional moments.

Container carriers

- Roll, motions and accelerations. Some importance.
- Violent motions cause large forces on the lashings for containers on deck.
- Shipping of water. Some importance. See 'Ro-Ro' ships.
- Slamming. Significant importance. See 'Ro-Ro' ships.
- Vertical bending moment. Significant importance.

  Large magnitudes of bending moments are introduced when the large bow flare enters the water. However, a hull girder failure is unlikely.
- Torsional moment. Significantly important.
  The constructions with very large deck openings make the resistance to torsion low.

Other types of ships may be subject to similar discussions, such as passenger ships where the comfort of the passengers give motion responses high priorities, and liquefied gas carriers where sloshing impacts are, of importance.

It is hoped that this discussion has served to describe some of the considerations decisive for the strategy of manoeuvring various ships in rough seas.

Down by the head

There is one particular condition which 1 do not think receives sufficient attention and that is ships down by the head. This is probably the most dangerous situation which can occur to a cargo vessel and is often overlooked because the subject is examined only in terms of intact stability and shifting cargoes.

A ship proceeding into heavy head seas is subjected to:

I. Slamming with its subsequent whipping effect.
II. Panting due to the variation of pressure from high to low as a wave passes the bow.
III. Slapping or bow flare slamming causing wave impact on the flare of the bow of low pressure but acting over a large surface area which can induce strong whipping.
IV. Shipping green seas.

These processes can rupture plating and in the case of the Marina di Equa broke open No 1 hatch. First of all, it is difficult to tell when a ship with low freeboard is going down by the head in rough weather. Tell-tale signs could be uneasy roll due to free surface, more seas breaking over the forecastle and lack of directional stability so that the rudder has to be used much more.

A ship down by the head in heavy weather rapidly suffers water on deck, further free surface effect, loss of stability with wave crests amidships and soon after loss of waterplane area. We all know it is impossible to take soundings and that ships are very difficult to control when navigating stern first into rough weather. If the for'd hatch cannot be battened down or pumps started the advice following the Pool Fisher case would be to prepare to abandon ship in good time. Good seamanlike practices are so important e.g., properly securing all for'd hatches and ensuring the bilge lines are clear.

Structural failure

Whilst the small ship is probably more prone to capsizing, the large ship has problems of its own due to its size. Serious bow damage has occurred in tankers and large container ships, which were not even noticed at the time by the watchkeeping officers. Under certain conditions instrumentation is desirable.

Racking stresses have been alluded to above, and the important lesson is a simple one. If a ship is subject to distortion by racking stresses, the designers and owners need to give some guidance on tolerances. At night in a Force 10 it is very difficult to appreciate how a ship is working and instrumentation can be helpful.

Structural failure of large ships can be seen in terms of bending moment and sheer force, to which must be added exceptional distortion and fatigue. The idea of a ship working in a seaway is well understood; without instrumentation, however, it is often not possible to tell what stresses are being incurred. Changes of heading and speed will enable the encounter rate to be modified and the amplitudes kept within limits.

1.6 Ships have six degrees of motion in a most irregular sea.
"The Wordsworth Concise English Dictionary"

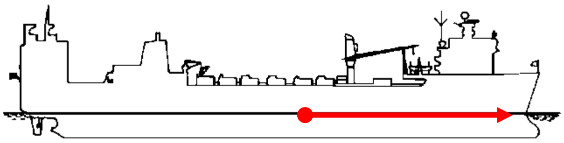
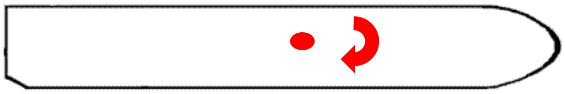
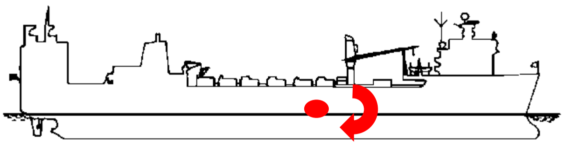
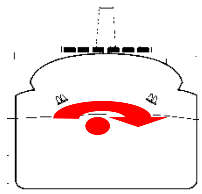
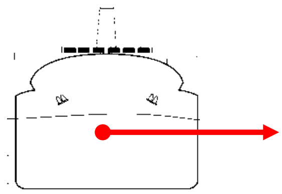
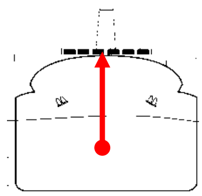
SURGE **A sudden increase of power**	
YAW **Turn out of line**	
PITCH **To oscillate about transverse axis**	
ROLL **A swaying about an axis in direction of motion**	
SWAY **From side to side** Directing force of influence	
HEAVE **To lift up**	

Fig. 7 Grades of motion

1.7 Rough Weather Damage on Supertankers and other Large Ships

The Norwegian Maritime Directorate has received reports of a certain extent of major rough weather damage on large ships sailing in poor weather conditions. This could be due to a combination of the sizie of the ship, extreme weather conditions and, consequently, greatly reduced opportunities for inspection en route.

Examples of damage range from the loss of an anchor, unnoticed by personnel on the bridge, to damage to the hull and to equipment in the forepart of the vessel. Holes in the bow and sides of vessels have, also been reported, and for tankers this means that cargo (oil) leaks into the sea causing pollution.

Maritime Investigators have been called in on several occasions in cases, of serious breakdowns.

The Norwegian Maritime Directorate would therefore point out to owners to remind their captains that ships must at all times be handled in accordance with good seamanship. This means that ships should, not be pushed, in. extreme weather to the extent that major damage ensues.

Indications that a ship is being pushed too hard are for example, that speed is noticeably reduced and that the propeller “slips” more than usual in comparison with sailing in normal weather conditions.

To prevent damage and to facilitate control on board, the following measures may be of assistance:

- reduce level or engine power in rough weather,
- if possible. change course to minimize strain on the vessel
- if necessary, reduce speed considerably or heave to,
- use the fixed decklights or floodlight arrangement, when this can be done without inconveniencing other shipping in the area, for remote inspection of the most exposed areas of the ship
- keep check of the condition of the ship by conducting inspections, when safe to do so, of the most. exposed areas.

For experienced seafarers, the above measures may seem obvious. However, reports show that some of the larger ships have never before sailed in waters with weather conditions dangerous to the ship and its crew. As mentioned above, large ships have received major damage, and in some cases, lack of experience, in handling ships in extreme weather conditions would seem to be a contributory factor. Cargo is expected to be delivered on schedule and this can also lead to higher speeds than appropriate in poor weather. The Norwegian Maritime Directorate would emphasize that the speed and handling of the ship must always be adapted to suit the weather conditions at hand so that neither the ship nor the crew are unnecessarily put at risk.
(Despatches from the Norwegian Maritime Directorate, nr 332 1 April 1991, nr 2/91)

1.8 Freak Waves

From: SA Sailing Directions Vol 1 page 43:

3.9 ABNORMAL WAVES. As described in section 3.8.9, the Agulhas Current flowing off and parallel to the East coast of South Africa is about 60 miles wide and attains rates of up to 5 knots on occasions. This current is normally kept outside the continental shelf by the fact that it extends downwards to a depth of more than 200m. It attains its greatest rate along its western edge. Between Durban and Port St. Johns the average width of the continental shelf is 5 miles, and it is in this area between the shore and the western edge of the Agulhas Current that a counter current is sometimes generated when a strong wind from the SW is associated with an atmospheric depression moving to the ENE. This current, moving in a NE direction, is composed of a gradient current caused by the level of the sea being raised in the low pressure area and the surface drift caused by wind friction.

In the NW quadrant of the depression, strong to gale force SW winds blowing contrary to the direction of the Agulhas Current cause very steep waves, especially in the western part of the current immediately to seaward of the shelf edge. These waves are approximately 5 - 1O m high, have a frequency of about 10 *seconds and a length of 60 - 80 m. At the same time there may be wave trains emanating from storm centres further south, whose lengths are much longer and whose frequency is about 16 seconds. These also travel in a general NE direction against the current.*

lt is thought that a combination of the waves in these different wave trains, together with some aberration in the Agulhas Current caused by the influence of the counter current, has on several occasions caused an exceptionally large wave to form, the notorious Freak Wave of the Natal Coast. For some reason, as yet not fully understood, a very deep trough precedes the crest of the wave, with the result that a ship steaming against the sea suddenly and without any warning, plunges into it, and before the bows can lift to the oncoming wall of water, which may be as much as 20 m high, the forepart buries itself in this mountainous wave with disastrous results.
The lifetime of such a freak wave is very short, and it will extend over a distance of not much more than 11 cables, so that the chances of a ship encountering it are small. Nevertheless, mariners are warned to treat that section of the coast between Richards Bay and East London with caution when steaming SW into a rough sea when the barometer is low and there is a strong SW wind blowing, on a course lying within 20 miles to seaward of the 100 m bathymetric contour.

Between 1964 and 1973 six ships reported having encountered freak waves in this area. One of these, the tanker World Glory, broke her back and sank on 13th June 1968.

Fig. 8 World Glory

1.9 Mystery of monster waves solved By Tony Paterson in Berlin
(Filed: 06/01/2002)

GERMAN scientists claim to have explained the mystery behind so-called monster waves - the term given by oceanographers for near-vertical breaking seas up to 120ft high. Such seas are thought to have sunk more than 200 supertankers and container ships without trace during the past two decades.

Often dismissed as sailors' yarns, monster waves have terrified seafarers for centuries and provided the raw material for countless novels and films including Sebastian Junger's recent best-seller The Perfect Storm.

Yet until now scientists and oceanographers had been unable to determine exactly what formed such gigantic "one-off" seas that are capable of breaking a 600ft-long ship in half and sending it to the bottom within seconds.

A team of oceanographers at the Technical University in Berlin has now managed to explain the phenomenon with the aid of computers and by simulating monster waves in a tank.

"Our wave experiments have proved for the first time that monster waves are physically possible and that they really do exist," said Prof Gunther Clauss, who led the team of scientists.

"This represents a breakthrough for the shipping and oil industries because we can now start to design structures that can cope with these monsters," he added.

Using a computerised, hydraulically powered wave-making machine in a specially designed tank supplied by oceanographers at Hanover University, Prof Clauss's team has established that monster waves can occur with little or no warning.

The waves are created in a storm when slow-moving waves are caught up by a succession of faster waves travelling at more than twice their speed. "What happens then is that the waves simply pile up on top of each other to create a monster," said Prof Clauss.

"The result is an almost vertical wall of water which towers up to 120ft in height before collapsing on itself. Any vessel caught by one of these has little chance of surviving."

Photographs of the experiments show the monster wave building into a vertical wall of water before exploding into an uncontrollable boiling mass as it collapses on itself.

"Even in the tank the effect was awe-inspiring," said Prof Clauss. "The exploding wave was so powerful that it broke through the ceiling of the building in which the tank is located," he added.

Monster waves are thought to have caused the loss of at least 200 "super carriers" or ships measuring more than 600ft in length on the world's oceans over the past 20 years. The unexplained disappearance of many smaller vessels including trawlers and yachts could put the total number of losses much higher.

Yet accounts by seamen who have witnessed such waves are comparatively rare. One, dating from 1995, was when the QE2 was hit by a hurricane on a crossing to New York.

She survived what was estimated to be a 95ft high wave which the ship took directly over her bow. Her captain, Ronald Warwick, described the phenomenon as "like going into the White Cliffs of Dover".

One of the few small-boat sailors to survive a monster wave was the British yachtsman, Brigadier Miles Smeeton, who did so twice. His 50ft ketch, Tzu Hang was dismasted twice by such waves while attempting to round Cape Horn in the 1950s - once after being "pitchpoled", toppled stern over bow.

In Germany, the horrors of monster waves have been brought right up to date after revelations about the near-sinking of the German Antarctic cruise liner Bremen in the south Atlantic last year. The ship with 137 passengers aboard was hit by a 114ft wave in March while heading towards make Rio de Janiero after an Antarctic cruise.

The impact smashed windows on the bridge and cut the ship's electricity supply. The vessel drifted engineless for more than half an hour heeling at an angle of 40 degrees in huge seas whipped by hurricane-strength winds.

"I have been at sea for 48 years, but never have I experienced such a wave," said the Bremen's captain, Heinz Aye, 65, who is now retired.

Prof Clauss said that his team's research would help naval architects in their efforts to construct ships and oil platforms that were capable of withstanding such freak wave forces.

"In many cases it is as simple as building a bridge on a ship that is not slab-sided but rounded, so it can cope with being hit by a monster wave. Most ships plying the oceans right now are not built along these lines," he said.

The team also hopes that its research will help in the development of radar that is specifically designed to warn of sea conditions that could produce the monster-wave phenomenon.

"This could help the captains of ships to steer clear of a danger area, but the truth is we can do nothing to prevent monster waves. They are a product of nature," Prof Clauss added.

Fig. 9 Freak waves built up by 3 different wave systems with different wavelength.

1.10 Practical experience with hull stress monitors in rough weather *(Summary of a course in shiphandling in rough weather, Det Norske Veritas, 1981)*

A master changed from a small ship to a larger ship. His experience from the small ship told him to take the wave 15-30º off the bow in rough weather to reduce the vertical motions. Sailing the larger ship he learned by observing the ships motion monitor that this was not always the case for this ship. In fact head seas turned out some times to be more favourable. (Wavelength shorter than ship length). Consult rough weather guidance charts).

A master learned that vertical motions sometimes were reduced by sailing at full speed, head into the waves and increased when the speed was reduced. (Wave-length much shorter than the ship-length).

A ship entered a heavy storm area experiencing increased motions. By reducing speed the master limited the loads to a certain value on his motion monitoring meter. Being short of time he decided to move around the storm area in an attempt to save time. Within a short period of time while moving away from the storm the monitor told him of reductions in loads. This was not observable by human senses. But following the indications of the motion monitoring unit he was back at original course at full speed within two hours. A manoeuvre he could not have completed so successfully without the aid of the instruments.

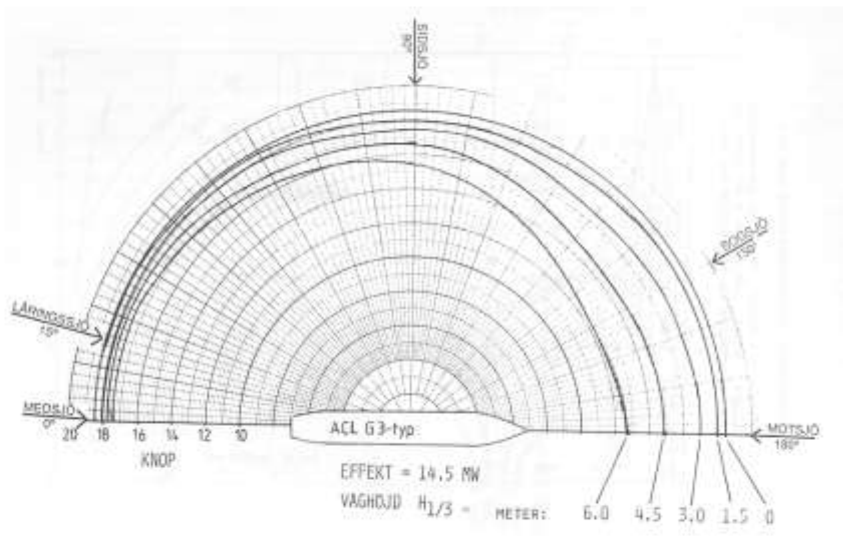


Fig. 10 Speed reduction as function of wave direction at different wave height. (Fartygsdrift TFB rapport 1990:2)

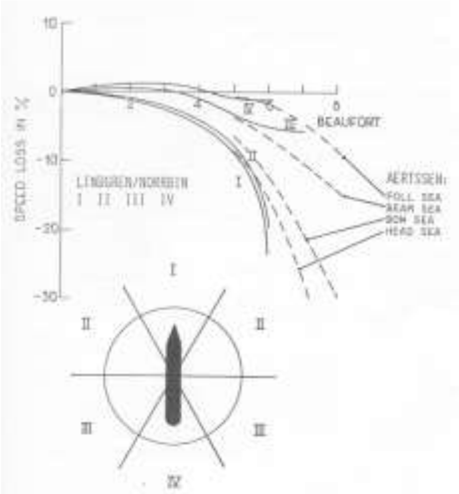


Fig. 11. Measurement of speed reduction in different seas. (Fartygsdrift TFB rapport 1990:2)

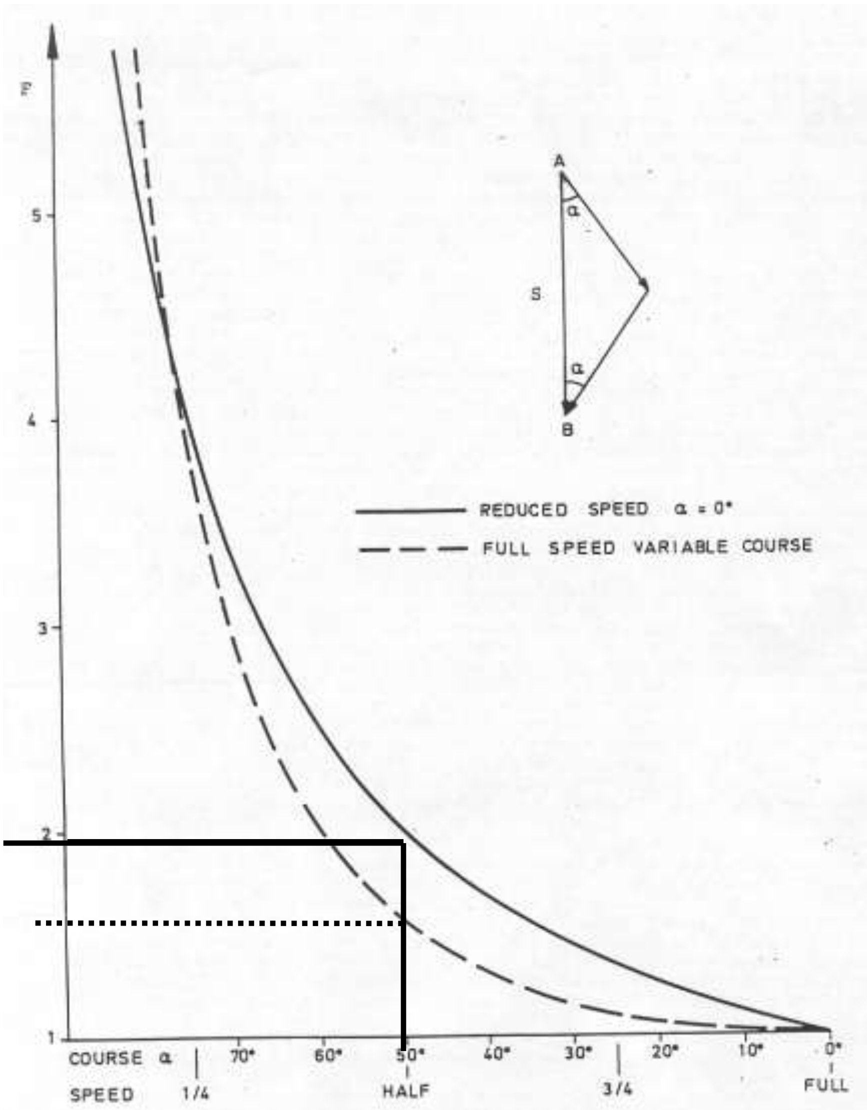


Fig. 12 The time needed to travel from A to B with reduced speed or altered course
(Från "Shiphandling in rough weather, DNV 81.0782")

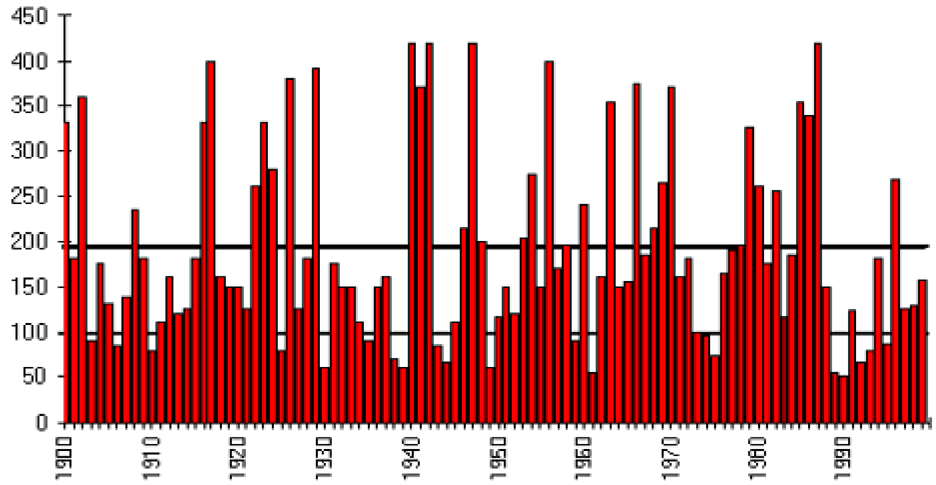
Example: If a ship reduces speed to 50% of full speed the trip will take twice as long. If the vessel changes course 50° but manage to keep full speed the trip will take 1,6 times as long time compared to a direct route at full speed.

2. Is – isbrytning mm

2.1 Vintrarnas svårighetsgrad

Isvintrarna indelas i "lindriga", "normala" och "stränga". Den grundläggande faktorn vid bedömning av en isvinters totala svårighetsgrad är havsisens utbredning. Även andra förhållanden som inverkat på sjöfarten tas dock också i beaktande. Dit hör isperiodens längd, istäckets framkomlighet under inverkan av vind- och strömförhållanden m.m.
Inom begränsade områden kan svårighetsgraden avvika från den totala svårighetsgraden. Under en isvinter som betecknas som lindrig kan t.ex. isarna i Bottenviken ha en utbredning och framkomlighet som kännetecknar en normal isvinter.

Diagram 1. Isutbredningen för vintrarna 1900-1999



Ovanstående diagram visar den maximala isutbredningen i Östersjön, Kattegatt och Skagerrak olika år, 1900 - 1999. Gränsen mellan "lindrig" och "normal" isvinter går vid 98.000 km2. Gränsen mellan "normal" och "sträng" isvinter går vid 193.000 km

2.2 Isbrytningsverksamheten

Isbrytningsverksamheten leds från isbrytarledningen i Norrköping. Isbrytarledningen fördelar isbrytare till arbetsområden, utfärdar restriktioner, följer upp det operativa läget och informerar sjöfartsintressenter om is- och trafikläge. Ute i isbrytarverksamheten arbetar isbrytarbefälhavarna relativt självständigt inom sina arbetsområden.

Så assisteras fartygen
När isen lagt sig i Bottenvikens skärgårdar är den första isbrytaren på plats. Isbrytarledningen meddelar i sin isberättelse att alla fartyg som ska trafikera isfarvatten ska anmäla sig i god tid vid passage av en särskild angiven punkt, exempelvis fyren Svenska Björn. Fartyget blir därmed upplagt på isbrytarens datasystem och isbrytaren kan följa fartyget på sin grafiska plottingskärm. Då fartyget anmäler sig till isbrytaren får det anvisningar om lämpliga färdvägar runt om och i isen.

Om isläget är svårt kan fartygets befälhavare anvisas en samlingspunkt för konvojering. Om allt går som planerat samlas ett antal fartyg i ett vänteläge och så småningom kommer en isbrytare, som vanligtvis lämnar en sydgående konvoj i lätt is eller öppet vatten. Isbrytaren assisterar därefter den samlade konvojen genom isen och lämnar fartyg efter fartyg vid deras destinationshamnar eller till någon annan isbrytare - ibland kanske till en finsk sådan - för vidare assistans.

Ofta gör oförutsedda förändringar i isläget, att planerna måste läggas om eller korrigeras. Under svåra förhållanden kan det bli nödvändigt att bogsera ett fartyg i taget eller att avdela ytterligare en isbrytare för att få konvojen framåt. Det kan också hända att framkomligheten plötsligt blir bättre än man räknat med. Fartygen kan då gå vidare på egen hand, efter att man ha låtit helikoptern leta lämpliga vägar mot hamnarna. Isbrytaren kan då ta sig an andra uppgifter eller i bästa fall lägga sig stilla och ägna sig åt övervakning och dirigering av trafiken.

IBNet
På senare år har den snabba utvecklingen på datorområdet underlättat planeringen för isbrytningsverksamheten. Idag utväxlas meddelanden mellan isbrytarna inbördes och mellan isbrytarna och isbrytarledningen via ett datorbaserat informations- och ledningssystem IBNet.

Kontakt med SMHI
Vintersjöfarten är i hög grad beroende av väder och vind. Isbrytaren planerar varje assistans med hänsyn till rådande isläge och gällande vindprognoser. Istjänsten vid SMHI sänder dagligen väderprognoser och förändringar i isläget, samt speciella vindprognoser för olika havsområden till isbrytarna. Dessutom har isbrytarna tillgång till iskartor, satellitbilder och radarsatellitbilder.

Isbrytarledningen har dagliga telefonkonferenser med meteorologer på SMHI för att diskutera dagens isläge och komma till klarhet om möjliga utvecklingstendenser av isläget.

Varje vinter utnyttjas ett antal helikoptrar för att isbrytarna skall finna de mest lättframkomliga vägarna och för att medverka i SMHI:s iskartläggning. Helikoptrarna har sin bas på isbrytarna och de kan även användas för att byta isbrytarbesättning.

2.3 Råd och anvisningar
Råd och anvisningar beträffande navigering, manövrering etc finner man bl. a. i följande källor:

- Svensk lots del A
- Statens isbrytartjänst (bilaga till Ufs varje år)
- Bridge Procedures Guide (ICS checklistor)
- SJÖFS A:20.1966
- SOLAS, kap. V (Safety of navigation)
- The Mariners Handbook NP 100 (Hydrographer of the Navy)

Fig.13 Sannolikhet för isförekomst i svenska och närliggande vatten. 100 % anger att is kan förväntas varje vinter, 10 % is att förvänta i genomsnitt en isvinter av 10.

2.4 Kungliga Sjöfartsstyrelsens meddelande Nr 20 1966 Föreskrifter rörande Statens isbrytarverksamhet. Kungl. Sjöfartsstyrelsens reglemente för statens isbrytarverksamhet

9 §

För fartyg, som under resa till nordisk hamn kan behöva anlita isbrytarhjälp, skall, om isbrytardirektören så förordnat, i god tid före ankomsten till isbelagt farvatten föranmälan göras till vederbörande isbrytarmyndighet.
Föranmälan skall innehålla uppgift om fartygets namn, nationalitet, isklass (isförstärkning), storlek, maskinstyrka, byggnadsår, lastkvantitet och destinationsort ävensom tidpunkt för beräknad ankomst till isbelagt farvatten. På begäran skall lämnas de ytterligare uppgifter rörande fartyget och dess last, som kan erfordras för isbrytarverksamheten.
Inställer eller avbryter föranmält fartyg sin resa, skall meddelande härom snarast lämnas isbrytardirektören, iskontor eller isbrytarombud.

13 §

Fartyg skall under föranmäld resa noga följa av isbrytardirektören, iskontor eller chef för isbrytare i samband med prövning av föranmälan eller därefter givna trafikmeddelanden eller särskilda anvisningar.
Senast vid ankomsten till isfarvatten skall fartyget om så kan ske per radio direkt eller genom närmaste kustradiostation anmäla sig till isbrytare, som assisterar trafiken på destinationsorten. Sedan kontakt med isbrytare upprättats skall, om icke annat överenskommits med isbrytaren, fortlöpande radioavlyssning äga rum.

15 §

Befälhavare på föranmält fartyg är skyldig att iakttaga av isbrytare givna anvisningar om samlingsplats, avgångstid och färdväg samt om ordningsföljd i konvoj. Vid assistans av isbrytare skall följande särskilt iakttagas.
a Noggrann utkik skall hållas efter signaler från isbrytaren eller från annat fartyg i konvojen.
b Fartygets framdrivningsmaskineri skall ständigt vara klart för snabb manöver.
c Isbrytaren bestämmer när fartyget skall bogseras.
d Fartyget skall vara berett att när som helst göra fast eller kasta loss bogserkabel.
e Fartyg, som bogseras av isbrytare, får endast använda framdrivningsmaskineriet enligt anvisningar, som ges från isbrytaren.
f Om fartyget blir läck eller lider annat haveri, skall förhållandet omedelbart meddelas isbrytaren.
g I konvoj ingående fartyg, som fastnat i isen, skall hålla sina strålkastare släckta, om sådana finns.

17 §

Fartyg, som icke följer dessa bestämmelser eller därav föranledda anvisningar givna av isbrytardirektören, iskontor eller befälhavare på isbrytare, kan icke påräkna isbrytarassistans.

2.5 Statens Isbrytartjänst

A. Allmänna upplysningar om isbrytartjänsten

a) Ledningen av statens isbrytartjänst utövas av Sjöfartsverket (SjöV). Isbrytarnas verksamhet omhänderhas av statens isbrytardirektör, vilken biträds av isbrytarombud samt då så erfordras dessutom av i Malmö, Göteborg och Trollhättan upprättade iskontor.
Isbrytarombuden och iskontoren har till uppgift att inom sitt arbetsdistrikt inhämta och förmedla upplysningar, önskemål och anvisningar angående isbrytartjänsten mellan isbrytardirektören och isbrytare samt företräda för sjöfarten, industrin och övriga intressenter och i övrigt utföra de uppgifter som isbrytarledningen ålägger dem.
b) Statsisbrytarna är **ODEN, YMER, FREJ, ATLE, NJORD, TOR** och **ALE.** Dessutom används vid behov arbetsfartygen **BALTICA** och **SCANDICA** och inhyrda hjälpisbrytare. Den statliga isbrytningens huvuduppgift är havsisbrytning d.v.s. isbrytning mellan öppet vatten och farvatten, som är skyddat för havsis, packis och liknande ishinder. Helikoptrar är normalt baserade ombord på de större isbrytarna och utnyttjas främst för isflygspaning och dirigering.

B. Isbrytarledningarna i Sverige, Finland, Danmark, Estland, Lettland och Norge
SVERIGE
Postadress: Sjöfartsverket, Isbrytningsavdelningen,
601 78 NORRKÖPING
Telefon: Växel (0800-1640) +46-(0)11-19 10 00
Isbrytardirektören +46-(0)11-19 12 13
Ledningscentralen +46-(0)11-19 12 10
Under tiden då isbrytarexpeditionen är obemannad och jour upprätthålls erhålls journummer genom telefonsvarare:
Telefon: +46-(0)11-19 12 10
Telex: 64416 Iceserv S
Fax: +46-(0)11-10 31 00
E-post: opc@sjofartsverket.se
Internet: http://www.sjofartsverket.se

Aktuell information: Kortfattad redogörelse för dagens issituation, isbrytarnas arbetsområden samt anvisningar för sjöfarten kan under vintern erhållas genom telefonsvarare. Aktuell information spelas som regel in omkring kl 1100.
Telefon: +46-(0)11-10 84 80
Under rubriken ”Isnytt” på Sjöfartsverkets hemsida www.sjofartsverket.se finns dagsaktuell information om isläget och isbrytarnas verksamhet.

C. Allmänna direktiv, trafikföreskrifter och trafikanvisningar
Isbrytarkungörelsen reglerar att fartyg lämpade för vintersjöfart kan erhålla isbrytarassistans i svenska kustfarvatten och på sjövägarna dit mellan öppet vatten till havs och farvatten, som är skyddade för havsis, drivis, packis eller liknande ishinder. I Vänern, Mälaren och Ångermanälven kan i viss omfattning, som SjöV bestämmer, svårare is brytas genom statlig hjälp.
För att fartyg skall erhålla statlig isbrytarassistans, skall det inneha lägst den svensk-finska isklass (motsvarande) och minst den dödvikt (dwt) som gäller för ett visst isområde enligt av Sjöfartsverket utfärdade restriktioner. Vid vintersjöfart i områden där särskilda isrestriktioner ej är utfärdade bör följande krav ställas på fartyg:

a) fartyget skall ha högsta klass hos av vederbörande stat godkänd klassificeringssällskap eller vid verkställd sjövärdighetsbesiktning ha visat sig äga motsvarande konstruktion och styrka.
b) fartyget skall ha framdrivningsmaskineri, med en effekt som gör det möjligt för fartyget att ta sig fram genom lättare is och i bruten inomskärsränna utan isbrytarhjälp.
c) fartyget skall vara på minst 500 dwt.
d) fartyget skall ha sådan stabilitet, även då däckslast förs, att det tål en viss nedisning utan att fara för kantring uppstår.

För att tillgodose säkerheten i vintersjöfarten utfärdar isbrytarledningen vid SjöV, vid behov trafikanvisningar och trafikbegränsningar. Trafikbegränsningen anges som lägsta krav på svensk-finsk isklass (isförstärkning och maskinstyrka) samt lägsta krav på fartygsstorlek (dwt). Vid utfärdande av trafikanvisningar och trafikbegränsningar för ett visst havsområde tas hänsyn till rådande is- och vädersituation och förväntad utveckling samt till disponibla isbrytarresurser.
Sjöfartsverket kan vägra att lämna statlig isbrytarassistans till fartyg, vars anordningar före assistansen icke fungerar eller vilket med avseende på skrov, maskineffekt, utrustning eller besättning är sådant att gång i is kan antagas äventyra fartygets säkerhet, eller om det kan anses föreligga skäl att antaga att fartygets lämplighet för gång i is är sämre än vad i allmänhet förutsättes för fartyg hörande till samma isklass. Exempel på sådana fartyg är fartyg, som är speciellt konstruerade för trafik på floder och kanaler. Denna typ av fartyg betecknas i de dagliga SMHI:s israpporterna som flodfartyg.
SjöV utfärdar ifrågavarande anvisningar och begränsningar samt lämnar uppgift på statsisbrytarnas arbetsområden dagligen under isbrytarsäsongen i anslutning till av SMHI upprättad isberättelse. Isberättelsen jämte ifrågavarande uppgifter från SjöV utsänds i rundradio i program 1 i anslutning till sjörapporten kl 1555. På engelska lämnas samma uppgift per Navtex samt per telefoni över vissa kustradiostationer. Efter förfrågan till kustradiostation kan fartyg kostnadsfritt erhålla varningar, väder och israpport på LV telegrafi.
Assistanssökande fartyg sammanförs till konvojer när förhållandena så påfordrar. Dispens från utfärdade trafikbegränsningar kan inte påräknas.
Anvisning på alternativhamn kan även lämnas. Krav på endast en lastnings-och/ eller lossningshamn samt viss minimilast kan uppställas för att assistans skall lämnas. Fartyg, som med hänsyn till utfärdade trafik-

anvisningar som inte medgivits rätt till assistans av isbrytare kommer att anmodas att avstå från att fullfölja i föranmälan angiven resa.
Med hänsyn till utfärdade trafikanvisningar, avgör isbrytardirektören, om föranmält fartyg kan påräkna isbrytarassistans av isbrytare samt om fartyget därvid skall anlita ”islots”.’
Fartyg, som kan påräkna assistans av isbrytare, erhåller erforderliga anvisningar för resan.
Skyldighet för fartyg att verkställa föranmälan till isbrytarombud viss tid före ankomst till eller passage av särskild angiven punkt eller linje kan föreskrivas.

För att tillgodose isbrytarledningens och isbrytarnas behov av information om fartygstrafiken vintertid anmodas fartyg destinerade till svenska och finska hamnar med trafikbegränsningar, belägna i Bottenviken och Bottenhavet, att rapportera på VHF enligt följande:

Rapporteringslinje:	**Vid passage av Svenska Björn* 59 33N 20 01E***
Anrop:	**LOTSARNA STOCKHOLM**
Anropskanal:	**VHF kanal 84 (alt tel +46-(0)8-666 66 22)**
Rapportinnehåll:	**- fartygets namn**
	- nationalitet
	- destination och ETA
	- fart
Språk:	**Svenska eller engelska (använd IMO:s Marina Standardfraser)**

***Sydligare linje kan anges, om isläget motiverar detta.**

I samband med rapportering erhåller fartyg destinerade till vissa hamnar information om skyldighet att före passage av en särskild punkt kontakta aktuell statsisbrytare för att erhålla information och direktiv beträffande färdväg och assistans. Begäran om statlig isbrytarassistans görs vanligtvis direkt till isbrytare i aktuell distrikt eller till särskild angiven anmälningsisbrytare.
Information om rapporteringsförfarandet lämnas i de dagliga israpporterna och i utsändningar från kustradiostationer.
På fartyg skall fortlöpande radioanpassning hållas.
Då särskilda skäl ej annat föranleder, assisteras hjälpbehövande fartyg oavsett deras nationalitet i följande ordning:
a) fartyg i nöd eller i behov av hjälp på grund av fara för ombordvarandes liv,
b) fartyg destinerade till eller kommande från Sverige, Danmark, Finland eller Norge, varvid företräde lämnas passagerarfartyg och fartyg, som fraktar varor av särskild betydelse,
c) annat fartyg.
För av statsisbrytare i samband med havsisbrytning utförd bogsering eller annan isbrytarassistans uttas ingen avgift. Bistånd lämnas fartyg på dess egen risk. Vid ordergivning mellan isbrytare och assisterat fartyg, skall VHF-trafik på anbefallda trafikkanaler användas. Vid utebliven kontakt på VHF skall de ljudsignaler, som anges i *Signaltabellen* på sidan 6 och 7 användas.
Isbrytarledningen rekommenderar att fartyg som trafikerar i isfarvatten skall vara utrustade med en transponder för automatisk identifiering av fartyg (AIS).

D. Instruktioner för befälhavare på fartyg under isbrytarassistans
1. Alla instruktioner, givna från isbrytare, skall följas.
2. Följande skall särskilt iakttas:
   a) Noggrann utkik skall hållas efter signaler från isbrytaren eller från annat fartyg i konvojen. Ständig passning av VHF skall hållas på anbefalld kanal.
   b) Fartygets framdrivningsmaskineri skall ständigt vara klar för snabb manöver.
   c) Isbrytaren bestämmer, när fartyget skall bogseras.
   d) Fartyget skall vara berett, att när som helst göra fast eller kasta loss bogser-kabel.
   e) Fartyg, som bogseras av isbrytare, får endast använda framdrivningsmaskineriet enligt anvisningar, som ges från isbrytaren.
   f) Om fartyget blir läck eller lider annat haveri, som kan påverka fartygets förmåga att följa isbrytare eller i övrigt efterfölja av isbrytaren givna direktiv, skall detta omedelbart meddelas isbrytaren.
   g) Fartyg, som navigerar i isfarvatten skall, för att kunna påräkna isbrytarassistans, vara utrustad med en kraftig strålkastare. I konvoj ingående fartyg, som fastnat i isen, skall hålla strålkastare släckta.
   h) Under svåra isförhållanden t.ex vid hård ispress eller passage genom större isvallar kan bogsering vara enda möjligheten för en säker och effektiv assistans. Bogsering sker då normalt genom att det

bogserade fartygets förstäv tas in i isbrytarens bogserklyka. Isbrytaren lämnar över två stycken vajrar som skall kopplas till pollare avsedda för bogsering.

Särskilda förutsättningar för säker bogsering.

– för fartyg med bulb gäller att avståndet mellan bulbens översida och isbrytarens skrov skall vara minst två meter (se bild)
– för fartyg med ankare placerade på fartygets utsida på ett sådant sätt att dessa kan komma kontakt med isbrytarens bogserklyka gäller att ankarna måste ”kattas” d.v.s. flyttas akterut (se bild) eller lyftas upp på däck innan bogsering kan påbörjas.
– under bogsering skall det bogserade fartyget styras med handstyrning, maskin skall vara färdig för manöver.

Om ovanstående förutsättningar ej kan uppfyllas, kan säker bogsering i klyka ej ske. Isbrytarens befälhavare kan då vägra att assistera fartyget intill dess assistans kan ske utan bogsering.
Bogsering av fullt trafikdugligt fartyg med isbrytare är avgiftsfri. Avgiften för bogsering som har karaktär av bärgning och för annat assistansarbete, fastställs årligen av SjöV.

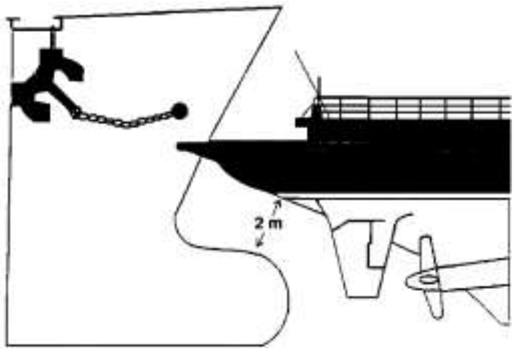


Fig 14 Bogsering i klyka.

3. Instruktioner till assisterat fartyg ges via VHF (anvisad assistanskanal). Vid avbrott i radioförbindelse ges motsvarande instruktioner med ljudsignaler enligt nedan:
   Isbrytare utrustad med både bas- och diskanttyfon, avger signalerna i tabellen
   – med bastyfon till alla fartyg i konvojen
   – med diskanttyfon till fartyget närmast isbrytaren.
4 Bastyfonsignal, som ges från isbrytare, skall repeteras av fartyg under konvoj, så långt det är möjligt, i den ordning de framförs efter isbrytaren.
5. Bastyfonsignal kan förtydligas med hjälp av ljussignal med vitt sken, synligt horisonten runt, på minst 5 M avstånd, så anordnad att den avges samtidigt och i anslutning till ljudsignalen.
6. Statens isbrytarfartyg för, under mörker, på masttoppen ett ljus med blått sken synligt horisonten runt.
7. Fartyg, som ej följer utfärdade trafikföreskrifter och trafikanvisningar eller från isbrytare givna order, kan vägras assistans.
8. Svenska staten påtar sig inte något ansvar för försening, skada eller annan förlust, som vållats fartyg, dess personal, passagerare eller last på grund av isförhållanden. Varje fartyg är ansvarigt för sin egen säkerhet.
9. På finska isbrytare har installerats två ovanför varandra placerade roterande röda varningsljus, som tänds när isbrytaren oväntat stannat eller farten betydligt reducerats. Det assisterade fartyget (de assisterade fartygen) skall då omedelbart tillgripa alla möjliga åtgärder för att snabbt upphäva farten. Observera att denna signalanordning ej finns på de svenska isbrytarna.

E. Radiotrafik med statsisbrytare

Statsisbrytare passar kontinuerligt under gång VHF kanal 16. Samtal till isbrytare kan även förmedlas genom kustradiostation. Isbrytare kan också kontaktas via mobil-telefon (NMT).

Signaltabell,
Instruktioner till assisterat fartyg ges via VHF.

Internationella signaler använda inom isbrytartjänsten i Danmark, Finland, Norge och Sverige. Nedanstående signaler vid utebliven radiokommunikation har, då de utväxlas mellan isbrytare och assisterat fartyg, endast den i tabellen angivna betydelsen och kan endast ges som ljud- och/eller ljussignaler.

En punkt (•) betyder en kort ljud-/ljussignal, ett streck (–) en lång ljud-/ljussignal.
WM • – – – – Isbrytarassistansen börjar. Använd särskilda isbrytarassistans-signaler och var ständigt uppmärksam på ljud-, visuella- eller radiosignaler (radiomeddelande).
WO • – – – – – Isbrytarassistansen är avslutad. Fortsätt resan till destinationsorten.

Nr		Signalen betyder då den ges från	
	Signal	Isbrytare	Assisterat fartyg
1	• –	Gå framåt (fortsätt i isrännan)	Jag går framåt (fortsätter i isrännan)
2	• – – •	Minska maskinstyrkan	Jag minskar maskinstyrkan
3	– •	Stoppa maskinen	Jag stoppar maskinen
4	• • • •	Slå back i maskinen	Slå back i maskinen *)
5	• • – • •	Stoppa framfarten (ges endast till fartyg i isränna för om eller kommande mot isbrytaren)	Jag stoppar framfarten.
6	– • – –	Var klar att mottaga (eller kasta loss) bogserkabeln	Är klar att mottaga (eller kasta loss) bogserkabeln.
7	• • • • •	Jag påkallar uppmärksamhet.	Jag påkallar uppmärksamhet.

*) Vid assistans lämnad av danska, finska, norska och svenska isbrytare används denna signal endast som repetition av order given från isbrytaren.

Anmärkningar
1. Signalen, **– • –** given som ljud- eller ljussignal, från isbrytaren må användas för att erinra fartyg om skyldigheten att kontinuerligt passa sin radio.
2. Om fler än ett fartyg assisteras, skall avstånden mellan fartygen hållas så jämna som möjligt; håll uppmärksamhet på eget och framförvarande fartygs framfart.
Skulle det egna fartygets framfart minska, avge uppmärksamhetssignal (• • • • •) till efterföljande fartyg.

F. Isklassbeteckningar
För att ange kraven på isförstärkning använder Sjöfartsverket de svensk-finska isklassbeteckningarna som fastställts att gälla från och med den 1 januari 1987. Det största isklassdjupgående midskepps skall normalt tagas som djupgåendet på färsvattenlastlinjen sommartid enligt finsk-svenska isklasser SJÖFS 1986:14.
Fartygets maskineffekt anses vara den sammanlagda effekt hos framdrivningsmaskineriet, för vilken fartyg och maskineri är konstruerat. Om det med tekniska medel förhindrats att maskineriet drivs med full effekt eller detta är förbjudet enligt bestämmelser som följs ombord, betraktas den så begränsade effekten som maskineffekt.
I nedanstående tabell lämnas en jämförelse mellan de svensk-finska isklassbeteckningarna och av olika klassificeringssällskap använda klassbeteckningar jämte tillägg för att angiva graden av isförstärkning.

De svensk-finska isklassbeteckningarna

Isklass	För trafik i
1A Super	**extrema isförhållanden**
1A	**svåra isförhållanden**
1B	**medelsvåra isförhållanden**
1C	**lätta isförhållanden**
II	**mycket lätta isförhållanden**

Jämförelsetabell mellan isklassbeteckningar

Svensk-Finska Isklasser	American Bureau of Shipping	Bureau Veritas	Det Norske Veritas
1A Super	Ice Class 1AA	I 3/3 E Ice Class 1A Super	1A1 ICE 1A*F 1A1 ICE 1A*
1A	Ice Class 1A	I 3/3 E Ice Class 1A	1A1 ICE 1A
1B	Ice Class 1B	I 3/3 E Ice Class 1B	1A1 ICE 1B
1C	Ice Class 1C	I 3/3 E Ice Class 1C	1A1 ICE 1C
II	--	--	--
II	A1	I 3/3 E	1A1

Svensk-Finska Isklasser	Germanischer Lloyd	Lloyds Register of Shipping	Polski Rejestr Statkow 1)	Russian Register of Shipping 1)
1A Super	100 A5 E4 100 A5 E4K 100 A5 E4M	100 A1 Ice Class 1AS	KM YLA KM YL	KM y**П**A KM y**П**
1A	100 A5 E3 100 A5 E3K 100 A5 E3M	100 A1 Ice Class 1A	KM L1	KM **П**1
1B	100 A5 E2 100 A5 E2K 100 A5 E2M	100 A1 Ice Class 1B	KM L2	KM **П**2
1C	100 A5 E1 100 A5 E1K 100 A5 E1M	100 A1 Ice Class 1C	KM L3	KM **П**3
II	100 A5 100 A5 E04 100 A5 E03 100 A5 E02 100 A5 E01	--	KM L4	KM**П** 4
	II 100 A5 E 100 A5 KE 100 A5 ME	100 A1 Ice Class 1D	KM	KM

Anm 1) För ett fartyg klassat hos Polski Rejestr Statkow eller Russian Register of Shipping och vars dödvikt är mindre än 15 000 ton, skall skrovbesiktningsmannen kontrollera att fartygets maskineffekt är som följer:

1A Super: P ≥0,57 x dwt + 600 (ahk): ≥3500 (ahk) 1B P ≥0,43 x dwt + 200 (ahk): ≥900 (ahk)

1A P≥ 0,50 x dwt + 400 (ahk): ≥900 (ahk) 1C P≥ 0,35 x dwt (ahk): ≥900 (ahk)

G. Krav på isklass och tonnagestorlek

För skeppningar på Norrland bör normalt räknas med följande tidpunkter för trafikbegränsningarnas ikraftträdande.

Här angivna tidpunkter är riktvärden för ifrågavarande havsområden. SjöV kommer om möjligt att tillkännage ändringar i trafikbegränsningar, 6 dagar före ikraftträdandet. Mindre hamnar och lastageplatser måste räkna med stängning även om sjöfart pågår inom området i övrigt.

Lägst is-klass/minsta dwt	Bottenviken	Bottenhavet
II / 1 300	1/12	1/1
II / 2 000 eller1C / 1 300	15/12	15/1
1B/ 2 000	1/1	1/2
1A / 3 000	15/1	15/2
1A / 4 000	31/1	–
1A / 3 000	10/4	–
1B / 2 000	10/5	1/4
II / 2 000 eller1C / 1 300	15/5	15/4

Vid svåra isförhållanden kan högre tonnagegränser komma ifråga eller assisteras fartyg endast efter tillstånd i varje särskilt fall.
Tidvis tillämpas särskilda restriktioner för s.k. flodfartyg (se sida 3 avsnitt C) även om dessa formellt uppfyller gällande krav på isklass.
Lokala isbrytare av erforderlig storlek och med tillräcklig maskinstyrka måste finnas inom de olika distrikten. Lokala isbrytare kan normalt inte påräkna assistans från ett distrikt till ett annat eller inom distriktet.
För skeppningar på övriga kustområden kan med hänsyn till variationerna i förekommande ishinder inte motsvarande riktvärden lämnas. I Vänern och Mälaren måste man normalt räkna med att restriktioner införs under månaderna januari – april.
Kraven på isklass och tonnagestorlek varierar med vinterns svårighetsgrad. Framförallt mindre hamnar och lastageplatser måste härvid stängas i avsaknad på egna lokala isbrytare och begränsad tillgång på statsisbrytare.

H. Nedisningsfaran

Redan innan fartyget anlänt till isbelagt farvatten eller sedan sådant farvatten lämnats, kan under vissa förhållanden fara uppstå för fartyg och last genom nedisning.
Så snart ytvattnets temperatur sjunkit till nära 0°C (+3°C och därunder) kan vid överspolning eller överstänk is bildas på fartygets däck, överbyggnad och eventuell däckslast. Allteftersom islagret växer, äger en viktförskjutning rum, som hela tiden minskar fartygets stabilitet. Om isen inte kan undanskaffas, nås så småningom den gräns, då metacenterhöjden blir så liten, att fartyget löper risk att kantra. Nedisning kan ske även vid högre vattentemperaturer, då temperaturen i luften ligger under 0°C, varvid det överspolade vattnet nedkyls av luften och is bildas, då det träffar de kalla ytorna ombord.
Befälhavare på fartyg, som vintertid trafikerar Östersjöområdet, måste därför ständigt vara beredda på att fartyget vid hårt väder kan bli nedisat. Då hård vind är att förvänta och väderleksläget i övrigt är sådant att nedisning kan befaras, tillråds mindre fartyg, som befinner sig till sjöss, att söka lä, fartyg i hamn bör kvarligga, till dess vädret blir bättre.
Följande diagram visar sambandet mellan nedisningsgraden, vindhastigheten och lufttemperaturen. Andra faktorer som påverkar nedisningsgraden är fartygets egen kurs och fart, våghöjd och ytvattentemperatur.
Diagrammet är tillämpbart för förhållandena i Östersjön och Bottniska Viken för fartyg över 500 dwt.

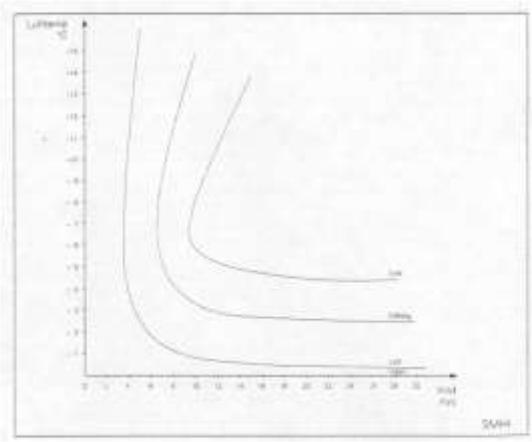


Fig 15   Diagram för bedömning av risk för nedisning

I. Sjöräddning
Med anledning av sjökatastrofer, som inträffat i Östersjön på grund av hårt väder och nedisning, uppmanas alla fartygsbefälhavare, inte minst utländska sådana, som inte har erfarenhet av nedisning, att så snart svårigheter uppstår för deras fartyg till sjöss utanför Sveriges kuster, ta kontakt med svensk kustradiostation och anmäla svårigheterna samt position, kurs och övriga upplysningar, som är av betydelse i sammanhanget. Situationen blir därigenom känd för sjöräddningstjänstens olika organ, vilka, om läget förvärras, kan vara beredda att ingripa, innan det blir är sent. Dylika säkerhetsåtgärder är kostnadsfria för fartyget.

J. Anvisningar för skeppsbrutna
Skulle en sjöolycka inträffa vintertid, varvid de nödställda tvingas att hoppa i vattnet eller gå i livbåtarna, är det av största vikt att vara varmt klädd. Behåll våta kläder på, kasta framför allt inte bort handskar eller vantar. Händerna måste skyddas från snabb avkylning för att den nödställde skall kunna hålla sig fast i räddningslinor och dylikt.
Prov har utförts i Sverige med vattentät dräkt i vatten, som varit plus 4°C. Händerna har varit dels oskyddade, dels skyddade. Vid prov utan skydd hade efter 30 minuter hudtemperaturen i händerna sjunkit till 10°C, fingertopparnas temperatur var 5°C och smärtan i dessa så stor, att fingrarna inte kunde användas. Med goda vantar på var temperaturen i händerna efter 30 minuter fortfarande ca 20°C.
Utsatt för kyla och vind sker lokal förfrysning av huden vid lufttemperatur och vindstyrka enligt följande:

-4˚C	ca 20 m/s	-14˚C	ca 5 m/s
-8˚C	ca 10 m/s	-34˚C	ca 1 m/s

2.6 ISPATRULLERING - ISBERG

Haveri

(Saxat från Svensk Sjöfartstidning 34/1991)

Det finländska lastfartyget "Finnpolaris", som seglade under Bahamasflagg, körde den 11 augusti på ett stort isflak eller isberg utanför den grönländska västkusten. Fartyget fick skador i styrbords sida och började ta in vatten. Besättningen på 18 man samt en passagerare lämnade fartyget och räddades sex timmar senare av den danska tankern "Sofie Theresa" (ex finländska "Amanda"). "Finnpolaris" sjönk på morgonen den 12 augusti.

"Finnpolaris" var på väg från Nanisivik i Kanada till Darrow i USA med last av anrikad zink. Hon byggdes i Spanien 1981 och var på 14.907 ton DW. Hon hade högsta isklass 1A Super och hade tidigare bl a fört expeditioner till Antarktis. Fartyget ägdes av Finnlines dotterbolag FCRS-Shipping på Caymanöarna.

Den internationella ispatrulleringen

Is, och i synnerhet isberg, utgör en allvarlig fara för sjöfarten. En fara som befälet ombord på fartygen måste beakta. Denna risk blev i högsta grad en realitet 1912 när passagerarfartyget "Titanic" förliste, efter en kollision med ett isberg utanför Newfoundland.

Denna händelse medförde att man kontinuerligt började spana av området efter tecken på is och isberg. Sedan 1914 har denna ispatrullering ombesörjts av US Coast Guard. Denna uppgift, som utförs av den amerikanska kustbevakningen, kallas idag för "International Ice Patrol" (IIP).

As of 1992 the governments contributing to the Ice Patrol included Belgium, Canada, Denmark, Finland, France, Germany, Greece, Israel, Italy, Japan, Netherlands, Norway, Panama, Poland, Spain, Sweden, United Kingdom, United States of America, and Yugoslavia.

Originally, there were thirteen nations which signed the 1914 SOLAS (Safety of Life at Sea) Convention agreement. These nations agreed to share costs in accordance with a formula approximating their degree of individual benefit. This sharing arrangement has been updated over the years as shipping patterns changed and as additional nations acceded to the treaty.

Financial relations are handled by the U.S. Department of State which does the actual billing of each nation for its share of the cost. In the early days this share was a fixed percentage, changed from time to time by treaty revision. In recent years, the cost share has been based on each participating nation's percentage of the total cargo tonnage transiting the patrol area during the ice season**.**

Isbergen i området utanför Newfoundland kommer huvudsakligen från glaciärer på Grönlands västkust. Därifrån förs de söderut mot "Grand Banks" (utanför Newfoundland) av den kalla sydgående Labradorströmen. Det är också i detta område som denna kalla Labradorström möter den betydligt varmare Golfströmen. Temperaturdifferenser, i vattnet, på upp till 20°C är inte ovanliga. På grund av denna stora temperaturdifferens råder i området ofta tät tjocka, under 40 - 50% av året.

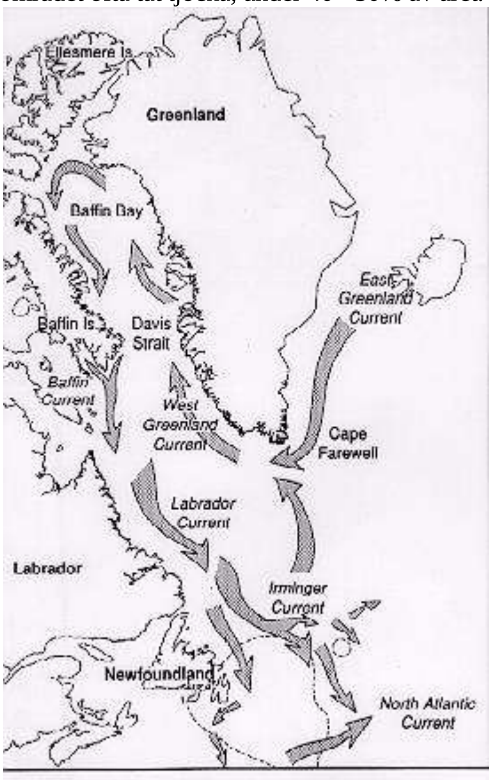


Fig. 16 Isbergen utanför Newfoundland kommer med Labradorströmen från i huvudsak Grönlands västkust.

Området runt Newfoundland och "Grand Banks" är ett av de farligaste havsområdena i världen, detta på grund av bl a följande orsaker:

- frekvent tät tjocka,
- isberg,
- ofta hårt väder,
- den täta transatlantiska trafiken
- stora mängder fiskefartyg,
- oljeutvinningsplattformar.

Den Internationella Ispatrulleringens uppgift är att observera och studera isbergens rörelser i syfte att kunna varna sjöfarten i området. Kostnaderna för att bedriva denna ispatrullering betalas, via USA, av de nationer som undertecknat SOLAS. (Se faktaruta föregående sida).

Ispatrulleringen/spaningen genomförs i huvudsak med flygplan. Det vanligaste flygplanet för denna uppgift har under de senaste 20 åren varit "Hercules HC-130. Dessa plan är bl a utrustade med SLAR (Side Looking Airborne Radar). Normalt sker spaning 7 dagar per två veckors period under perioden februari till augusti. Bas för denna flygspaningsverksamhet är St John's på Newfoundland.

Information om isläget isbergens position etc erhålls från denna flygspaning men även fartygsrapporter är viktiga och står för en betydande del av samtliga rapporterade isberg. (Se även SOLAS Kap V - om befälhavares skyldighet att rapportera). Nedanstående tabell visar att fartygen står för ca 30 % av alla rapporterade upptäckter av is i området. (Se exempel på isvarning)

Tabell 2. Rapporteringskällor för olika typer av is i området kring New Foundland AMVER Bulletin 1/90

	GROWLER	SMALL TABULAR	SMALL PINNACLE	MEDIUM TABULAR	MEDIUM PINNACLE	LARGE TABULAR	LARGE PINNACLE	RADAR	TOTALS	% TOTAL
COAST GUARD SLAR	**31**	**144**	**55**	**149**	**66**	**84**	**45**	**80**	**654**	**21,90%**
COAST GUARD VISUAL	**39**	**116**	**20**	**118**	**14**	**55**	**21**	**2**	**385**	**12,89%**
CANADIAN SLAR	**5**	**19**	**3**	**21**	**5**	**3**	**1**	**7**	**64**	**2,14%**
CANADIAN VISUAL	**18**	**70**	**25**	**44**	**9**	**19**	**3**	**1**	**189**	**6,33%**
OIL AIR RECON	**47**	**101**	**9**	**66**	**18**	**25**	**3**	**0**	**269**	**9,01**
SHIP REPORTS	***74***	***122***	***91***	***198***	***185***	***83***	***94***	***26***	***873***	***29,24%***
LIGHTHOUSE/SHORE	**0**	**1**	**3**	**6**	**7**	**6**	**4**	**0**	**27**	**0,90%**
DOD	**0**	**61**	**1**	**116**	**6**	**55**	**11**	**6**	**256**	**8,57%**
OTHER	**4**	**5**	**10**	**17**	**9**	**9**	**5**	**5**	**64**	**2,14%**
BAPS	**7**	**43**	**23**	**79**	**23**	**20**	**9**	**1**	**205**	**6,87%**
TOTALS	**225**	**682**	**240**	**814**	**342**	**359**	**196**	**128**	**2986**	**100%**

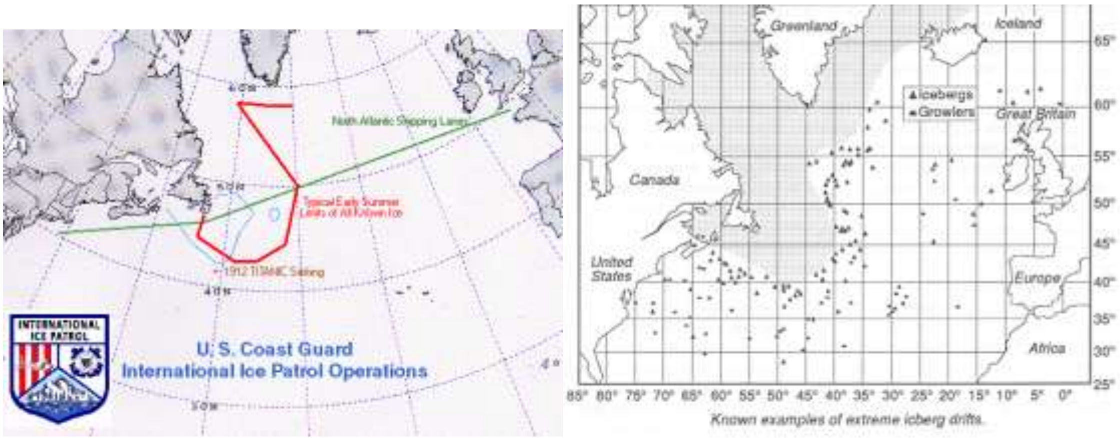


Fig. 17 Ispatrulleringen samt typisk utbredning av isberg.

Alla fartyg i området utanför Newfoundland ombeds att rapportera iskonditionen var 6:e timma till IIP-operationscentralen i Groton, Connecticut. En sådan rapport bör innehålla:

- *Fartygets namn - anropssignal*
- *Fartygets - isens position (ange vilket)*
- *Fartygets kurs och fart*
- *Tid för upptäckt*
- *Metod för upptäckt (visuellt, radar)*
- *Storlek och utseende av isberg (se tabell ovan)*
- *Iskoncentration*
- *Vattentemperatur.*

Fartyg som ej har upptäckt/har kontakt med is ombeds även de att rapportera. Ange i sådana fall:

- *"No ice observed".*

Även sådana rapporter är värdefulla. Rapporterna sänds kostnadsfritt via US Coast Guard Communication eller Canadian Coast Guard Marine Radio Station.

Erhållen isinformation, från alla källor, matas in i en dator två gånger dagligen vid IIP's operationscentral. Havsströmmar och väderdata inmatas och en modell används för att beräkna drift etc av isbergen. Beräknade positioner av isbergen används för att uppskatta gränsen för all känd is var 12 timma. Varning för isgränser och kritiska isberg utsänds som en "ice bulletin" till sjöfarten.

För att kontinuerligt kunna följa isbergens rörelse "färgbombar" man dessa. Detta sker genom att från flygplan släppa ut färgbehållare som slås sönder mot isberget. Vissa större isberg i området har drivit omkring mer än 3 år innan de visat tecken till att upplösas.

2.7 Utdrag från SOLAS Kap V "Safety of navigation"

Regulation 6 Ice Patrol Service

1. *The Ice Patrol contributes to safety of life at sea, safety and efficiency of navigation and protection of the marine environment in the North Atlantic. Ships transiting the region of icebergs guarded by the Ice Patrol during the ice season are required to make use of the services provided by the Ice Patrol.*

2. *The Contracting Governments undertake to continue an ice patrol and a service for study and observation of ice conditions in the North Atlantic. During the whole of the ice season, i.e. for the period from February 15th through July 1st of each year, the south-eastern, southern and south-western limits of the region of icebergs in the vicinity of the Grand Banks of Newfoundland shall be guarded for the purpose of informing passing ships of the extent of this dangerous region; for the study of ice con-*

ditions in general; and for the purpose of affording assistance to ships and crews requiring aid within the limits of operation of the patrol ships and aircraft. During the rest of the year the study and observation of ice conditions shall be maintained as advisable.

3. *Ships and aircraft used for the ice patrol service and the study and observation of ice conditions may be assigned other duties provided that such other duties do not interfere with the primary purpose or increase the cost of this service.*

4. *The Government of the United States of America agrees to continue the overall management of the ice patrol service and the study and observation of ice conditions, including the dissemination of information therefrom.*

5. *The terms and conditions governing the management, operation and financing of the Ice Patrol are set forth in the Rules for the management, operation and financing of the North Atlantic Ice Patrol appended to this chapter which shall form an integral part of this chapter.*

6. *If, at any time, the United States and/or Canadian Governments should desire, to discontinue providing these services, it may do so and the Contracting Governments shall settle the question of continuing these services in accordance with their mutual interests. The United States and/or Canadian Governments shall provide 18 months written notice to all Contracting Governments whose ships entitled to fly their flag and whose ships are registered in territories to which those Contracting Governments have extended this regulation benefit from these services before discontinuing providing these services.*

APPENDIX TO CHAPTER V

Rules for the management, operation and financing of the north atlantic ice patrol

1. *In these Rules:*

1.1 ***Ice season*** *means the annual period between February 15 and July 1.*

1.2 ***Region of icebergs guarded by the ice patrol*** *means the south-eastern, southern and south-western limits of the region of icebergs in the vicinity of the Grand Banks of Newfoundland.*

1.3 ***Routes passing through regions of icebergs guarded by the Ice Patrol*** *means:*

1.3.1 *routes between Atlantic Coast ports of Canada (including inland ports approached from the North Atlantic through the Gut of Canso and Cabot Straits) and ports of Europe, Asia or Africa approached from the North Atlantic through or north of the Straits of Gibraltar (except routes which pass south of the extreme limits of ice of all types).*

1.3.2 *routes via Cape Race, Newfoundland between Atlantic Coast ports of Canada (including inland ports approached from the North Atlantic through the Gut of Canso and Cabot Straits) west of Cape Race, Newfoundland and Atlantic Coast ports of Canada north of Cape Race, Newfoundland.*

1.3.3 *routes between Atlantic and Gulf Coast ports of the United States of America inland ports approached from the North Atlantic through the Gut of Canso and Cabot straits) and ports of Europe, Asia or Africa approached from the North Atlantic through or north of the Straits of Gibraltar (except routes which pass south of the extreme limits of ice of all types).*

1.3.4 *routes via Cape Race, Newfoundland between Atlantic and Gulf Coast ports of the United States of America (including inland ports approached from the North Atlantic through the Gut of Canso and Cabot Straits) and Atlantic Coast ports of Canada north of Cape Race, Newfoundland.*

1.4 ***Extreme limits of ice of all types*** *in the North Atlantic Ocean is defined by a line connecting the following points:*

A - 42° 23'.00N, 59° 25'.00W
B - 41° 23'.00N, 57° 00'.00W
C - 40° 47'.00N, 55° 00'.00W
D - 40° 07'.00N, 53° 00'.00W
E - 39° 18'.00N, 49° 39'.00W
F - 38° 00'.00N, 47° 35'.00W
G - 37° 41'.00N, 46° 40'.00W
H - 38° 00'.00N, 45° 33'.00W
I - 39° 05'.00N, 43° 00'.00W
J - 39° 49'.00N, 41° 00'.00W
K - 40° 39'.00N, 39° 00'.00W
L - 41° 19'.00N, 38° 00'.00W

M - 43° 00'.00N, 37° 27'.00W
N - 44° 00'.00N, 37° 29'.00W
O - 46° 00'.00N, 37° 55'.00W
P - 48° 00'.00N, 38° 28'.00W
Q - 50° 00'.00N, 39° 07'.00W
R - 51° 25'.00N, 39° 45'.00W.

1.5 ***Managing and operating*** *means maintaining, administering and operating the Ice Patrol, including the dissemination of information received therefrom.*
1.6 ***Contributing Government*** *means a Contracting Government undertaking to contribute to the costs of the ice patrol service pursuant to these Rules.*
2. *Each Contracting Government specially interested in these services whose ships pass through the region of icebergs during the ice season undertakes to contribute to the Government of the United States of America its proportionate share of the costs for the management and operation of the ice patrol service. The contribution to the Government of the United States of America shall be based on the ratio which the average annual gross tonnage of that contributing Government's ships passing through the region of icebergs guarded by the Ice Patrol during the previous three ice seasons bears to the combined average annual gross tonnage of all ships that passed through the region of icebergs guarded by the Ice Patrol during the previous three ice seasons.*
3. *All contributions shall be calculated by multiplying the ratio described in paragraph 2 by the average actual annual cost incurred by the Governments of the United States of America and Canada of managing and operating ice patrol services during the previous three years. This ratio shall be computed annually, and shall be expressed in terms of a lump sum per-annum fee.*
4. *Each of the contributing Governments has the right to alter or discontinue its contribution, and other interested Governments may undertake to contribute to the expense. The contributing Government which avails itself of this right will continue to be responsible for its current contribution up to 1 September following the date of giving notice of intention to alter or discontinue its contribution. To take advantage of the said right it must give notice to the managing Government at least six months before the said 1 September.*
5. *Each contributing Government shall notify the Secretary-General of its undertaking pursuant to paragraph 2, who shall notify all Contracting Governments.*
6. *The Government of the United States of America shall furnish annually to each contributing Government a statement of the total cost incurred by the Governments of the United States of America and Canada of managing and operating the Ice Patrol for that year and of the average percentage share for the past three years of each contributing Government.*
7. *The managing government shall publish annual accounts including a statement of costs incurred by the governments providing the services for the past three years and the total gross tonnage using the service for the past three years. The accounts shall be publicly available. Within three months after having received the cost statement, contributing Governments may request more detailed information regarding the costs incurred in managing and operating the Ice Patrol.*
8. *These Rules shall be operative beginning with the ice season of 2002.*

Guidance notes

1. This Regulation replaces Regulation 6 of SOLAS V/74 and sets out the commitments made by the Governments of the United States of America and Canada to provide the North Atlantic Ice Patrol.
2. The service is financed by contributions made by "Contributing Governments", which comprise a number of IMO member States the ships of whose fleet trade within the North Atlantic iceberg region. The UK is Contributing Government.
3. Paragraph 1 requires ships transiting the iceberg area guarded by the service to make use of the Service.
4. For full details of the Service and reporting requirements for ships in the ice area refer to the Admiralty List of Radio Signals Vol.3 part 2.
5. More information about the service with regularly updated ice reports can be found on the US Coastguard website:
   http://www.uscg.mil/lantarea/iip/home.html
6. Paragraph 5 refers to rules forming an integral part of Chapter V. These are reproduced as Appendix 1 to this publication.

Regulation 32
Information required in danger messages
The following information is required in danger messages:
1. *Ice, derelicts and other direct dangers to navigation:*
1.1 *The kind of ice, derelict or danger observed.*
1.2 *The position of the ice, derelict or danger when last observed.*
1.3 *The time and date (Universal Co-ordinated Time) when the danger was last observed.*
2. *Tropical cyclones (storms)**
2.1 *A statement that a tropical cyclone has been encountered. This obligation should be interpreted in a broad spirit, and information transmitted whenever the master has good reason to believe that a tropical cyclone is developing or exists in the neighbourhood.*
2.2 *Time, date (Universal Co-ordinated Time) and position of ship when the observation was taken.*
2.3 *As much of the following information as is practicable should be included in the message:*

- *barometric pressure,** preferably corrected (stating millibars, millimetres, or inches, and whether corrected or uncorrected);*
- *barometric tendency (the change in barometric pressure during the past three hours);*
- *true wind direction;*
- *wind force (Beaufort scale);*
- *state of the sea (smooth, moderate, rough, high);*
- *swell (slight, moderate, heavy) and the true direction from which it comes. Period or length of swell (short, average, long) would also be of value;*
- *true course and speed of ship.*

Subsequent observations
3. *When a master has reported a tropical cyclone or other dangerous storm, it is desirable but not obligatory, that further observations be made and transmitted hourly, if practicable, but in any case at intervals of not more than 3 hours, so long as the ship remains under the influence of the storm.*
4. *Winds of force 10 or above on the Beaufort scale for which no storm warning has been received. This is intended to deal with storms other than the tropical cyclones referred to in paragraph 2; when such a storm is encountered, the message should contain similar information to that listed under the paragraph but excluding the details concerning sea and swell*
5. *Sub-freezing air temperatures associated with gale force winds causing severe ice accretion on superstructures:*
5.1 *Time and date (Universal Co-ordinated Time).*
5.2 *Air temperature.*
5.3 *Sea temperature (if practicable).*
5.4 *Wind force and direction.*
** The term tropical cyclone is the generic term used by national meteorological services of the World Meteorological Organization. The term hurricane, typhoon, cyclone, severe tropical storm, etc., may also be used, depending on the geographical location.*
*** The standard international unit for barometric pressure is the hectopascal (hPa) which is numerically equivalent to the millibar (mbar).*
Examples

Ice
TTT ICE. LARGE BERG SIGHTED IN 4506 N, 4410W, AT 0800 UTC. MAY 15.
Derelicts
TTT DERELICT. OBSERVED DERELICT ALMOST SUBMERGED IN 4006 N, 1243W, AT 1630 UTC. APRIL 21.
Danger to navigation
TTT NAVIGATION. ALPHA LIGHTSHIP NOT ON STATION. 1800 UTC. JANUARY 3.
Tropical cyclone
TTT STORM. 0030 UTC. AUGUST 18. 2004 N, 11354 E. BAROMETER CORRECTED 994 MILLIBARS, TENDENCY DOWN 6 MILLIBARS. WIND NW, FORCE 9, HEAVY SQUALLS. HEAVY EASTERLY SWELL. COURSE 067, 5 KNOTS.
TTT STORM. APPEARANCES INDICATE APPROACH OF HURRICANE. 1300 UTC. SEPTEMBER 14. 2200 N, 7236 W. BAROMETER CORRECTED 29.64 INCHES,

TENDENCY DOWN .015 INCHES. WIND NE, FORCE 8, FREQUENT RAIN SQUALLS. COURSE 035, 9 KNOTS.
TTT STORM. CONDITIONS INDICATE INTENSE CYCLONE HAS FORMED. 0200 UTC. MAY 4. 1620 N, 9203 E. BAROMETER UNCORRECTED 753 MILLIMETRES, TENDENCY DOWN 5 MILLIMETRES. WIND S BY W, FORCE 5. COURSE 300, 8 KNOTS.
TTT STORM. TYPHOON TO SOUTHEAST. 0300 UTC. JUNE 12. 1812 N, 12605 E. BAROMETER FALLING RAPIDLY. WIND INCREASING FROM N.
TTT STORM. WIND FORCE 11, NO STORM WARNING RECEIVED. 0300 UTC. MAY 4. 4830 N, 30 W. BAROMETER CORRECTED 983 MILLIBARS, TENDENCY DOWN 4 MILLIBARS. WIND SW, FORCE 11 VEERING. COURSE 260, 6 KNOTS.
Icing
TTT EXPERIENCING SEVERE ICING. 1400 UTC. MARCH 2. 69 N, 10 W. AIR TEMPERATURE 18°F (-7.8°C). SEA TEMPERATURE 29°F (-1.7°C). WIND NE, FORCE 8.

Regulation 34
Safe navigation and avoidance of dangerous situations

1. *Prior to proceeding to sea, the master shall ensure that the intended voyage has been planned using the appropriate nautical charts and nautical publications for the area concerned, taking into account the guidelines and recommendations developed by the Organization.**

2. *The voyage plan shall identify a route which:*

2.1 *takes into account any relevant ships' routeing systems*

2.2 *ensures sufficient sea room for the safe passage of the ship throughout the voyage*

2.3 *anticipates all known navigational hazards and adverse weather conditions; and*

2.4 *takes into account the marine environmental protection measures that apply, and avoids, as far as possible, actions and activities which could cause damage to the environment*

3. *The owner, the charterer, or the company, as defined in regulation IX/1, operating the ship or any other person shall not prevent or restrict the master of the ship from taking or executing any decision which, in the master's professional judgement, is necessary for safe navigation and protection of the marine environment.*

**Refer to the Guidelines for Voyage Planning, adopted by the Organization by Resolution A.893(21)*

2.8 Exempel på isvarningar

FICN11 CWIS 231550
ICEBERG BULLETIN FOR EAST COAST WATERS ISSUED BY ENVIRONMENT CANADA ICE CENTRE OTTAWA AT 1600 UTC FRIDAY 23 FEBRUARY 1996.

THE LIMIT OF ALL KNOWN ICEBERGS AT 1200 UTC IS ESTIMATED TO EXTEND FROM THE NEWFOUNDLAND COAST NEAR 4830N 5300W TO 4830N 5120W TO 5115N 4755W TO 5400N 4700W TO 5540N 4730W TO 5800N 5600W THEN EASTWARD.

THERE ARE ISOLATED TO SCATTERED ICEBERGS AND GROWLERS SOUTH OF 5300N AND SCATTERED TO MANY ICEBERGS AND GROWLERS NORTH OF 5300N.

ALL SHIPS OPERATING IN THIS AREA ARE REQUESTED TO REPORT THEIR POSITION COURSE AND ICE OBSERVATION EVERY SIX HOURS TO ICE ST JOHNS VIA ANY CANADIAN MARINE RADIO STATION.

END

FICN01 CWIS 021450
ICE HAZARD BULLETIN FOR THE GULF OF ST LAWRENCE ISSUED BY ENVIRONMENT CANADA FROM CANADIAN ICE SERVICE IN OTTAWA AT 1500 UTC SATURDAY 2 MARCH 1996.

ICE WARNING IN EFFECT FOR RAPID CLOSING OF LEADS OF NEW ICE ALONG THE QUEBEC SHORE WEST OF 63W AND IN NORTHERN CHALEUR BAY AND FOR STRONG ICE PRESSURE IN NORTHUMBERLAND STRAIT SATURDAY EVENING.

ICE EDGE AT 1500 UTC ESTIMATED FROM THE CAPE BRETON COAST NEAR 4555N 5950W TO 4555N 5920W TO 4655N 5920W TO 4800N 6020W TO THE NEWFOUNDLAND COAST NEAR 4740N 5920W.

MARINERS ARE ADVISED TO OBTAIN FURTHER INFORMATION BEFORE ENTERING THE ICE AREA. FOR MORE ICE INFORMATION PLEASE CONTACT CANADIAN ICE SERVICE ENVIRONMENT CANADA AT PHONE 613-996-1550 OR FAX AT 613-947-9160.

END

2.9 Beware – ICE

On studying our internal statistics, firstly we can immediately note which winters have been severe. Secondly, we can pinpoint the most exposed areas as the St Lawrence. The additional premiums we receive for the St Lawrence area does not cover claims. These are Hull & Machinery statistics. We know the vessels, following such damage, are also taken out of service. The cost for the ship-owner, including deductibles and loss of use, is often higher than our exposure as a Hull underwriter.

We also note that there are more claims from non-ice-stengthened vessels than from vessels which possess ice-class. The cost, however, is the other way around. The reason may be either that ice-classed vessels trade further into restricted areas, with higher speeds, or when damage is suffered, additional amounts of steel are required due to the strengthening of the hull.

Our advice to our members is to be careful!

Ice and, for that matter, very low temperatures may cause more severe damage than the freight income warrants. Delays can be extensive; the lost time may be costly. Crews have to be very experienced in order to be able to navigate in such an environment. Check the prevailing conditions prior to agreeing to a charter. Have a second thought to contemplate whether or not it is really worthwhile trading in these areas. We have members, with ice-classed ships, who think it is better to stay away and keep the ship engaged rather than be exposed to a long interruption. Remember, even ice-breakers may face problems during a severe winter.

If you want to discuss this subject, please feel free to contact the Club at anytime. We have experience from previous years that we are always willing to share with you. Remember, the ice may be more than 1 meter thick but the steel plate is only 20 mm.

(News, the Swedish club 2/1995)

3. Manöverbarhetskriterier

Behovet av någon form av riktlinjer och kriterier, för fartygs manöveregenskaper, har under 1980-talet emellertid uppmärksammats, bl a inom IMO. Man hade i början av arbetet inte något underlag för siffermässiga rekommendationer och IMO bad därför medlemsländerna att inkomma med lämpligt provtursmaterial och sådana synpunkter som kunde ligga till grund för en formulering av kriterier.

Målet var att kunna ställa upp en "provturskod" med karakteristiska jämförelsetal (minsta, största, eller annat rekommenderat värde) som i ett visst avseende definierar ett fartygs manöveregenskaper.
Under hösten 1995 antog IMOs Assembly en resolution A.751(18) "Interim Standards for Ship Manoeuvrability" där man identifierar signifikanta egenskaper som skall ligga till grund för värdering av fartygs manöverförmåga. Denna resolution ersattes I december 2002 med MSC Resolution 137 (76) ”Standards for Ship Manoeuvrability" samt förklaringar i MSC/Circ.1053 ”Explanatory notes to the Standards for Ship Manoeuvrability”

De av IMO nämnda delegenskaperna rörande fartygs manöverförmåga kan sammanfattas i följande manöveregenskaper:

1. Course keeping ability - Kurshållningsegenskaper, kurssstabilitet
2. Initial turning/course changing ability -Kursändringsförmåga
3. Yaw checking ability - Stöttningsförmåga
4. Turning ability - Girförmåga
5. Stopping ability – Stoppförmåga

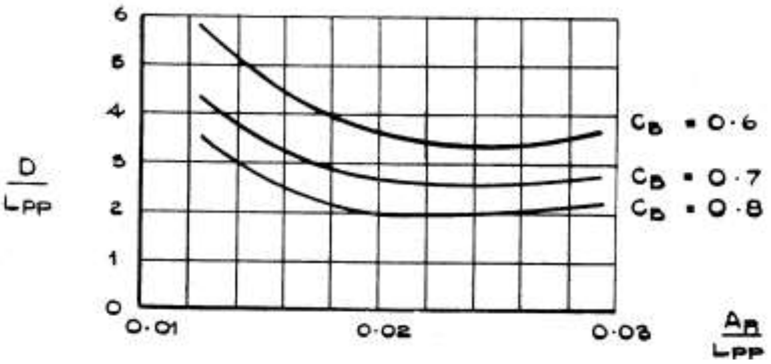


Fig. 18 Ett fartygs manöverförmåga påverkas av många faktorer, t ex roder och roderytans storlek. Figuren visar roderareans procentuella storlek och dess betydelse för girdiametern.

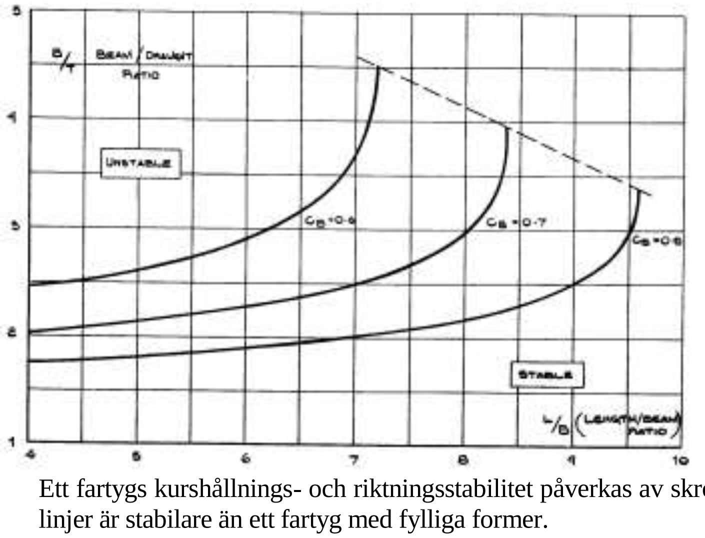


Fig. 19 Ett fartygs kurshållnings- och riktningsstabilitet påverkas av skrovformen. Ett fartyg med smäckra linjer är stabilare än ett fartyg med fylliga former.

3.1 Fastslagna kriterier i resolution MSC Resolution 137 (76)

MSC Resolution 137(76) gäller för fartyg med en längd över hundra meter oberoende av framdrivningssystem och rodertyper samt för alla kem- och gastankfartyg oavsett storlek. Undantagna är HSC, (High Speed Craft). (För den fullständiga texten se bilaga) De manöveregenskaper som anges i resolutionen och där man fastställt kriterier kan sammanfattas enligt följande

Turning ability
Vid både styrbords som babord gir, med fullt roderutslag och vid test fart skall;

- "advance" ej överstiga 4,5 fartygslängder och
- "tactical diameter" ej överstiga 5 fartygslängder

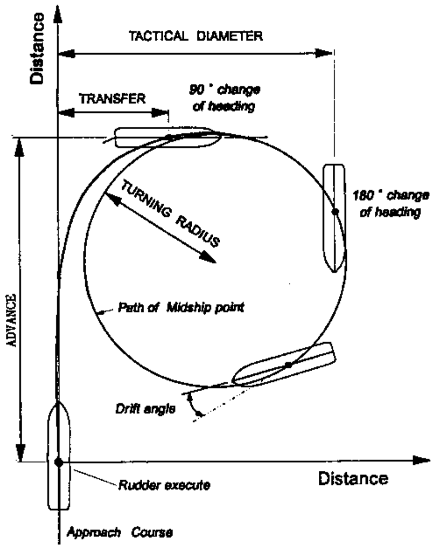


Fig. 20 Girkurvan med förklaringar

Initial turning ability
Med rodret 10° till styrbord eller babord skall fartyget ha girat minst 10° innan det förflyttat sig mer än 2,5 fartygslängder

Yaw checking and course keeping ability
Värdet på den första "overshoot angle" vid 10°/10° zig-zag prov skall ej överstiga;

- .1 10° om L/V är mindre än 10 s;
- .2 20° om L/V är 30 s eller mer; och
- .3 (5 + 1/2(L/V)) degrees if L/V är 10 s eller mer, men mindre än 30 s,

L = fartygslängd uttryckt i meter)
V = fartygets hastighet uttryckt i m/s.

Andra "overshoot angle" i 10°/10° zig-zag provet skall ej överstiga värdet med mer än

- .1 25°, om L/V är mindre än 10 s;
- .2 40°, om L/V är30 s eller mer; och
- .3 (17.5 + 0.75(L/V))°, om L/V är 10 s eller mer, men mindre 30 s.
- .3 Värdet på första "overshoot angle" vid 20°/20° zig-zag prov skall ej överstiga 25°.

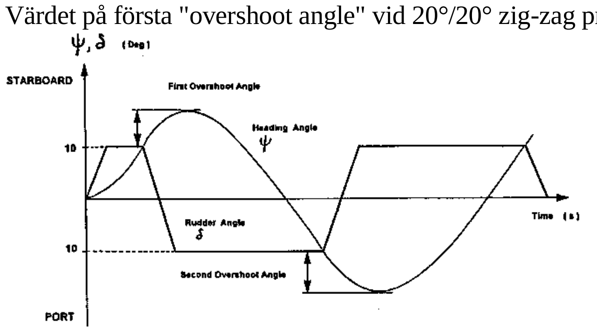


Fig. 21 Zig-Zag test

Stopping ability
”Track reach" vid stopprov, full back skall ej överstiga 15 fartygslängder. För fartyg med stort deplacement kan undantag beviljas men ”track reach” skall i inget fall överstiga 20 fartygslängder

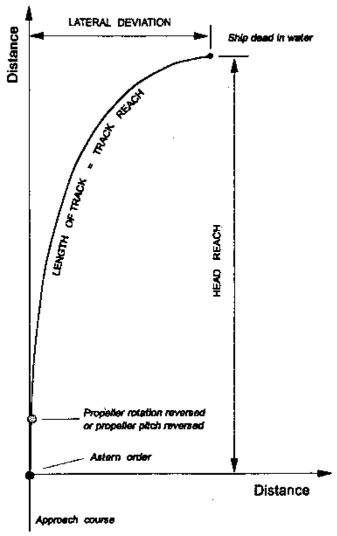


Fig 22 Crash stop test

3.2 MANÖVERPROV

När ett nybyggt fartyg, innan leverans, går ut på provtur testas alla dess funktioner, radio, navigationsutrustning, pumpar, kök etc. Vidare testas fartygets manöveregenskaper i enlighet med det som avtalats mellan rederi och varv. Regler för manöverprov, hur de skall utföras, vilka prov som skall utföras och vilka kriterier som gäller finns i både nationell lagstiftning, i klassreglementen och i internationella konventioner. Det praktiska förfarandet beträffande manöverprov beskrivs längre fram i texten.

3.3 Klassens krav på manöverprov

Utdrag från DNV´s klassreglemente

- **K 400 Trials**

401. The steering gear is to be tried out on the trial trip in order to demonstrate to the surveyor's satisfaction that the requirements of the rules have been met. (The design requirement given in J102 d) need not be proved by trials at maximum astern speed and maximum rudder angles.) The trial is to include the operation of the following:

a) Trial conditions:

- loaded on summer load waterline

- running ahead at maximum service speed corresponding to maximum nominal shaft RPM and maximum continuous rating (MCR) of the main engine(s) and if equipped with controllable pitch propeller(s), the propeller pitch is to be at the maximum design pitch corresponding to the nominal shaft RPM and MCR of the main engine(s).If the vessel cannot be tested on summer load waterline, alternative trial conditions may be specially considered. See 402 and 403.a1) Main steering gear trial:

- turning the rudder over from 35° on one side to 35° on the other side and vice versa

- from 35° on either side to 30° on the other sides respectively within required time as given in J102, or if class notation Tug, Supply Vessel, or Ice Classes ICE 05-15 or POLAR 10-30, or Icebreaker in the respective rule sections. Where main steering gear comprises two or more identical power units, the steering gear is to be tested with each power unit individually and all together, provided these are intended for simultaneous running. For capacity versus number of power units in operation, see J104.a2) Auxiliary steering gear trial:

- turning the rudder over from 15° on one side to 15° on the other side in not more than 60 seconds with the ship on summer load waterline and running ahead at one half of the maximum ahead service speed or 7 knots, whichever is the greater.

b) the steering gear power units, including transfer between steering gear power units

c) the isolation of one power actuating system, checking the time for regaining steering capability

d) the hydraulic fluid recharging system

e) the emergency power supply required in J900

f) the steering gear controls, including transfer of control and local control

g) the means of communication between the steering gear compartment and the wheelhouse, also the engine room, if applicable

h) the alarms and indicators

i) where steering gear is designed to avoid hydraulic locking this feature shall be demonstrated. Test items d), g) and h) may be effected at the dockside.

402. When performance test is carried out with reduced draught with partly submerged rudder, calculations showing corresponding rudder force and torque for the trials are to be submitted on request.

403. Ships fitted with semi-spade rudders are normally to be tested with the rudders completely submerged. However, when satisfactory results are proved by sister ships, tests according to 402 with partly submerged rudder may be accepted. Calculations of the expected rudder force and torque for the trials are to be submitted. If test results for sisterships are not available, steering gear test with rudder partly submerged may be accepted upon special consideration in each case.

SECTION 8 Ship Manoeuvring Information

A. General.

A 100 Application.

101 Ships requesting Class Notation W1 shall comply with the Rules in this Section.

A 200 General.

201 Information about the ship's manoeuvring characteristics enabling the navigator to safely carry out manoeuvring functions shall be available on the bridge.

202 This Section deals with:

- manoeuvring information to be provided

- presentation of the manoeuvring information.

203 The manoeuvring information to be provided shall be presented by means of:

- pilot card
- wheelhouse poster
- manoeuvring booklet.

204 The method of identifying the manoeuvring characteristics of the ship and the results of individual tests and trials are subject to approval.

A 300 Manoeuvring information.

301 Before being assigned Class Notation W1, the information on the manoeuvrability of the ship shall be established for at least one loading condition.

302 Information on the manoeuvrability of the ship not covered by the original data shall be compiled as experience is gained in manoeuvring the ship under different operating conditions.

303 Additional information compiled on the manoeuvring characteristics shall be registered in the manoeuvring booklet and the wheelhouse poster when applicable.

A 400 Sister ships.

401 For ships built in series according to identical drawings, only one ship in the series has to undertake the complete trial program according to these Rules.

402 A sister ship shall at least make the following trials:

- speed trial at full speed ahead
- stopping trial from full speed ahead
- turning circle trials at full speed ahead to both port and starboard.

403 All information which is duplicated from a sister ship shall be marked with a statement to this effect together with the identification of the sister ship

B. Provision of Manoeuvring Information
B 100 General.

101 Information regarding the ship's manoeuvring characteristics shall be provided to give the navigator the best presumption in selecting the correct speed and rudder angle relative to the prevailing conditions and intended manoeuvre.

102 The Guidance Notes specifying how to achieve the information required on manoeuvring characteristics refer to full scale manoeuvring trials.

B 200 Speed ability.

201 Information about speed ability in terms of the actual speed potential of the ship at various engine settings shall be provided.

Guidance note:In ballast condition, trials should be performed at three engine settings:
- *at full speed ahead (approximately 90% of maximum continuous power rating, MCR)*

- *at half speed ahead (approximately 75% of MCR)*

- *at slow speed ahead (approximately 50% of MCR).*

B 300 Stopping ability.

301 Information about the ship's stopping abilities at various speed settings applying different astern power shall be provided.

Guidance note:Trials should be made from an initial full speed ahead and with application of the following astern powers:

- *constant full astern power*

- *Andreassen stop manoeuvre*

- *with propulsion and engine stopped.*

B 400 Turning ability.

401 Information about the ship's turning ability shall be provided.

Guidance note:

a) Turning trial runs should be made to port and to starboard using maximum rudder angle without changing engine control setting from the following initial speeds:

- *initial full speed ahead*

- *initial slow speed ahead.*

b) Turning trials should be made to port and to starboard using maximum rudder from an initial full speed ahead and then stopping the engine at the start of the turn (coasting turn).

c) The turning ability at low speed should be determined by making a turn from initial standstill with propeller stopped and applying half speed ahead using maximum rudder simultaneously (accelerated turning trial).

B 500 Course change ability.

501 Information about the ship's initial turning ability at various rudder angles shall be provided for full and slow speed situations.

Guidance note:Course change trials should be made to port and to starboard for rudder angles equal to 10° and 20° in loaded condition.

B 600 Low speed steering abilities.

601 Information about the lowest constant engine revolutions or lowest pitch control setting at which the ship can safely be steered in ballast and loaded conditions shall be provided.

B 700 Course stability.

701 Information about the course stability of the ship shall be provided.

Guidance note: A pull-out trial gives an indication whether the ship is course-stable or not. A spiral trial measures the steady state rate of turn as a function of rudder angle and provides quantitative measures of the course stability. A spiral trial shall be made if the pull-out trial indicates that the ship is unstable.

B 800 Auxiliary manoeuvring device trial.

801 Information about the performance and effect of auxiliary devices installed in order to improve the manoeuvring abilities of the ship shall be provided.

Guidance note:Ships which are equipped with auxiliary devices to assist in manoeuvring should carry out trials to establish the performance and limitations of such manoeuvring devices. In the case of ships fitted with more than one auxiliary unit, trials should be made to demonstrate the performance of each single unit and of combinations of units.

802 The ability to turn by means of thrusters shall be determined.

803 The forward speed at which the device ceases to be effective shall be determined.

804 When applicable, the ability to move sideways shall be determined. Depending on the device configuration, the trial shall be made with at least one unit at maximum output and the others adjusted to give practically pure sidling.

B 900 Man-overboard rescue manoeuvre.

901 Information about the performance of an effective man-overboard rescue manoeuvre shall be provided.

Guidance note: A Williamson turn should be carried out to port and to starboard in both loaded and ballast conditions.

C. Presentation of Manoeuvring Information.

C 100 Pilot card.

101 A pilot card shall provide the pilot with information on the current condition of the ship with regard to its loading condition, propulsion and manoeuvring equipment and other relevant equipment.
102 A pilot card form shall be available on the bridge at each port call.

Guidance note:An example of information content and layout of a pilot card is given in Appendix 1. (se resolution A601.15)

C 200 Wheelhouse poster.

201 A summary of manoeuvring information on the ship shall be worked out in the format of a wheelhouse poster.

Guidance note:An example of information content and layout of a wheelhouse poster is given in Appendix 2. (se resolution A601.15)

202 The wheelhouse poster shall be permanently displayed in the wheelhouse. It shall contain general particulars and detailed information describing the manoeuvring characteristics of the ship, and be of sufficient size to ensure ease of use.

203 The wheelhouse poster shall be marked with a warning that the manoeuvring performance of the ship may differ from that shown on the poster due to environmental, hull and loading conditions.

C 300 Manoeuvring booklet.

301 The manoeuvring booklet shall be available on board and shall contain details of the ship's manoeuvring characteristics and other relevant data. The manoeuvring booklet shall include the information shown on the wheelhouse poster together with other available manoeuvring information. Most of the manoeuvring information in the booklet can be estimated, but some shall be obtained from trials. The information in the booklet may be supplemented in the course of the ship's life.

3.4 RESOLUTION MSC.137(76)
(adopted on 4 December 2002)

STANDARDS FOR SHIP MANOEUVRABILITY

THE MARITIME SAFETY COMMITTEE,

RECALLING Article 28(b) of the Convention on the International Maritime Organization concerning the functions of the Committee,

RECALLING ALSO that by resolution A.751(18) the Assembly approved Interim Standards for ship manoeuvrability (the Interim standards), whereby Governments were recommended to encourage those responsible for the design, construction, repair and operation of ships to apply the Interim Standards and invited to collect data obtained by the application of the
Interim Standards and report them to the Organization,

RECALLING FURTHER that by circular MSC/Circ.1053 the Committee approved
Explanatory notes to the Standards for ship manoeuvrability, to provide Administrations with specific guidance so that adequate data may be collected by the Organization on the manoeuvrability of ships,

RECOGNIZING the manoeuvring capability of ships to be an important contribution to the safety of navigation,

BELIEVING that the development and implementation of standards for ship manoeuvrability, particularly for large ships and ships carrying dangerous goods in bulk, will improve maritime safety and enhance marine environmental protection,

HAVING CONSIDERED the recommendation made by the Sub-Committee on Ship
Design and Equipment at its forty-fifth session,

1. ADOPTS the Standards for ship manoeuvrability, the text of which is set out in the Annex to the present resolution;

2. INVITES Governments to encourage those responsible for the design, construction, repair and operation of ships to apply the Standards to ships constructed on or after 1 January 2004;

3. RESOLVES that the provisions annexed to the present resolution supersede the
provisions annexed to resolution A.751(18).

ANNEX
STANDARDS FOR SHIP MANOEUVRABILITY

1 PRINCIPLES

1.1 The Standards for ship manoeuvrability (the Standards) should be used to evaluate the manoeuvring performance of ships and to assist those responsible for the design, construction, repair and operation of ships.

1.2 It should be noted that the Standards were developed for ships with traditional propulsion and steering systems (e.g. shaft driven ships with conventional rudders). Therefore, the Standards and methods for establishing compliance may be periodically reviewed and updated by the Organization, as appropriate, taking into account new technologies, research and development, and the results of experience with the present Standards.

2 GENERAL

2.1 The Standards contained in this document are based on the understanding that the manoeuvrability of ships can be evaluated from the characteristics of conventional trial manoeuvres. The following two methods can be used to demonstrate compliance with these Standards:

.1 scale model tests and/or computer predictions using mathematical models can be performed to predict compliance at the design stage. In this case full-scale trials should be conducted to validate these results. The ship should then be considered to meet these Standards regardless of full-scale trial results, except where the Administration determines that the prediction efforts were substandard and/or the ship performance is in substantial disagreement with these Standards; and

.2 the compliance with the Standards can be demonstrated based on the results of the full-scale trials conducted in accordance with the Standards. If a ship is found in substantial disagreement with the Standards, then the Administration should take remedial action, as appropriate.

3 APPLICATION

3.1 Notwithstanding the points raised in paragraph 1.2 above, the Standards should be applied to ships of all rudder and propulsion types, of 100 m in length and over, and chemical tankers and gas carriers regardless of the length.

3.2 In the event that the ships referred to in paragraph 3.1 above undergo repairs, alterations or modifications, which, in the opinion of the Administration, may influence their manoeuvrability characteristics, the continued compliance with the Standards should be verified.

3.3 Whenever other ships, originally not subject to the Standards, undergo repairs, alterations or modifications, which, in the opinion of the Administration, are of such an extent that the ship may be considered to be a new ship, then that ship should comply with these Standards.
Otherwise, if the repairs, alterations and modifications, in the opinion of the Administration, may influence the manoeuvrability characteristics, it should be demonstrated that these characteristics do not lead to any deterioration of the manoeuvrability of the ship.

3.4 The Standards should not be applied to high-speed craft as defined in the relevant Code.

4 DEFINITIONS

4.1 **Geometry of the ship**
4.1.1 *Length (L)* is the length measured between the aft and forward perpendiculars.
4.1.2 *Midship point* is the point on the centreline of a ship midway between the aft and forward perpendiculars.
4.1.3 *Draught (*T_a*)* is the draught at the aft perpendicular.
4.1.4 *Draught (*T_f*)* is the draught at the forward perpendicular.
4.1.5 *Mean draught (*T_m) is defined as $T_m = (T_a + T_f)/2$.
4.1.6 *Trim (τ)* is defined as $\hat{o} = (T_a - T_f)$.
4.1.7 Δ is the full load displacement of the ship (tonnes).

4.2 Standard manoeuvres and associated terminology
Standard manoeuvres and associated terminology are as defined below:
.1 The test speed (V) used in the Standards is a speed of at least 90% of the ship's speed corresponding to 85% of the maximum engine output.

.2 Turning circle manoeuvre is the manoeuvre to be performed to both starboard and port with 35° rudder angle or the maximum rudder angle permissible at the test speed, following a steady approach with zero yaw rate.
.3 Advance is the distance travelled in the direction of the original course by the midship point of a ship from the position at which the rudder order is given to the position at which the heading has changed 90° from the original course.
.4 Tactical diameter is the distance travelled by the midship point of a ship from the position at which the rudder order is given to the position at which the heading has changed 180° from the original course. It is measured in a direction perpendicular to the original heading of the ship.
.5 Zig-zag test is the manoeuvre where a known amount of helm is applied alternately to either side when a known heading deviation from the original heading is reached.
.6 The 10°/10° zig-zag test is performed by turning the rudder alternately by 10° to either side following a heading deviation of 10° from the original heading in accordance with the following procedure:
.1 after a steady approach with zero yaw rate, the rudder is put over to 10° to starboard or port (first execute);
.2 when the heading has changed to 10° off the original heading, the rudder is reversed to 10° to port or starboard (second execute); and
.3 after the rudder has been turned to port/starboard, the ship will continue turning in the original direction with decreasing turning rate. In response to the rudder, the ship should then turn to port/starboard. When the ship has reached a heading of 10° to port/starboard of the original course the rudder is again reversed to 10° to starboard/port (third execute).
.7 The first overshoot angle is the additional heading deviation experienced in the zig-zag test following the second execute.
.8 The second overshoot angle is the additional heading deviation experienced in the zig-zag test following the third execute.
.9 The 20°/20° zig-zag test is performed using the procedure given in paragraph 4.2.6 above using 20° rudder angles and 20° change of heading, instead of 10° rudder angles and 10° change of heading, respectively.
.10 Full astern stopping test determines the track reach of a ship from the time an order for full astern is given until the ship stops in the water.
.11 Track reach is the distance along the path described by the midship point of a ship measured from the position at which an order for full astern is given to the position at which the ship stops in the water.

5 STANDARDS

5.1 The standard manoeuvres should be performed without the use of any manoeuvring aids which are not continuously and readily available in normal operation.

5.2 **Conditions at which the standards apply**
In order to evaluate the performance of a ship, manoeuvring trials should be conducted to both port and starboard and at conditions specified below:
.1 deep, unrestricted water;
.2 calm environment;
.3 full load (summer load line draught), even keel condition; and
.4 steady approach at the test speed.

5.3 **Criteria ***
The manoeuvrability of the ship is considered satisfactory if the following criteria are complied with:
.1 Turning ability
The advance should not exceed 4.5 ship lengths (L) and the tactical diameter should not exceed 5 ship lengths in the turning circle manoeuvre.
.2 Initial turning ability
With the application of 10° rudder angle to port/starboard, the ship should not have travelled more than 2.5 ship lengths by the time the heading has changed by 10° from the original heading.
.3 Yaw-checking and course-keeping abilities
.1 The value of the first overshoot angle in the 10°/10° zig-zag test should not exceed:
.1 10° if L/V is less than 10 s;
.2 20° if L/V is 30 s or more; and

.3 (5 + 1/2(L/V)) degrees if L/V is 10 s or more, but less than 30 s, where L and V are expressed in m and m/s, respectively.

.2 The value of the second overshoot angle in the 10°/10° zig-zag test should not exceed:

.1 25°, if L/V is less than 10 s;

.2 40°, if L/V is 30 s or more; and

.3 (17.5 + 0.75(L/V))°, if L/V is 10 s or more, but less than 30 s.

.3 The value of the first overshoot angle in the 20°/20° zig-zag test should not exceed 25°.

.4 Stopping ability

The track reach in the full astern stopping test should not exceed 15 ship lengths.

However, this value may be modified by the Administration where ships of large displacement make this criterion impracticable, but should in no case exceed 20 ship lengths.

* For ships with non-conventional steering and propulsion systems, the Administration may permit the use of comparative steering angles to the rudder angles specified by this Standard.

6 ADDITIONAL CONSIDERATIONS

6.1 In case the standard trials are conducted at a condition different from those specified in paragraph 5.2.3, necessary corrections should be made in accordance with the guidelines contained in the Explanatory notes to the Standards for ship manoeuvrability, developed by the Organization.

6.2 Where standard manoeuvres indicate dynamic instability, alternative tests may be conducted to define the degree of instability. Guidelines for alternative tests such as a spiral test or pull-out manoeuvre are included in the Explanatory notes to the Standards for ship manoeuvrability, referred to in paragraph 6.1 above.

3.5 USCG-REGULATIONS

1.5.2. Sec. 164.35 Equipment: All vessels.

Each vessel must have the following:

(a) A marine radar system for surface navigation.

(b) An illuminated magnetic steering compass, mounted in a binnacle, that can be read at the vessel's main steering stand.

(c) A current magnetic compass deviation table or graph or compass comparison record for the steering compass, in the wheelhouse.

(d) A gyrocompass.

(e) An illuminated repeater for the gyrocompass required by paragraph (d) of this section that is at the main steering stand, unless that gyrocompass is illuminated and is at the main steering stand.

(f) An illuminated rudder angle indicator in the wheelhouse.

(g) The following maneuvering information prominently displayed on a fact sheet in the wheelhouse:

(1) A turning circle diagram to port and starboard that shows the time and distance and advance and transfer required to alter course 90 degrees with maximum rudder angle and constant power settings, for either full and half speeds, or for full and slow speeds. For vessels whose turning circles are essentially the same for both directions, a diagram showing a turning circle in one direction, with a note on the diagram stating that turns to port and starboard are essentially the same, may be substituted.

(2) The time and distance to stop the vessel from either full and half speeds, or from full and slow speeds, while maintaining approximately the initial heading with minimum application of the rudder.

(3) For each vessel with a fixed propeller, a table of shaft revolutions per minute for a representative range of speeds.

(4) For each vessel with a controllable pitch propeller, a table of control settings for a representative range of speeds.

(5) For each vessel that is fitted with an auxiliary device to assist in maneuvering, such as a bow thruster, a table of vessel speeds at which the auxiliary device is effective in maneuvering the vessel.

(6) The maneuvering information for the normal load and normal ballast condition for:

(i) Calm weather--wind 10 knots or less, calm sea;

(ii) No current;

(iii) Deep water conditions--water depth twice the vessel's draft or greater; and
(iv) Clean hull.
(7) At the bottom of the fact sheet, the following statement:
warning
The response of the (name of the vessel) may be different from that listed above if any of the following conditions, upon which the maneuvering information is based, are varied:
(1) Calm weather--wind 10 knots or less, calm sea;
(2) No current;
(3) Water depth twice the vessel's draft or greater;
(4) Clean hull; and
(5) Intermediate drafts or unusual trim.

(h) An echo depth sounding device.
(i) A device that can continuously record the depth readings of the vessel's echo depth sounding device, except when operating on the Great Lakes and their connecting and tributary waters.
(j) Equipment on the bridge for plotting relative motion.
(k) Simple operating instructions with a block diagram, showing the change-over procedures for remote steering gear control systems and steering gear power units, permanently displayed on the navigating bridge and in the steering gear compartment.
(l) An indicator readable from the centerline conning position showing the rate of revolution of each propeller, except when operating on the Great Lakes and their connecting and tributary waters.
(m) If fitted with controllable pitch propellers, an indicator readable from the centerline conning position showing the pitch and operational mode of such propellers, except when operating on the Great Lakes and their connecting and tributary waters.
(n) If fitted with lateral thrust propellers, an indicator readable from the centerline conning position showing the direction and amount of thrust of such propellers, except when operating on the Great Lakes and their connecting and tributary waters.
(o) A telephone or other means of communication for relaying headings to the emergency steering station. Also, each vessel of 500 gross tons and over and constructed on or after June 9, 1995 must be provided with arrangements for supplying visual compass-readings to the emergency steering station.

Subpart 78.21--Maneuvering Characteristics

Sec. 78.21-1 Data required.

For each ocean and coastwise vessel of 1,600 gross tons and over, the following apply:
(a) The following maneuvering information must be prominently displayed in the pilothouse on a fact sheet:
(1) For full and half speed, a turning circle diagram to port and starboard that shows the time and the distance of advance and transfer required to alter the course 90 degrees with maximum rudder angle and constant power settings.
(2) (2) The time and distance to stop the vessel from full and half speed while maintaining approximately the initial heading with minimum application of rudder.
(3) For each vessel with a fixed propeller, a table of shaft revolutions per minute for a representative range of speeds.
(4) For each vessel with a controllable pitch propeller a table of control settings for a representative range of speeds.
(5) For each vessel that is fitted with an auxiliary device to assist in maneuvering, such as a bow thruster, a table of vessel speeds at which the auxiliary device is effective in maneuvering the vessel.
(b) The maneuvering information must be provided in the normal load and normal light condition with normal trim for a particular condition of loading assuming the following--
(1) Calm weather--wind 10 knots or less, calm sea;
(2) No current;
(3) Deep water conditions--water depth twice the vessel's draft or greater; and
(4) Clean hull.
(c) At the bottom of the fact sheet, the following statement must appear:

Warning
The response of the (name of the vessel) may be different from those listed above if any of the following conditions, upon which the maneuvering information is based, are varied:
(1) Calm weather--wind 10 knots or less, calm sea;
(2) No current;
(3) Water depth twice the vessel's draft or greater;
(4) Clean hull; and
(5) Intermediate drafts or unusual trim.

(d)The information on the fact sheet must be:
(1) Verified six months after the vessel is placed in service; or
(2) Modified six months after the vessel is placed into service and verified within three months thereafter.
(e) The information that appears on the fact sheet may be obtained from:
(1) Trial trip observations;
(2) Model tests;
(3) Analytical calculations;
(4) Simulations;
(5) Information established from another vessel of similar hull form, power, rudder and propeller; or
(6) Any combination of the above.
The accuracy of the information in the fact sheet required is that attainable by
ordinary shipboard navigation equipment.
(f) The requirements for information for fact sheets for specialized craft such as semi-submersibles, hydrofoils, hovercraft and other vessels of unusual design will be specified on a case by case basis.

Sec. 157.445 Maneuvering performance capability.

(a) A tankship owner or operator shall ensure that maneuvering tests in accordance with IMO Resolution A.751(18), sections 1.2, 2.3-2.4, 3-4.2, and 5 (with Explanatory Notes in MSC/Circ.644) have been conducted by July 29, 1997. Completion of maneuvering performance tests must be shown by--

(1) For a foreign flag tankship, a letter from the flag administration or an authorized classification society, as described in Sec. 157.04 of this part, stating the requirements in paragraph (a) of this section have been met; or

(2) For a U.S. flag tankship, results from the vessel owner confirming the completion of the tests or a letter from an authorized classification society, as described in Sec. 157.04 of this part, stating the requirements in paragraph (a) of this section have been met.

(b) If a tankship undergoes a major conversion or alteration affecting the control systems, control surfaces, propulsion system, or other areas which may be expected to alter maneuvering performance, the tankship owner or operator shall ensure that new maneuvering tests are conducted as required by paragraph (a) of this section.

(c) If a tankship is one of a class of vessels with identical propulsion, steering, hydrodynamic, and other relevant design characteristics, maneuvering performance test results for any tankship in the class may be used to satisfy the requirements of paragraph (a) of this section.

(d) The tankship owner or operator shall ensure that the performance test results, recorded in the format of Appendix 6 of the Explanatory Notes in MSC/Circ.644, are prominently displayed in the wheelhouse.

(e) Prior to entering the port or place of destination and prior to getting underway, the tankship master shall discuss the results of the performance tests with the pilot while reviewing the anticipated transit and the possible impact of the tank ship’s maneuvering capability on the transit.

4. SHIP to SHIP MANOEUVRING AND MOORING

(Utdrag från "Ship to Ship Transfer Guide, ICS & OCIMF)

Fig 21 Ship to ship transfer operation

4.1 BASIC PRINCIPLES

Experience has shown that the most successful method of mooring is with both ships underway. One ship, preferably the larger, maintains steerage way on a constant heading as requested by the manoeuvring ship, usually with wind and sea dead ahead. The manoeuvring ship then manoeuvres alongside.

Successful mooring operations have been undertaken with one ship at anchor in fine weather conditions, and this is not a difficult operation if there is an appreciable current and a steady wind from the same direction. Where tide and wind are not from the same direction or the wind varies in velocity or direction the anchored ship can yaw, making it difficult for the manoeuvring ship to berth alongside. In these circumstances some tug assistance may be advisable to hold the anchored ship on a steady heading during the operation. Tug assistance for the other ship is also used at some in-port locations.

It is recommended that the manoeuvring ship approach and berth with her port side to the starboard of the other, whether underway or at anchor. However, mooring alongside a ship at anchor may be performed on either side with the aid of tugs and a pilot.

4.2 POSITIONING OF FENDERS

Fenders can be placed on either ship, preferably on the manoeuvring ship where they can be so positioned as to cover the anticipated areas of contact along the parallel body of the larger ship, irrespective of where contact may occur.

Where fenders are placed on the manoeuvring ship, primary fenders should be positioned one at each end of the parallel body, with additional units in between if required. Secondary fenders should be positioned fore and aft of the parallel body where contact may occur in cases of misalignment during mooring or unmooring. To minimise the possibility of primary fenders riding onto the deck of either ship these fenders should be floating throughout the operation.

4.3 MOORING EQUIPMENT AND PREPARATIONS

The importance of good quality mooring lines and efficient winches and deck machinery should be recognized. Mooring lines and deck machinery should be in good condition. Mooring operations should be planned in a manner which ensures expeditious line handling during mooring and maintains the desired safety procedures for line tending and brake setting while moored.

The mooring arrangement adopted will depend upon the sizes of the vessels carrying out the operations and the difference between their sizes. As a general guideline the diagram below illustrates a recommended and proven mooring arrangement for a transfer operation in offshore waters.

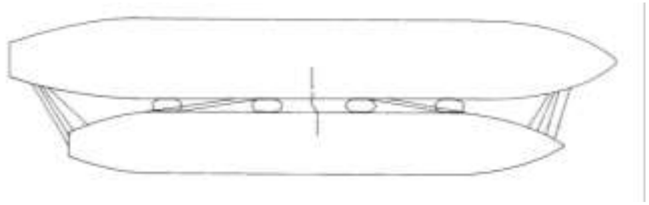


Fig. 22 Fender and mooring arrangement

4.4 MANOEUVRING

Although individual masters will have their own preference for the method of mooring their ship, the following points are emphasised:

(a) The wind and sea should be ahead or nearly ahead.

(b) The angle of approach should not be excessive.

(c) The two ships should make parallel contact at the same speed with no astern engine movement being necessary.

(d) The effects of interaction should be anticipated when manoeuvring at close quarters. The hydrodynamic interaction between ships varies and an awareness of the pressure fields around a ship moving through the water and how they will be influenced by the presence of another ship is important. For example, the forward motion of the two ships driving the sea between them may push the bows of the ships apart and it is therefore important to make fast the forward breast and head lines as soon as possible. Experience has shown that the best method of mooring is for the manoeuvring ship to approach the constant heading ship from broad on the quarter on the side of berthing, then parallel her course about 50-100 metres off. The manoeuvring ship should then position her manifold in line with that of the constant heading ship and match the speed as nearly as possible. Time must be allowed for this matching of speeds as it is important for the safety of the operation. The contact is then made by the manoeuvring ship, reducing the distance between the two ships by appropriate rudder movements until the primary fenders make contact.

(e) Consideration should be given to the unmooring procedures when the mooring arrangements are discussed and mutually agreed between masters. It is strongly recommended that the final lines to be let go when unmooring should be turned up on the bitts on board the vessel accepting the lines.

(f) The masters of both ships should always be prepared to abort the operation if necessary. The decision should be taken in ample time while the situation is still under control. The masters of both ships should immediately be informed of each other's actions. The International Regulations for Preventing Collisions at Sea must be complied with.

(g) At all times each ship is responsible for keeping its own lookout and when at anchor each ship should keep its own anchor watch.

(h) The manoeuvring ship should be informed of any engine and rudder movements made by the constant heading ship manoeuvring to anchor.

(h) From the time the manoeuvring ship is all fast alongside to the time the constant heading ship is anchored, the latter assumes responsibility for the navigation of the two ships.

(i) When mooring or anchoring are carried out during hours of darkness, all unnecessary lights should be switched off and visual lookouts supplemented by the continuous radar lookouts of one ship.

4.5 APPROACH AND MOORING

4.5.1 Both Ships Underway

When both ships are underway, the following should be taken into account:

(a) Engine controls, steering gear and all navigation and communications equipment should be in working order.

(b) A proficient helmsman should be assigned to steer the ship.

(c) Speed should be controlled by adjusting engine revolutions or propeller pitch.

(d) There should be effective communications between the bridge and each mooring gang and between the masters of each vessel.

4.5.2 Ship at Anchor

One ship anchors in a predetermined position using the anchor on the side opposite that on which the other ship will moor. When the anchoring ship is brought up and lying steady with reference to the tidal or wind conditions prevailing, the master should advise the other ship.

This type of mooring is similar to normal mooring alongside a jetty. However, a careful watch should be kept on the heading of the anchored ship and the manoeuvring ship advised immediately of any tendency to yaw. Where there is a marked tendency to yaw a tug should be employed to hold the anchored ship steady or the operation postponed.

4.5.3 Ship Maintaining Constant Heading

When a ship is maintaining a constant heading, the following should be taken into account:

(a) Engine controls, steering gear and all navigation and communications equipment should be in working order.

(b) A proficient helmsman should be assigned to steer and the master should specify the course to be steered.

(c) Speed should be controlled by adjusting engine revolutions only at the request of the manoeuvring ship. Any adjustment should be limited, e.g. plus or minus 5 RPM.

(d) At night the deck should be adequately lighted and if possible the ship's side and fenders should be spot lighted.

(e) The proposed side for mooring should be clear of all obstructions, permanent and otherwise.

(f) The lights and shapes referred to in Section 5.7 should be displayed.

(g) Whenever it is possible there should be radio and/or telephone contact between the bridge and each mooring gang.

(h) Small changes of course and/or speed may be requested by the manoeuvring ship during the manoeuvre.

4.5.4 Anchoring

On completion of mooring the constant heading ship will proceed to the anchoring position previously agreed, during which time the manoeuvring ship will have its engines stopped and rudder amidships or angled towards the constant heading ship. It should be emphasized that in order to avoid severe problems for the manoeuvring ship created by the astern wash, the constant heading ship should not use strong astern engine movements. At the slow speed under which the berthing manoeuvre is carried out the ships will tend to lose speed rapidly without strong astern movements.

The constant heading ship should use the anchor on the side opposite that on which the other ship is moored.

4.5.5 Underway Transfer

Local conditions such as water too deep for anchoring may require the transfer operation to be carried out underway. As long as adequate searoom is available and traffic conditions are suitable underway transfer may be conducted, but suitable large diameter fenders should be used.

In this case, after completion of mooring the discharging ship maintains steerage way on a constant heading and the receiving ship stops its engine, keeps its rudder amidships and remains as a towed vessel. If it is thought necessary to minimize the towing load on the moorings, the receiving ship should use her engines sparingly, adjusting speed very gradually.

The course and speed should be agreed by the two masters and should result in minimum relative movement of the two ships and minimum turbulence of the sea between them.
Whenever sea and swell conditions permit, consideration should be given to placing the relative wind in such a direction that hydrocarbons from venting are carried clear of the ships, and in particular of the accommodation and ventilation intakes.

Safe navigation and collision avoidance while ships are moored is usually the responsibility of the constant heading ship (see Section 6.4(i)). When mooring has been completed and the movement of the fenders is acceptable to both masters, hose connecting and cargo operations may commence in the manner indicated by this guide.

Constant attention should be paid to moorings and fenders to avoid chafing and undue stress, particularly that caused by changes in relative freeboard. If at any time moorings need to be repositioned or adjusted, this should only be done under strictly controlled conditions.

4.5.6 Drifting Transfer

Provided conditions are suitable it may be advantageous to carry out the transfer while drifting.

If deteriorating weather conditions are likely to cause the vessels to roll, they should be brought to a heading which results in minimum movement.

UNMOORING

4.6 GENERAL

Under normal conditions unmooring may be carried out at anchor. However, if in the judgement of both masters weather and tidal conditions so require, it can be carried out underway, following the precautions for underway mooring.

4.6.1 ESSENTIAL POINTS

Sufficient men should be allocated to unmooring stations and consideration should be given to the following points:

(a) Efficient radio communications between the bridge and the unmooring gang on each ship.

(b) Having winches ready for immediate use.

(c) Having fire axes, rope messengers and stoppers available at each unmooring station.

4.6.2 OBSTRUCTIONS

Before unmooring commences the adjacent sides of both vessels should be clear of obstructions.

4.6.3 PROCEDURE FOR UNMOORING

Moorings should only be cast off after the timing and sequence for doing so have been agreed.

Experience has shown that satisfactory unmooring can be achieved by singling up fore and aft, then letting go the remaining forward moorings and allowing the bow to swing away from the constant heading ship to a suitable angle, at which time the remaining moorings astern are let go and the manoeuvring ship moves clear. After disengaging neither ship should attempt to steam ahead or fall astern of the other until the ships are well separated. Some masters prefer to let go aft first and then let go the remaining forward moorings. In either case the angle of disengagement should be small, about 50.

4.7 FENDERS FOR TRANSFER OPERATIONS

Fenders used in ship-to-ship transfers can be divided into two categories:

Primary fenders which are positioned along the parallel body of the vessel to afford the maximum possible protection during mooring and unmooring.

Secondary fenders which are used to protect bow and stern plating from inadvertent contact during mooring and unmooring.

Fig. 23 Ship to ship manoeuvring

4.7.1 FENDER REQUIREMENTS

Some operators may be able to call upon past experience when assessing their fender requirements for any particular transfer operation. It is advisable, however, to estimate the forces which will be generated and to select appropriate fenders for any operations which are not routine or when there is no relevant experience. information published by manufacturers of fenders will prove useful in selection. The table below gives guidance when deciding on fender requirements for a particular transfer.

The fenders used should be suitable in terms of energy absorption and stand-off, and the compressed diameter should be sufficient to ensure that there can be no contact of the superstructures through rolling throughout the period of the transfer operation. The length of the fender string should be such that the fenders will be able to distribute the maximum anticipated impact load adequately over the parallel body length of both ships.

At anchor and in smooth waters, traditional types of fenders have been used successfully for ship to ship mooring operations between smaller vessels. Although suitable for this purpose, it should be realised that their limitations demand restrictions on berthing methods and locations to ensure that they will be able to absorb the impact velocity and provide sufficient stand-off.

For fendering two ships of deadweight A and B tonnes respectively, the equivalent value (C) can be obtained from the formula: $C = \frac{2AB}{A+B}$ (For two ships of equal deadweight $C = A = B$)

Table 3.

Size of ship (or equivalent value (C) for two ships)	Berthing velocity	Effective berthing energy at % point contact	Fender Details (High Pressure Pneumatics or Foam)		Fender Detail S (Low Pressure Pneumatics)	
DWT	m/sec	Tonnes	Diam. x Length metres	Minimum Quantity	Diam. X Length metres	Minimum Quantity
1,000	0.30	3	1.0 X 2.0	3	1.5 x 4.0	3
3,000	0.30	8	1.5 X 3.0	3	1.8 x 6.0	3
6,000	0.30	14	2.0 X 3.5	3	2.3 x 8.0	3
10,000	0.25	15	2.0 X 3.5	3	2.3 x 8.0	3
25,000	0.25	36	2.5 X 5.5	3	2.75 x 12.0	3
50,000	0.20	45	2.5 X 5.5	4	2.75 x 12.0	3
100,000	0.15	48	3.3 X 4.5	4	3.2 x 12.0	3
200,000	0.15	91	3.3 X 6.5	4	2.75 x 16.0	3

This table is intended purely as a guide and in deciding the tendering required for a particular transfer, reference should be made to the supplying manufacturer's specifications and guidance on the use of their fenders in order to determine if the fenders are in fact suitable in terms of energy absorption and stand-off capability.

4.8 MOORINGS

Standard mooring equipment is generally suitable for STS transfers but ships equipped with wire moorings should fit rope tails of suitable length to introduce a degree of elasticity and electrical discontinuity and to permit cutting in an emergency, it is customary to use the lines of the smaller ship but it may be necessary to supplement these with lines from the other ship.

4.8.1 BUOYANT LINES

Where possible, heaving lines and messengers should be of buoyant material. An adequate number of heaving lines should be provided.

4.8.2 FAIRLEADS

It is recommended that all fairleads used during STS transfer operations are of the enclosed type which will remain effective as the freeboard difference between the two vessels changes. Such fairleads should be strong enough to take the anticipated mooring loads and large enough to permit the mooring line and any tail and shackle to pass through comfortably.

Where appropriate, effective leads to winches should be available for the handling of heavy moorings when such moorings are expected to be used.

4.8.3 BITTS

While no hard and fast rules can be given it is recommended that in addition to the normal mooring equipment, ships are fitted with bitts of sufficient strength on each side of the vessel, positioned in line with enclosed fairleads in order to accommodate an acceptable mooring arrangement such as that illustrated in figure.

5. SPM- mooring

Ett antal olika system har utvecklats för användning på oljefälten och i närheten av vissa hamnar på djupt vatten för att lasta stora tankfartyg.

Manövrering till SPM boj.
Vid manövrering till en SPM boj måste hänsyn tagas till bl.a följande faktorer:

- rådande väderförhållanden (Sjöhävning)
- vind
- ström (tidvattenström, vindström)
- dyning
- vattendjup

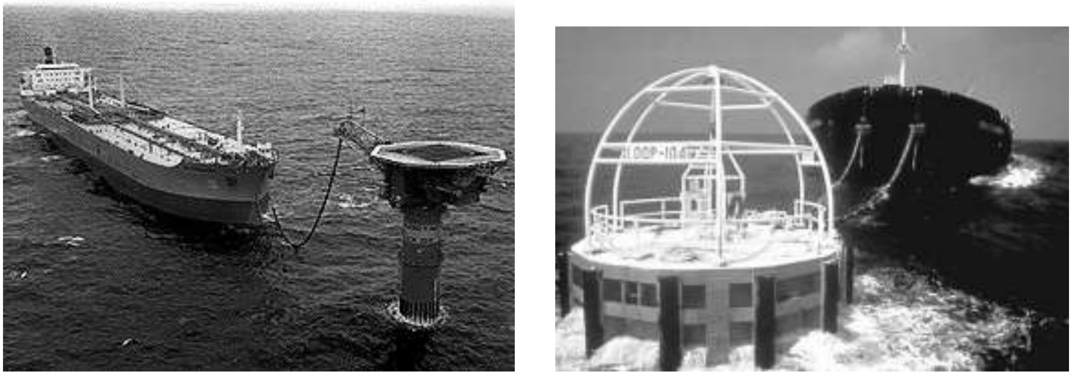


Fig 24 Different system for SPM mooring

Innan fartyget ankommer till lastningsområdet bör fartyget och terminalen se till att de har fått den information de behöver.

Sådan information kan vara:

- Antal och storlek på förtöjningsutrustning. (t.ex. kättingdiameter).
- Lyftutrustningens kapacitet (SWL).
- Storlek på slangar och reducers.
- Behov av bogserbåt.
- Avstånd från för till manifold.
- Max djupgående, samt fartygets max djupgående.
- Områden som är förbjudna att ankra på.

För att undvika att skada pipelines och boj kätting så skall fartygets ankare vara säkrade när man närmar sig bojen. Vid förtöjning till boj finns oftast personal från terminalen att tillgå (mooring masters) samt personal som kopplar slangar.

Plan över förtöjningen skall upprättas (mooring plan) tillsammans med mooring mastern. Den utrustning som behövs skall diskuteras ex. utrustning för säkring av slang, upptagande av förtöjning etc. Manövrering upp till dessa SPMB) sker i de allra flesta fall utan hjälp av bogserfartyg.

Vid angöring av boj bör man studera rådande väder förhållande för att fastställa bästa angörings riktningen Man skall försöka att närma sig bojen mot vindriktningen för att avdriften påverkan skall bli så liten som möjligt. Mooring masterns assistent bör vara stationerad vid bogen när fartyget angör bojen. Kursen skall ej vara mitt på bojen för att undvika kontakt med den och dess slangar som ligger i vattnet. Om fartyget missar bojen skall den kunna passera säkert utan att förstöra bojen.

När fartyget har kommit tillräckligt nära bojen det skall förtöjas till plockas en ”pick-up lina” upp. Denna lina används till att hiva ombord förtöjningskättingen med. Vid ombordtagandet av pick-up linan dras den igenom eller intill den låsanordning som skall användas, för att man enkelt skall kunna låsa kättingen ombord.

Försiktighet skall iakttas när pick-up linan vinschas ombord, man skall alltid försäkra sig att det alltid är lite slack i linan. Man ska aldrig använda pick-up linan för att hiva fartyget på plats eller att hålla fartygets position eftersom det kan vara väldiet farligt för personalen som håller på med förtöjningen. Utan fartyget bör istället gå med sakta framfart ända tills kättingen är ombord och säkrad i kättingstopparen ombord.

Vanligtvis så är den första delen av förtöjningsgodset speciellt avpassad till låsanordningen, vilket medför att säkringen kan genomföras snabbt och säkert.

Manövrering från SPM boj.
Efter avslutad lastnings- eller lossningsoperation, när fartyget skall kopplas loss från bojen bör man först ta hänsyn till de faktorer som nämnts i föregående kapitel. Förtöjningsgodset kopplas loss genom att man försiktigt hivar upp det, vilket medför att låsningsanordningen avlastas. Detta kan uppnås genom att ge fartyget en "kick" framåt med sin maskin.

Efter att låsning kopplats bort bör försiktighetsåtgärder vidtagas för att undvika personskador. Därefter firas kättingen sakta ned. Om fartyget har en bogserbåt kopplad akteröver kan man låta denna dra fartyget bort från bojen i annat fall får man köra med egen maskin. Under tiden slackas pick-up linan ut.

Fartyget backas bort från boj och pick-up lina. Om flytslang använts så måste fartyget se till att man även går klar från denna innan man börjar manövrera i området.

Säkerhetsarrangemang vid SPM
När ett fartyg är förtöjt till en SPM-boj skall rekommendationer i International Safety Guide for Oil Tankers and Terminal (ISGOTT) följas.

- Goda kommunikationer är av största betydelse.
- Om mooring master anser det nödvändigt skall en besättningsmedlem utrustad med en radio vara stationerad i fören under lastningen/lossningen.
- En besättningsmedlem skall under hela operationen vara ute på däck. Och tillräckligt med besättnings medlemmar skall finnas ombord.
- När man börjar lasta/lossa, och vid vakt byte skall ansvarigt befäl och terminalen fastställa att kommunikationen fungerar tillfredställande.
- Under lastning/lossnings operationer skall SPM-boj, slangar, manifold och området omkring manifolder regelbundet övervakas om läckage uppstår.
- Nödstopp och normal slutlastning skall vara förstådd av både terminalen och fartyget.

Glossary of Terms for Single Point Moorings

Type	Glossary
ELSBM	Exposed Location Single Buoy Mooring
FLP	Floating Loading Platform
FTSPM	Fixed Tower Single Point Mooring
OLT	Offshore Loading Tower
RMD	Rigid Mooring Buoy
SAL	Single Anchor Loading
SALM	Single Anchor Leg Mooring
SBM	Single Buoy Mooring
SPMB	Single Point Mooring Buoy
SBS	Single Buoy Storage
SLB	Submerged Loading Buoy
SPM	Single Point Mooring
SPOLS	Single Point Offshore Loading System
SPT	Single Point Turret

6 TOWING

6.1. LOSS PREVENTION BULLETIN December 1994 (West of England P&I Club)

Tug Assistance in Port

Damage to port facilities while berthing or unberthing has been the subject of many costly claims. Research carried out by the Club has established that major incidents typically involve large vessels with limited manoeuvrability, usually in calm conditions and often with no more than one tug in attendance. In response to this finding, all incidents believed to be due to insufficient tug assistance are now recorded.

A more detailed review of the latest data shows that between February 1993 and November 1994 there were 43 cases of property damage arising from insufficient tug assistance, resulting in claims exceeding $5.5 million. Over half the incidents involved bulk carriers or tankers, representing 98% of the total value.

The Club is concerned at the high incidence of such claims and wishes to remind Members of the risks associated with handling vessels with less tugs than the circumstances may demand. Safe margins while manoeuvring in port often leave little room for error, and a misjudged current, a sudden change in wind strength or an ill-timed engine movement or helm order may leave little time for corrective action.

It is accepted that miscalculations can and do arise, but an inadequate number of attending tugs may be unable to provide the degree of control needed to prevent contact damage from occurring.

Reasons for insufficient tug assistance may vary. In ports where the harbour or pilotage authority stipulates or recommends a specific number of tugs, the advice given may not always be appropriate. Similarly, a vessel's port agent may not order enough tugs if there has been no prior discussion with the ship

Masters should not be discouraged from insisting on additional support should they consider it necessary. It is also recognised that tug charges are often the most expensive component of a port disbursements account, and this fact has almost certainly led to masters being encouraged to berth or sail on some occasions with less tugs than desirable. The necessity of keeping port costs to a minimum is appreciated, but if sound operational practices are overtaken by financial considerations, the chances of the vessel becoming involved in a major incident will be magnified. Given the possible hull repair costs, downtime and claims which may ensue, reducing tug assistance to marginal levels is undoubtedly a false economy.

Occasions have also been noted where the number of tugs was satisfactory, but where dock damage occurred due to one or more of the tugs failing to make fast in time. Optimum use should be made of the tugs employed, and merely escorting a vessel until the last minute may prove detrimental if a crisis develops at an inopportune moment.

The risks associated with inadequate tug assistance underline the necessity of pre-planning a vessel's port entry or departure. Dialogue between the master and the pilot is essential, and the deployment of tugs should be considered during this exchange of information.

A mutually understood pilotage plan will allow the pilot's actions and the vessel's passage to be monitored by bridge personnel, allowing any deviation to be detected and questioned promptly. Given that masters have no immediate control over tug manoeuvres once under way and may be unable to comprehend messages between pilot and tugs, forward planning is important.

To reduce the likelihood of such incidents, Members may wish to consider the following suggestions;

- Incorporate a statement into the company's operational procedures making it clear that masters are expected to assess the prevailing conditions, berth restrictions and any other limitations before entering or leaving port, and giving them the authority to order tugs, or additional tugs, should they consider the existing arrangements inappropriate.
- Ensure that the company's bridge procedures require the master to discuss the intended tug assistance operations with the pilot when planning a vessel's port entry or departure.

- Carry out a review of ports in regular use and evaluate the potential risks while berthing and unberthing, and during the inward and outward transits. After consulting with masters, pilots and port authorities, draw up a schedule for each vessel listing the minimum number of tugs to be employed under normal circumstances in the ports visited most frequently. The schedule may also specify the preferred type, size and power of the tugs in each case.
- A similar exercise may be performed before a vessel calls at a new port, studying the charts for possible hazards and liaising with port services to determine the most suitable configuration of tugs. This may be followed up by a report from the master describing the vessel's experience in the port, retaining a copy on board for future reference and forwarding a further copy to head office for possible circulation throughout the fleet.
- Instruct masters to report all instances of questionable or unreliable tug assistance and maintain a record of the ports where such observations have been made. The company may then alert masters to the possible dangers when scheduled to call at one of the ports identified, warning them to exercise particular caution.

In view of the unsatisfactory claims experience, Members, particularly those operating bulk carriers and tankers, are urged to re-examine their procedures regarding the employment of tugs. It is known that many Members do operate in a responsible manner and have issued clear instructions in this respect. However, the frequency of incidents prompted by insufficient tug assistance suggests that others have no set policy, and the introduction of firm directions may be instrumental in overcoming some of the problems identified.

6.2 BOGSERBÅTSASSISTANS I FARLED

Större eller i övrigt svårmanövrerade fartyg assisteras i allmänhet av bogserbåtar i hamnarna, och det kan vara praktiskt att koppla båtarna på skyddat vatten utanför trånga inseglingsleder. Vid gång med låg fart är det ofta nödvändigt att utnyttja båtarna under inseglingen främst för att övervinna de yttre störkrafterna på fartyget. Mera sällan synes man böra acceptera att bogserbåtar skall erfordras för att ett fartyg över huvud taget skall kunna manövrera genom en viss farled under ideala yttre betingelser. Här diskuteras problemet i anslutning till en särskild realtidsstudie i SSPA-simulatorn.

Bogserbåtsassistans i farled - förväntningar
I sjöfartsinspektionens "Normer för farleder och säkerhetsanordningar i dessa" förutsättes på flera håll en säkerhetshöjande effekt av bogserbåtsassistans i farlederna. Så gäller t ex särskilda regler för fartyg med miljöfarlig last om trafiken sker utan bogserbåtsassistans. I avsnittet om farledsbredder sägs att "Den inre radien i en farledskurva får inte understiga fem gånger fartygslängden, om ej speciella arrangemang styrpropeller, bogpropeller, bogserbåtar m m - föreligger".

I enlighet med anvisningarna i farledsnormerna angives i lotsdistriktens lokala föreskrifter regler för bogserbåtsskyldighet för vissa fartyg och därjämte kan lotsen i särskilda fall begära assistans av en eller flera bogserbåtar.

Haverikommissionen ansåg i sin utredningsrapport beträffande påseglingen av Almöbron i farleden till Uddevalla att en bidragande orsak till olyckan var underlåtenhet att invänta dager och/eller utnyttja bogserbåt under rådande förhållanden. Intagandet av fartyget skedde dock i överensstämmelse med vid lotsplatsen utbildad praxis.

Krav på bogserbåtsassistans medför också krav på trafikplanering, minskar sannolikt transithastigheten och lägger givetvis ökade kostnader på trafiken. Assistansen av en bogserbåt innebär en större säkerhet i farleden endast om bogserbåten är lämpligt dimensionerad och om den användes på rätt sätt.

Alternativa bogserbåtskopplingar
Bogserbåtar har av tradition funnit två huvudsakliga användningsområden, det ena omfattande långbogseringar till havs eller i öppna kustfarvatten, det andra oftast kortvariga hjälpuppgifter till underlättande av vändningsmanövrar och tilläggningar i hamnar. Dessa primära användningsområden karakteriserar båtarnas skrovform, propulsionssystem, dragkrokar och vinschar, fendersystem och utrustning i övrigt. På

vissa håll har båtarna och deras hantering framgångsrikt anpassats till en speciell bogserteknik, som dock icke alltid utan vidare kan kopieras.
När intagningen av allt större och mera svårmanövrerade fartyg påfordrade bogserbåtsassistans genom längre avsnitt av de svenska kustfarlederna blev det till en början nödvändigt att utnyttja lokalt tillgängliga bogserbåtar, som ofta icke var lämpliga för de nya arbetsuppgifterna. Sålunda hade flertalet av hamnbogserarna i ostkusthamnarna knappast den maskineffekt som erfordras vid assistans av ballastade tankers i storlekar mellan 30 000 och 60 000 tdw.

När Torshamnen i Göteborg kunde tas i bruk för fullastade VLCC fanns där flera kraftigare hamnbogserare, men då fartygen förutsattes skola assisteras av fem båtar fick man till en början också utnyttja en kraftig havsbogserare. Den senare saknade stävfendert och kopplades därför alltid i dragwire till fartygets stäv.

Sådan bogsering i traditionell mening synes ännu vara den gängse metoden vid assistans av fartyg i svenska farleder. Orsakerna är flera: Svenska bogserbåtar är bl a med hänsyn till förekommande isförhållanden ännu idag nästan alltid av konventionell typ med en propeller, och kan därför icke manövreras sidledes. (I Göteborgs hamn finns idag två bogserbåtar av "traktortyp" med s k "azimuthing thrusters".) Båtarna är icke försedda med förlig dragkrok eller lämplig ridare. Uppgrundningen kring farlederna och den vanliga utmärkningen med höga prickar etc försvårar användningen av bogserbåtar i dragwires på fartygets sidor. Kännedom om fartygets manöverdynamik och om alternativ bogserteknik är icke tillräckligt utbredd.

Trafiken i farlederna förutsätter normalt att fartygen framföres för egen maskin. Normerna för farledsutformning och för val av största representativa fartyg utgår ifrån att bogserbåtar endast skall utnyttjas för att öka säkerheten i farleden där denna synes "marginell".

Ett fartyg som går för egen maskin påverkas förutom av propeller~ och roderkrafter av masskrafter till följd av rörelseändringarna och av vattenkrafterna på skrovet till följd av rörelsen genom vattnet. Fartygets rotation och tvärrörelse sammansättes på ett komplicerat sätt så att den s k pivotpunkten hela tiden rör sig fram och åter på fartygets längdaxel. När girrörelsen växer åt det ena hållet och fartyget går in i en cirkelbana rör sig pivotpunkten mot ett bestämt läge nära fartygets stäv.

I pivotpunkten är den lokala avdriften noll, medan aktern "sladdar" genom vattnet. Anbringas nu en tvärkraft - en bogserkraft eller reaktionskraften från en "bogstrålepropeller" - nära pivotpunkten åstadkommer den i första hand ingen ökning av girhastigheten utan endast en "dyrbar" tvärhastig het eller avdrift hos hela fartyget. (Jfr användningen av förliga djuproder på en ubåt för små djupkorrektioner utan trimändring och av akterliga djuproder för snabba dykningar med trimändring.)

Vid manövreringen av ett fartyg bestämmes rörelsen i första hand av de stora vattenkrafterna på undervattensskrovet, och tvärkraften från rodret bör främst användas för att initiera eller ändra riktningen på dessa skrovkrafter. På samma sätt bör bogserbåten utnyttjas i samspel med skrovkrafterna.

En bogserbåt i wire i fartygets stäv är uppenbarligen mest användbar för egentlig bogsering - ett försök till styrning åt sidan ger ofrånkomligen upphov till en långsam fartökning medan det tvärtom är önskvärt att i denna situation bromsa fartygets framfart för att ge mer utrymme för "propellersparkar" på fartygets eget roder.

En bogserbåt akterut (i enkel wire eller hanfot) utgör en effektiv broms, men propellervattnet från fartyget utgör ett riskmoment, och tekniken fordrar därjämte speciell däcksutrustning; den användes emellertid rutinmässigt i samband med passager genom t ex Manchester- och Panamakanalerna. För Suezkanalen har projekterats särskilda bogserbåtar av Duckpropeller-typ (med två vridbara propelleraggregat akterut), och prov i kanalen och i SSPA simulator har tidigare demonstrerat hanfotskopplingens fördelar. När det gäller användningen av konventionella båtar fordras en särskild teknik.

På senare år har man på flera håll i Sverige börjat koppla en eller flera bogserbåtar längs med fartygssidan enligt "den amerikanska metoden". (Metoden har naturligtvis varit vanlig också här i landet då det gällt förflyttning av mindre pråmar, etc.) Särskilt fördelaktig är långsideskopplingen om bogserbåten är utrustad med vertikalaxelpropellrar, t ex Voith-Schneider, eller med vridbara propelleraggregat. För användning i samband med konventionella bogserbåtar måste kopplingen under gång kunna justeras så att båten kan trycka mot fartygssidan eller dra ut från densamma. (Den realistiska dragvinkeln beror därvid på fartygets fart.)

Bogserbåtshantering är ett i hög grad specialiserat teknikområde, där den personliga erfarenheten har en avgörande betydelse, och där den samlade dokumentationen är bristfällig. Nyligen företogs på uppdrag av US Maritime Administration en serie prov i full skala med en 160 000 tdw turbintanker, assisterad av en eller två bogserbåtar. Totalt genomfördes under fyra dagar 34 olika prov för att undersöka förutsättning-arna för att i fall av haveri på tankerns huvudmaskineri eller roder bringa fartyget under kontroll. Proven gav värdefulla erfarenheter men det framhölls i rapporten att materialet knappast medgav några egentliga slutsatser utan att sådana borde baseras på kompletterande datorsimuleringar.

Inom det aktuella TFD-projektet blev det möjligt att uföra sådana jämförande realtidssimuleringar av bogserbåtshantering i samråd med nautisk expertis från sjöfartsverkets lotsdistrikt och Röda Bolaget. De utvalda alternativmetoderna illustreras i Fig nedan.

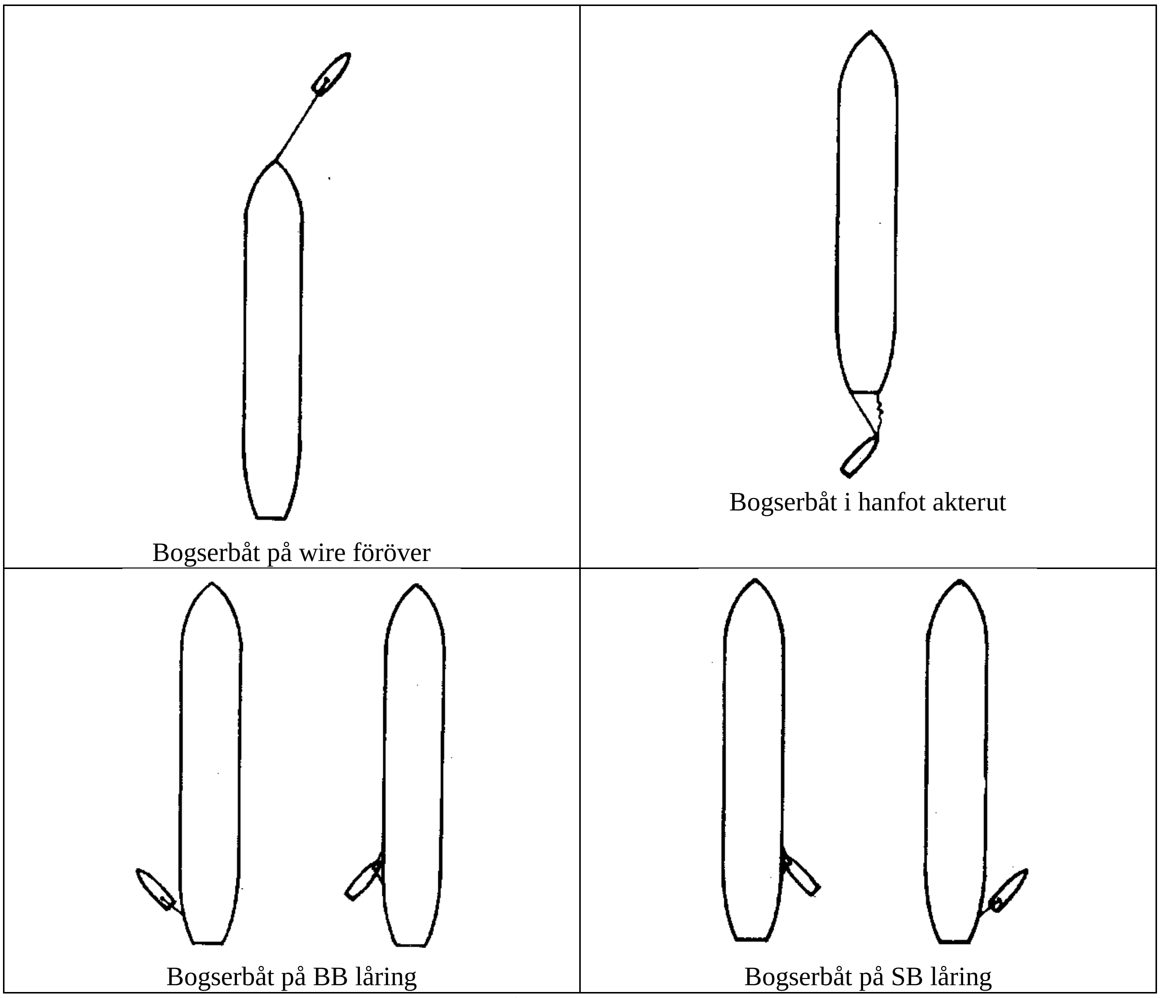


Fig. 25 Olika metoder för koppling av bogserbåt i samband med eskortbogsering.
Från Sjötransporter, farleder och säkerhet, Transportforskningsdelegationen.

Fig. 26 Vid koppling föröver löper bogserbåten risken att hamna tvärs framför bogen på det stora fartyget.

6.3 Utdrag från MARINE NOTICE No. 26 of 1997

TO ALL SHIPOWNERS, SHIPBUILDERS, HARBOUR AUTHORITIES, SHIPMASTERS, TUGMASTERS AND PILOTS

RE: THE SAFETY OF TUGS WHILE TOWING

Following a recent casualty in which the two man crew of a small harbour tug lost their lives the Department of Marine and Natural Resources wishes to bring to the attention of all concerned the dangers of capsizing when a towline reaches a large angle to the fore and aft line of a tug and the tug is unable to slip her tow.

The tug referred to was engaged in harbour duties and acting as stern tug to a ship of 20,000 gross tons berthing in favourable weather and tidal conditions. In repositioning herself and passing across the stern of the larger ship when the ship's engines were running ahead, the towline under stress quickly reached an angle of 90^{o} to the fore and aft line causing an overturning moment leading to rapid capsize.

In order to reduce the serious dangers associated with such conditions, particularly, but not exclusively in the case of smaller tugs engaged in harbour duties, the following recommendations are made:-

1. The towing gear should be designed to minimise the overturning moment due to the lead of the towline, commonly referred to as "girding" or "girting". This may be achieved by the fitting of permanent arrangements involving the use of a "gob" rope.

2. The towing hook should have a positive means of quick release operable under all conditions. It is recommended that the release mechanism should be controlled from the wheelhouse, from the after deck and independently at the hook itself.

3. Openings on the weather deck giving access to spaces below that deck should be fitted with weathertight closing arrangements and kept securely closed during towing operations. This also applies to openings in deckhouses and exposed machinery casings situated on the weather deck. Air pipes should be fitted with automatic means of closure . Engine room ventilation should be by means of high coaming ventilators.

Thomas Carroll
Secretary General
Department of Marine and Natural Resources
Dublin 2.
19 September, 1997.

7 ANCHORING

7.1 The Anchors Aweigh, But we can’t get it up.

A few times each year we are faced with incidents involving vessels which have either lost their anchor or can't heave it onboard. The reasons as to why it is not possible vary from windlass breakdown to the anchor being entangled with something on the sea bottom. A third reason occurs when the vessel is anchored in waters so deep that the windlass does not have the strength to lift the combined weight of anchor and cable. During your writer's apprenticeship onboard Johnson Line vessels it was handed down to us that anchoring in waters deeper than 3-4 shackles (82,3-109,7 metres) should be avoided due to limits in the lifting capacity of the windlass.

Class guidance?
Rules of thumb and tradition do not always correspond to technical reality; therefore, we have consulted the DNV rules to ascertain their requirements for windlasses fitted to newbuildings. The lifting power for windlasses is specified as a coefficient (in Newton) for normal lifting force to be sustained during 30 minutes multiplied with the square of the chain diameter. Coefficients differ with the grade of chain used onboard the vessel. For K1 (mild steel) chain the coefficient is 36.8 N for K2 (special quality steel) 41.7 N and for K3 (extra special quality steel) 46.6 N. To be able to deduce the maximum anchoring depth corresponding to the normal lifting capacity of the windlass it is necessary to know the diameter and steel grade of the chain, the weight of the anchor and the weight of one shackle of chain. A good approximation of the weight of one shackle of chain (27,4 m) is found by multiplying the square of the chain diameter with 0,6.

Based on information about chain diameters and anchor weights for different types and sizes of vessels we have calculated the normal lifting capacity for windlasses in accordance with the DNV rules to be between 4-5 shackles. It should be borne in mind that these are the performance requirements for new equipment and how well it will perform after ten years service is of course difficult to predict. Other than that, it is likely that the capacity will diminish. The class requirements seem to indicate that the rule of thumb is overly cautious. At the same time our experience with incidents in which the vessels have not been able to retrieve their anchors due to lack of windlass capacity does indicate that the rule of thumb is upheld. There seems to be a breaking point around the 100 metres level where the windlasses have difficulties in raising the anchors. In view of the cost of either salvaging the anchor or fitting a new one (and the time lost), it is worthwhile considering how to get the anchor back onboard before letting it go. We trust our members will use this information to gauge how their windlasses will perform both in theory and in practice.
(News, the Swedish club 1/1996)

Fig. 27 Kombinerat ankar- och förhalningsspe

7.2 Anchoring equipment and conditions

Från NORSKE VERITAS REGULATIONS

The anchoring equipment required is the minimum considered necessary for temporary mooring of a vessel in moderate sea conditions when the vessel is awaiting berth, tide, etc. The equipment is therefore not designed to hold a vessel off fully exposed coasts in rough weather or for frequent anchoring operations in open sea. In such conditions the loads on the anchoring equipment will increase to such a degree that its components may be damaged or lost owing to the high energy forces generated.

Guidance note: *If the intended service of the vessel is such that frequent anchoring in open sea is expected, it is advised that the size of anchors and chains is increased above the rule requirements, taking into account the dynamic forces imposed by the vessel moving in heavy seas. The Equipment Numeral (EN) formula for required anchoring equipment is based on an assumed current speed of 2,5 m/s, wind speed of 25 m/s and a scope of chain cable between 6 and 10, the scope being the ratio between length of chain paid out and water depth.*
End of Guidance notes

The anchoring equipment required by the Rules is designed to hold a vessel in good holding ground in conditions such as to avoid dragging of the anchor. In poor holding ground the holding power of the anchors will be significantly reduced.

Modern tumregel för nödvändig kättinglängd

$$L_k = \sqrt{D}$$

L_k = kättinglängd i schacklar
D vattendjup i meter

Ex 25 m vattendjup ger 5 schacklar = 5 x 27,5 m = 137 m
DNV 6 x 25 = 150 m

7.3 Hooked on expensive rigging

One of the third party risks covered under the P&I insurance is liability for damage caused by the ship's anchors. Through the years, the Club has dealt with a fair number of such cases and the following is a resumé of some of them.

And the lights went out...

In one case a ship involuntarily dropped her starboard anchor while underway in a narrow passage. The anchor chain went out, the anchor dropped into the water and dragged on the bottom. The mishap was not detected immediately.
Shortly after passing a bridge, the ship was called on the VHF by the bridge watch who was wondering what was going on. When the officer on watch looked behind he saw that the light on the bridge and nearby streetlights went out just as the ship passed...
Later it was found that the anchor had pulled several cables apart during its journey on the bottom.
Claims were presented for damage to telephone and electrical cables supplying power not only to road and bridge but also to the lighthouse system in the area. The damages paid by the Club were close to SEK 2,000,000 (appr. USD 250,000).

With the help of a radio amateur?

One of the strangest cases involved a tug towing an unmanned barge.
The barge was equipped with an anchor that could be released by a radio signal from the tug. The system was disturbed by external radio signals when the tow passed through an area with intense radioactivity.
The result was that the anchor was released without the knowledge of the crew on the tug! It was not until eight hours later, when they reduced speed and the tow almost stopped altogether, that they became aware of the accident.
The anchor had dragged on the bottom for quite some distance and one high-tension cable was severely damaged. Claimed damages amounted to about SEK 9 million (appr. USD 1,125,000) but thanks to the legislation on limitation the case could be settled close to SEK 1 million (appr. USD 800,000).

Large catch – large claim
In the early morning hours of a winter day a ship was sailing in the northern parts of the Öresund between Denmark and Sweden. The officer on watch noted that the vessel suddenly and unexpectedly altered her course in a most peculiar way. The ship's movement slowed down. The master contacted the engine room. However, there were no signs of problems relating to the engine. The master suspected that some foreign object was caught in the propeller. However, this was not the case.

Fig. 28 Large catch

Further investigation showed that the starboard anchor was released and the full length of the chain was out.
Heaving the anchor and continuing sailing might very well have been the end of this event if not for the fact that electrical cables are quit frequent in the Öresund waters. Our ship was passing a cable area when the incident happened and it was later alleged that no less than five cables were damaged.
The claims amounted to SEK 34 million which is equivalent to roughly USD 4.3 million. Security was required in that amount. However, the ship's limitation amount according to the 1976 convention was much lower and the Club was able to limit the security and liability to SEK 5.1 million.
(News, the Swedish club 2/1997)
Helena Wallerius Dahlsten, The Swedish Club, Göteborg

ANCHORING
SAFETY RECOMMENDATIONS
Background
The grounding of the product tanker *Willy* is the latest in a number of similar incidents that have occurred in UK waters in recent years. The circumstances of each have been very similar: a vessel anchors in what is judged to be a secure anchorage, but then drags when the weather subsequently deteriorates.
The Incident
Having discharged her cargo at Cattewater in Plymouth Sound on 30 December 2001, *Willy* shifted to a designated anchorage in Cawsand Bay to await orders. She anchored in a position nominated by the harbour authority in a depth of 9.6m. She used her port anchor with 4 shackles in the water, and this gave a stern swinging circle of 1.25 cables.
As an anchorage, Cawsand Bay is sheltered from all but south-east winds and the holding ground is mainly sand and broken shells. The nearest dangers to *Willy* were rocks some 4.25 cables to the north-west.
After anchoring, her position was established using radar ranges and bearings and, using the GPS receiver, a 3-cable guard zone was set around the position of the anchor. The main engine was shut down, but remained available for use within 10 minutes. A bridge anchor watch was kept throughout by an officer of the watch (OOW).
The conditions on the day after she anchored, 31 December, gave no cause for concern, with the wind blowing from the north-east force 3 to 4. By noon the following day, it had veered to the south-east and increased to force 7. Although the anchorage was now exposed and the conditions were less comfortable with the ship heading into wind and pitching in the increasing swell, her anchor appeared to hold.
At about 2240, on 1 January, the GPS guard zone alarm sounded. The OOW confirmed by radar that the ship was outside the guard zone and moving in a north-westerly direction and towards the shore. He called the master, who immediately ordered the main engine to be started, and then went straight to the bridge where he saw how close the shore was. He also noticed the GPS receiver displayed a speed over

the ground of 1.2 knots. After ordering the OOW to go forward and heave in the anchor, he put the main engine to full ahead just as soon as it was available, but it was too late. Within seconds, the rudder and the propeller had struck the rocks. The time was about 2250.
She remained hard aground and was very badly damaged.

Comment

In an anchorage exposed to deteriorating weather conditions, a vessel will remain safely at anchor so long as there is sufficient scope on the cable and the anchor continues to bite. Mariners will readily understand, however, that in certain situations and especially in deteriorating weather, vessels at anchor run the risk of dragging.

In the incidents investigated by the MAIB it seems that a feature common to them all is that those on board failed to recognise what was happening until the vessel concerned had already begun to drag well outside the swinging circle. In many instances the speed, sometimes as much as 1½ to 2 knots, was such that the time available to take corrective action was insufficient to prevent the vessel running aground on a lee shore.

It is, therefore, imperative that when anchored in close proximity to any hazard, or in an anchorage that has become exposed and a lee shore is close by, that any movement outside the calculated swinging circle is detected immediately so that steps can be taken to remedy the situation.

Those charged with keeping an anchor watch must ensure that they are well placed to detect dragging as soon as it starts, even though they may have taken various precautions to prevent it. Whatever means is adopted to check the vessel's position it must be sufficiently foolproof to give an instant warning of movement. Too often watchkeepers believe their means of checking their vessel's position is adequate. Experience reveals that such optimism is often misplaced. Every second counts.

If dragging is detected or suspected watchkeepers must, in addition to calling the master, be prepared to take immediate action themselves. Bringing the engine to immediate notice, preparing to let out more cable, or even letting go the second anchor are basic precautions.

In deteriorating weather conditions, the situation should be reassessed and precautionary measures taken to meet the additional risk of dragging. It is often safer to be at sea than in an exposed anchorage with a lee shore close by.

Safety Recommendations

Ship owners and masters should:

1. Ensure that watchkeeping practices and electronic navigational aids are optimised to provide immediate detection of a ship dragging her anchor.
2. Carefully consider the prevailing and forecast conditions when determining the amount of cable to be used when anchoring or when at anchor.
3. Ensure that the availability of engines is appropriate to the proximity of dangers and the prevailing and forecast conditions when at anchor.
4. Consider using a second anchor, or at least having it available for emergency use.
5. Carefully reconsider the safety of the anchored position in deteriorating weather conditions.
6. Not hesitate to shift anchor berths, or put to sea when there is an unacceptable risk of dragging, particularly when anchored off a lee shore.

http://www.maib.dft.gov.uk/safetybulletin/2002/sb12002.htm (20 nov 2002)

7.4 There is another, safer method of getting the anchor and cable laid out on the sea bed

When our grandfathers in the navy anchored, they wanted to be secure in the knowledge that they could maybe have a pink gin, or possibly a huge party and know absolutely that the ship was not going to move. So what they did was to steam with the tide and or wind, whichever was stronger, put the helm hard over and just as the ship started to swing, let go the cable on the run on the inside of the turn. They then ran it out to the required length, set the stopper and allowed the anchor and cable to snub the ship round into the weather. This set the anchor and the whole operation was over in about four minutes. By today's standards this sounds deeply shocking.

The navy still anchor in a very similar way, except that they use the brake -a bit, which is not the purpose for which it was designed, as already exhaustively described. This added caution they caught from their merchant service colleagues, no doubt. This practice of 'running out' had its roots in the days of sail, where Admiralty pattern (Fisherman) anchors with stocks were used and the danger of fouling the flukes was a serious risk. The anchor absolutely had to set correctly first time - no engine to get you out of trouble, so no second chance.

Such an anchor must lie' on the sea-bed in the correct direction, without any possibility of fouling& Therefore the hull movement had to be sufficiently brisk to ensure that the rope cable did not get entangled in the flukes or the stock. This happened naturally, because a sailing vessel's tendency when stopped with the sails aback is for the bow to fall off the wind, which gives the necessary sideways movement which is the secret of safe anchoring. The same thing applies today - it is fatal to get **the cable** fouling the anchor.

One could not possibly do that in today’s ships’, you Say. Certainly not deliberately, but one 250.000 tonne VLCC did just that by accident in the early 1970s. She was steaming towards Kharg Island, in ballast, at 19 knots when the starboard anchor was accidentally let go. Due to the great beam and the bluff hull form forward, the cable was deflected to the ship's side and the ship was turned by the cable 180' without the bitter end parting. How can this possibly happen? Is there a clue here in a safer way to anchor?

The secret lies in separating the momentum of the ship's hull from the forces necessary to control the movement of the cable

The reason is the difference between momentum of translation and momentum of rotation. This principle is seen in the operation of salvage tugs. When the load is taken up, it is observed that the tug master always aligns his tug at right angles to the fore and aft line of the ship towed. The ship is easily canted and the tug is then gradually aligned in the fore and aft line. This effect is well known. It avoids snatch of the tow wire.

To demonstrate this, you can take a walk into a marina and choose a small yacht. Push hard on the stern with your foot in the fore and aft line and the yacht will not move - you are trying to shove about five tonnes in a straight line. Now move round to the side and push at the end on the stern (or the bow) at right angles to the fore and aft line. The hull is easily deflected because the inertia, instead of being five tonnes, is now one tonne, with no friction and this can be moved quite easily.

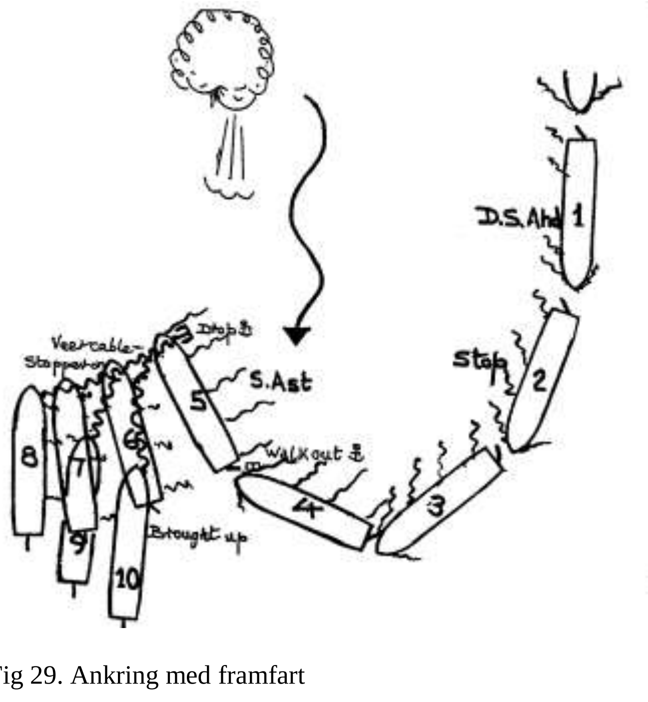


Fig 29. Ankring med framfart

8. HYDRODYNAMISKA EFFEKTER

8.1 **Marine Accident Reporting Scheme (MARS) Report No. 200026**

Squat Confusion
As a pilot operating in shallow waters an important part of my discussion with a ship's Master is about squat and how it affects his ship. Squat tables are becoming more common but there are still many vessels that do not carry this information. It may interest the reader to hear some of the comments I have received when I have asked about squat......

- On a 120m LOA fast feeder container ship: "We do not have any squat Mr. Pilot." When I expressed some surprise at this and suggested that I would expect about 1.5m, maybe more, on a vessel of this type, I was met with an emphatic "No Mr. Pilot, if we had that much squat the deck would be under the water !"
- ***On a 110m LOA fast feeder container ship: "Yes we have squat tables but I don't think they are right. I have been reading the midships draught and it does not change no matter what speed we do."***
- On a 160m LOA 9m draught bulker: "We have no tables but we have a squat gauge." I said that I had not heard of such a device and asked the Captain how it worked. That was not known and on further questioning it appeared that this gauge was actually showing trim....."Yes Mr. Pilot - Squat !"

It would appear that this subject still causes confusion.

Squat: The decrease in clearance beneath a ship which occurs when the ship moves through the water and is caused both by bodily sinkage and by change of trim. The effect is accentuated in shallow water and is reduced with a reduction in ship's speed.

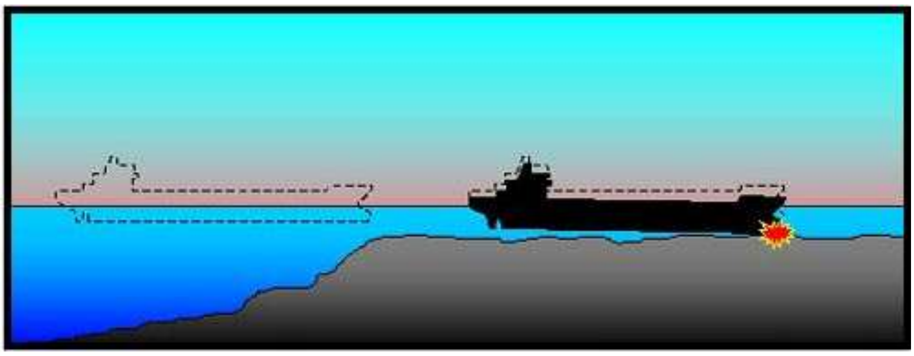


Fig 30 Risk for bottom contact

8.2 NAVIGATION AND VESSEL INSPECTION CIRCULAR NO. 2-97,CH-1 (USCG)

Guidance. The maneuvering poster and other maneuvering information required in IMO Resolution A.601(15) is more detailed than the information required by 33 CFR 164 or 46 CFR 35. Squat characteristics and additional engine information must be displayed along with the general turning circle information. The pilot card, required to be filled out by the vessel master, provides the pilot with quick reference to important propulsion, loading, and maneuvering information.

H. Minimum Under-Keel Clearance.
(1) Background. Beginning January 21, 1998, tank ship owners or operators must provide tank ship masters with written under-keel clearance guidance. Prior to transiting port, the tank ship master shall plan the ship's passage using the owner or operator's written guidance and estimate the anticipated under-keel clearance. The tankship master and the pilot shall discuss the transit plan including the anticipated under-keel clearance. Tank ships or tank barges that are 5,000 GT or more and are fitted with double bottoms covering the entire cargo tank length are not required to comply with this regulation but are encouraged to do so.

(2) Guidance.

- The master is responsible for estimating the minimum under-keel clearance along the transit route of the vessel, including the facility or anchorage. To assist the master with this requirement, the vessel owner or operator must provide the master with written under-keel clearance guidance. Vessel draft, controlling depth of the port, and the impact of weather and other environmental conditions such as sea conditions and vessel traffic must be addressed in written guidance. If conditions which mandate when the owner or operator must be contacted are not prescribed in writing, the guidance should provide the master with direct authority to delay the transit or take any action necessary to ensure the vessel's safe navigation.

- The effect of squat should be included as a factor to consider with calculating the ship's deepest navigational draft. Although prescriptive methods for calculating under-keel clearance are not provided in the final rule, consideration of squat and how it may affect the vessel's maneuverability during a transit is required by 33 CFR 164.11 for all vessels.

- The amended regulation ensures that the master and the pilot discuss the passage plan, including the anticipated under-keel clearance. This discussion should include speed, squat, and maneuverability criteria (as found in the wheelhouse poster information required by 33 CFR 157.450) and their effect on the vessel's safe transit. An entry must be made in the tankship's official log or in other on board documentation reflecting the discussion between the master and pilot.

- Although the phrase "but not limited to" has been removed from the final rule, company guidance should consider the types of contingencies intended by this phrase. These contingencies may include such things as: anticipated traffic; ship-specific maneuvering characteristics with respect to small under-keel clearance; or other existing company policies that may be affected.

- Local COTPs, who have knowledge of port-specific needs, may choose to implement speed restrictions or provide formulas for squat calculation. However, prior to implementation as a regulated navigation area, a rulemaking project must be initiated so that the public will have an opportunity to comment.

GUIDELINES FOR DEVELOPMENT OF WRITTEN UNDER-KEEL CLEARANCE GUIDANCE FOR TANK VESSEL MASTERS

1. The purpose of this requirement is to create an effective line of communication between the vessel owner or operator, the master, and the pilot in order to establish a safe under-keel clearance prior to the vessel entering port or getting underway. Tank ship owners and operators must provide vessel masters with written under-keel clearance guidance. This requirement will prevent situations in which a vessel master (and pilot) may feel compelled to enter port with a less than desirable under-keel clearance because of scheduling pressure.

2. Written under-keel clearance guidance should reflect ship-specific considerations. The emphasis of this guidance should be to consider the vessel's maneuvering constraints and the anticipated under-keel clearance along the planned passage and at the facility.

3. Tank barge owners and operators must provide written guidance to towing vessel operators on acceptable under-keel clearance criteria.

The following examples should help illustrate the intent of this requirement:

<u>EXAMPLE 1 - (TANK SHIP).</u>
The master shall consider the ship's deepest navigational draft and the controlling depth of the port transit before arrival at the pilot station or, when outbound, prior to getting underway. The ship's draft shall be calculated using guidance contained in the loading manual and the trim and stability booklet. The forward and aft draft readings shall also be visually confirmed prior to transiting port unless deemed unsafe by the master. The vessel's draft must be recorded in the pilot card prior to entering or leaving port. The

controlling depth of the port transit shall be estimated using charted information, tide calculations, and any pertinent information found in the Coast Pilot or Local Notice to Mariners. This information shall be used to estimate the minimum under-keel clearance.
The ship's draft, controlling depth of the port transit, and the anticipated under-keel clearance shall be discussed with the vessel's pilot. The pilot should be consulted for any additional information that may affect the controlling depth of the port transit. This discussion shall highlight important parts of the transit plan such as transit speed, squat effect, shoals, turn bearings, etc. The anticipated affect of weather and sea conditions must also be discussed with the pilot and considered in the transit plan. An entry must be made in the official log book reflecting this discussion.

The master shall take any appropriate action to ensure the vessel's safe transit. It is not necessary to notify (the vessel owner/operator) prior to taking such action unless significant delays or scheduling conflicts will result.

<u>EXAMPLE 2 - (TANK SHIP).</u>
NOTE: This example contains some additional guidance beyond that required by regulation.
The master shall use the guidance contained in the ship's loading manual to estimate the vessel's maximum navigational draft prior to transiting port. The vessel's draft shall be visually confirmed prior to the pilot boarding, unless weather endangers the crew. The squat data found in the vessel's maneuvering test information shall also be used to adjust the estimated draft based on the port's transit speed and depth under keel. The vessel's draft and other required vessel status information shall be recorded in the pilot card prior to transit.

The vessel's transit shall be laid out on appropriate charts and areas of restricted navigation or shallow areas shall be highlighted. The master shall review all turn bearings and critical transit points. Local Notice to Mariners, Coast Pilots, and regulated navigation areas as described in 33 CFR 165 shall be used to update the port chart. The master shall contact the facility to confirm the estimated dockside depth at the ship's arrival or departure time. With this information, the controlling depth of the port transit, including the facility, shall be estimated.

Using the estimated draft and controlling depth information, the master shall estimate the smallest under-keel clearance the vessel may encounter during the planned transit. The master shall use this information to identify maneuvering constraints, if any, that could develop.

The master shall discuss the entire planned passage with the pilot, specifically indicating how and what assumptions were used to develop the under-keel clearance estimate, and identifying potential maneuvering constraints. This discussion shall take as much time as the master deems necessary to fully understand the pilot's recommendations and concerns. The effects of recent or potential weather on the route, such as wind or reduced visibility, and environmental conditions, such as shoaling, swells, and unusual tides and currents, shall be discussed. Vessel traffic that may affect the ship's transit shall also be discussed. An entry must be made in the official log book reflecting this discussion.

The under-keel clearance estimated for all U.S. port transits shall be ___ meters unless a greater clearance is recommended by the pilot, Captain of the Port, or other port authority.
In the case where a greater clearance is recommended by the pilot, the master shall consider the basis for the recommendation when deciding whether to proceed with port transit. In any case, the master is authorized to take any reasonable action to ensure a safe port transit. Reasonable action may include delay of vessel transit, lightering, or employing a tug for assistance. If such action causes the vessel to be delayed by more than 2 hours, the Vessel Operations Department shall be notified.

<u>EXAMPLE 3 - (TANK BARGE).</u>
Under-keel Clearance:
The master must ensure that there is adequate underkeel clearance at all stages of the voyage and at all times while at anchorage or berth. In assessing the adequacy of underkeel clearance, the following factors must be taken into account:

- the mean and deepest draft of the vessel
- the effect of trim and/or list
- the effect of squat at the anticipated maximum transit speeds at each stage of the voyage.
- charted depths

- the effect of tide and current
- the impact of weather on tidal effect
- effect of sea/swell conditions
- depth of water at berth or anchorage

Where a government, port authority, or pilot organization establishes a mandatory or recommended minimum under-keel clearance, the master must ensure that, as a minimum, such under-keel clearance is maintained after taking into account the factors listed above.

Squat:
Squat is the phenomenon whereby the ship's draft is increased in shallow water due to the hydrodynamic effects between the ship and the sea floor causing an increase in draft. It effectively reduces the under-keel clearance in areas where clearance may be critical. Squat is approximately proportional to the $(\text{speed})^2$ of the ship, hence halving the speed reduces the squat effect by a factor of four. In general, squat effect starts to be felt in waters where the depth/draft ratio is less than four.

Masters must ensure that they take squat effect into account when calculating the vessel's deepest navigational draft and, in order to minimize its effect, they must not hesitate to reduce speed when operating in shoal water.

Notification:
The master is authorized to take any action necessary to ensure safe transit of the vessel. If such action results in delay of more than two hours, the master shall contact (vessel operator) to discuss intentions.

8.3 U.S. Notice to Mariners NM 1/03

VESSEL SQUAT IN SHALLOW WATER.
The following discussion is primarily aimed towards mariners who are navigating ocean-going commercial vessels on approaches to ports, where water depths are beginning to shoal (less than 3 times the ship's draft). The discussion describes the phenomenon of "squat" and is intended to help mariners recognize circumstances where it could significantly affect the navigational draft of their vessels.

In August 1992, a 950-foot passenger liner ran aground in an area where the charted depth of 39 feet was more than 7 feet greater than the vessel's maximum calculated draft. One major contributing factor was that neither the master nor the pilot adequately judged the considerable squatting effect (sinkage & trim) caused by the high-speed transit (24.5 knots) in relatively shallow water (which was about 1.22 times the ship's draft).

DISCUSSION OF SQUAT: The term "squat" describes the combination of sinkage (overall settling of the hull) and trim (the bow up/down rotation of the hull). This phenomenon occurs in waters of any depth, but is particularly affected by the proximity to the sea floor. Therefore, the effects of squat become more pronounced in shallow and/or restricted waters (such as canals or dredged channels). As a ship moves forward, water must quickly flow around and under the hull to fill the void left behind. This accelerated water flow affects the pressure distribution along the hull. Consequently, the vessel squats, effectively increasing its draft and trim.

Depending upon the vessel's speed and hull form, the ship may trim by either the bow or the stern. Generally, full-bodied hulls (where $C_b > 0.7$, such as tankers) tend to trim by the bow, whereas fine-bodied hulls (such as container ships) tend to trim by the stern.

SHALLOW WATER EFFECTS: Shallow water affects a ship in two manners: squat (which increases the effective draft at bow and/or stern), and maneuverability (which reduces maneuvering responses compared to open, deep water performance). Also, the faster the vessel's speed, the greater the magnitude of the effects.

CALCULATION OF SQUAT: Squat is a function of the vessel's speed through the water, the ratio of ship draft to water depth, the ratio of cross-sectional areas of the hull and channel, the block coefficient of the hull, and other factors. Formulas for predicting squat for any particular ship are complex and may not be practical for direct use by mariners. However, a useful "rule of thumb" can be used as long as mariners understand its limitations, as discussed below.

In general, shallow water effects can begin to appear when water depth is less than 3 times the vessel's draft, and can become significant by the time water depth is less than 1.5 times the draft. For a ship in unrestricted shallow water (i.e., not within the confines of a dredged channel or canal), a conservative rule-of-thumb for estimating squat is:

$$\boldsymbol{S = 0{,}033 \times C_b \times V^2}$$

where: S = squat (*ft*),
V = ship speed, including any head current (*knots*),
and C_b = block coefficient of hull.

For example: at 15 knots, the squat for a container ship (C*b* = 0.60) proceeding against a 1-knot head current would be approximately 5.1 feet and for a tanker (C*b* = 0.85) would be approximately 7.2 feet.

$$\boldsymbol{S = \frac{C_b \times V^2}{100}}$$

(Eget tillägg där ovanstående formel är korrigerad för att erhålla S i meter)
where: S = squat (*m*),
V = ship speed, including any head current (*knots*),
and C_b = block coefficient of hull.

The estimated squat should be added to the deepest calculated draft of the vessel (bow or stern). This rule-of-thumb conservatively overestimates the squat of a ship and is therefore considered to be safe for operational decisions.

However, the above rule-of-thumb is valid only when the ship's speed is less than:

$$\boldsymbol{V \leq 2{,}52 \times \sqrt{d}}$$

where: V = ship speed (*kts*),
d = square root of the water depth *"d"* (*ft*).

For example: in 50 feet of water, the above squat estimate is valid only if the ship's speed is less than 17.8 knots. As the ship moves into shallower water, the limiting speed will decrease. For example, in 30 feet of water, the limiting speed for the rule-of-thumb reduces to 13.8 knots. If the ship's speed is faster than the limiting speed, then the squat prediction is no longer reliable and a greater squat should be assumed. Therefore, if the ship maintains a constant speed as it proceeds into shallower water, it may eventually exceed the limiting speed and experience a significant increase in squat.

UNDERKEEL CLEARANCE: When evaluating the underkeel clearance in shallow waters, mariners are advised to also take into account the wave-induced motions of the ship (heave and pitch), the uncertainty within their own draft & trim calculations, as well as a prudent margin for uncertainty in the charted water depths (even modern hydrographic surveys may not locate all sea floor obstructions or the shallowest depths). In particular, sudden changes in water depth (such as passing over a shoal area) can cause transient squat effects that can be more substantial than predicted. Similarly, sudden changes in ship speed (acceleration or deceleration) can also cause transient changes in squat. For broad-beamed ships with a relatively "tender" rolling periods (such as modern, post-Panamax container ships), rolling motions can significantly increase drafts at the bilges, in addition to the effects of squat.

MANEUVERABILITY: In addition to squat, the mariner should also be aware that shallow water may increase turning diameter. Modeling of tankers has shown an increase in turning diameter of 60% to 100% in water less than 1.25 times the ship's draft. Hydrodynamic effects such as yawing and sheering should also be taken into account in shallow and restricted waters, especially when passing another vessel. Also, the vessel will require substantially more revolutions to maintain the same speed (during sea trials with a 270-foot destroyer drawing 8 feet of water, the ship required 400 rpm to reach 22 knots in 100 feet of water, but nearly 500 rpm to maintain the same speed in 45 feet of water).

RESTRICTED WATERS: When the ship is transiting shallow restricted waters (such as a dredged channel within a shallow bay), the hydrodynamic flow around the hull is confined by the banks of the channel, creating a different pressure distribution and aggravating the squat condition (usually by increasing the stern squat). The squat estimated by the above "rule of thumb" should be doubled. Maneuverability is also further degraded; which is of particular concern when passing (meeting or overtaking) another vessel in the waterway or when maneuvering near banks or in channel curves.

RECOGNIZING SHALLOW WATER EFFECTS: Signs that a ship has entered shallow water conditions can include one or more of the following:

- Vibration increases suddenly,
- Engine loads down and revolutions decrease,
- Wavemaking increases, especially at the bow,
- Ship becomes more stable and slower to respond to controls,
- Echo sounders indicate a change in clearance or depth,
- The shaft horsepower (shp) speed decreases at the same engine revolutions,
- Water flow around the ship changes, and water colour darkens (possibly indicating entrained mud).

(Supersedes NTM 1(59)02)

8.4 Marine Accident Reporting Scheme (MARS) Official Report No. 7010.

Grounding of the QE2

Contributory to the accident was the lack of information regarding squat. The USCG report comments that: The information on underkeel clearance obtained from the David Taylor Research Centre (DTRC) and the British Maritime Technology (BMT) indicates that many factors are involved in the sinkage and trim of high speed ships in shallow water and that the influence of these factors on a particular ship is not well understood. For example, DTRC computer simulations had a bow down attitude immediately before the grounding, while BMT model tests indicate a stern down attitude. Literature searches demonstrate a lack of information on shallow water effects of high speed ships.

Fig 31 QE 2

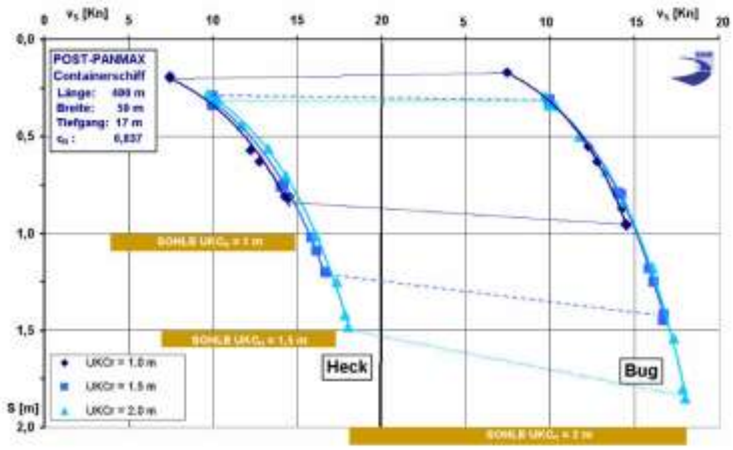


Fig. 32 Result from model trials conducted by Federal Waterways Engineering and Research Institute for large container vessels.

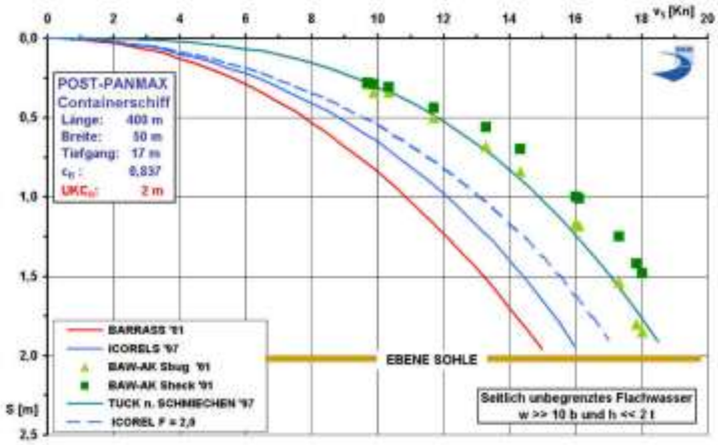


Fig. 33 Result from model trials conducted by Federal Waterways Engineering and Research Institute for large container vessels.

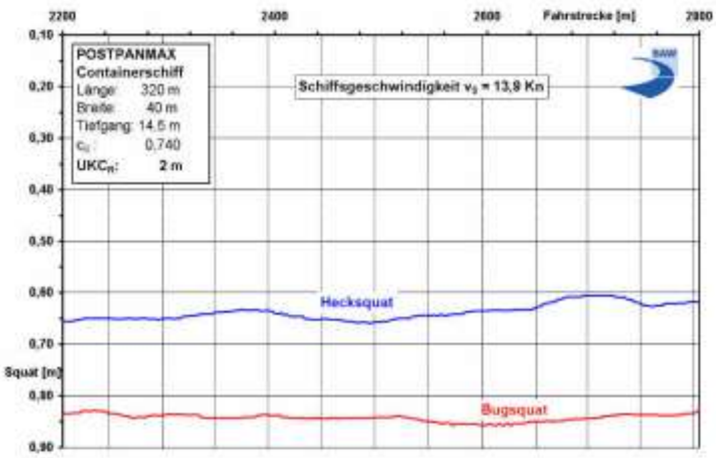


Fig. 34 Result from model trials conducted by Federal Waterways Engineering and Research Institute for large container vessels.

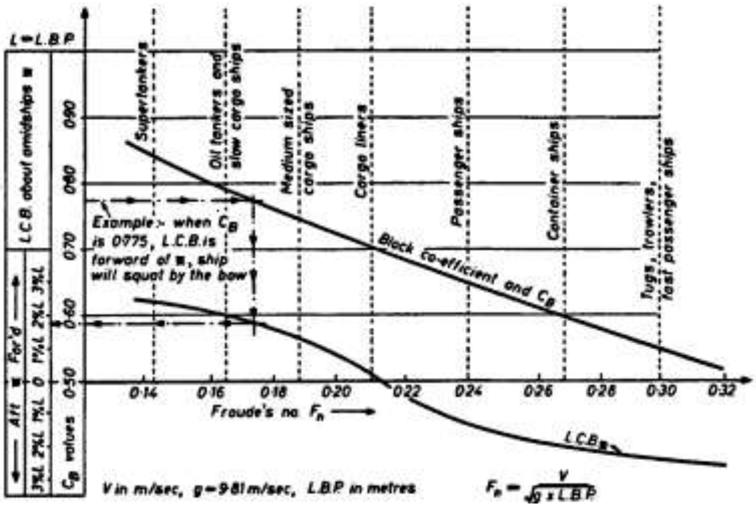


Fig. 35 The trim for a ship in shallow water depends on the hull form. Ships with C_b greater than 0,7 will normally obtain a forward trim.

8.5 Interaktion orsakade kollisioner mellan svenska och finska fartyg

Kollisionen mellan det svenska torrlastfartyget "Vingaren", byggt 1976 och 81,5 meter långt, och det finska ro-ro-fartyget "Garden", byggt 1977 och 151 meter långt, i oktober förra året orsakades av interaktion mellan fartygsskroven. Båda fartygen var på nordgående i Drogdenrännan när det större fartyget "Garden" skulle passera det något mer än hälften så långa "Vingaren". Det finska fartyget utnyttjade inte rännans hela bredd och passerade alltför nära. Interaktion innebär i princip att vattentrycket mellan två fartyg som passerar nära varandra förändras och när, som i det här fallet, ett mindre fartyg passeras på sin babordssida av ett större, kommer det mindre fartyget att få en kraftig girtendens åt babord mot det större fartygets styrbords låring när omkörningen håller på att avslutas. Sjöfartsinspektionen rekommenderar ett minsta passageavstånd vid omkörning i begränsade farvatten på 0,8 gånger längden av det största fartyget, i detta fall 120 meter. Drogdenrännan är 300 meter bred.
En närmast identisk olycka inträddade utanför Falsterbo i början av förra året när det finska ro-ro-fartyget "Styrsö" skulle passera det svenska torrlastfartyget "Nordgard". SST-GÖTEBORG (030212)

8.6 Sjöfartsinspektionen informerar… 4/2002

Interaktion som kollisionsorsak
De senaste åren har Utredningsenheten utrett tre kollisioner där interaktion uppstått då ett större fartyg passerat ett mindre. Vissa gemensamma händelser har inträffat i de tre fallen, som i korthet beskrivs här:

1. En ganska stor färja passerade ett mindre tankfartyg i trång farled. Färjan passerade tankern ganska nära och höll en fart om ca 11 knop. Plötsligt girade tankern, som gjorde ca 8-9 knop, häftigt mot färjans aktra del och en kraftig överhalning uppstod i och med den kraftiga kollisionen. Tankern sögs fast mot färjan och fartygen kunde skiljas åt först sedan tankfartyget backat loss.
2. Ett medelstort roro-fartyg passerade ett mindre torrlastfartyg på mycket nära håll i öppen sjö. Avståndet bedömdes från torrlastaren till endast några tiotals meter. Roro-fartyget hade farten 13-14 och torrlastaren 10- 11 knop. Plötsligt kom torrlastaren att gira mot roro-fartygets aktra del och en kraftig kollision uppstod. I samband med kollisionen gjorde torrlastaren en mycket kraftig överhalning.
3. Ett medelstort roro-fartyg passerade ett mindre torrlastfartyg i en relativt trång farled. Fartygen höll 14,5 respektive 11,5 knop. Passagen utfördes med ett avstånd mellan fartygen på 30-40 meter. Plötsligt kom torrlastaren att gira mot aktern på det omkörande fartyget och en kollision uppstod. I samband med denna gjorde torrlastaren en kraftig överhalning. Fartygen sögs ihop och kunde inte skiljas åt utan att torrlastaren fick backa sig loss.

Av de tre fallen kan man dra följande slutsatser:

- interaktion tycks kunna uppstå på avstånd på åtminstone 4-5 fartygsbredder. Vissa uppgifter tyder på att interaktion kan uppstå på betydligt större avstånd
- passagen kan gå utan problem fram till då det endast fattas några tiotals meter till passagen är helt genomförd
- på det omkörande fartyget uppfattar man det som att man på det andra fartyget utför en kraftig gir
- det omkörda fartyget utsätts för en kraftig kollision och en mycket kraftig överhalning (30-50º slagsida har förekommit)
- fartygen sugs fast mot varandra och kan inte utan ansträngning separeras.

De inblandade befälen i de tre fallen var erfarna och väl utbildade. Utredningsenheten finner därför anledning att rekommendera att man inom rederierna uppmärksammar samtliga befäl om riskerna och att man i fartygen undviker att passera andra fartyg på nära håll

Interaktion – teknisk beskrivning
Ett fartyg som gör fart genom vattnet förorsakar att vattnet runt skrovet strömmar på ett visst sätt. Vattenytan höjer sig i fartygets bog och låring och sänker sig längs sidan. Vattentrycket ökar runt bogen och aktern (där vattenytan höjs) och minskar vid fartygets mittparti (där vattenytan sänks). Se figur 37.

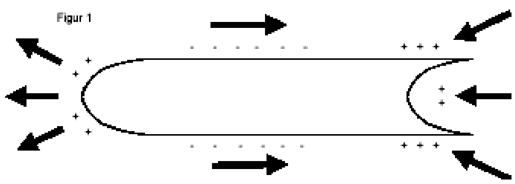


Fig 36 *Pilarna visar vattenströmningen i förhållande till det omgivande, stilla vattnet.*
Plus- och minustecknen visar vattnets ökade respektive minskade tryck.

Om två fartyg kommer nära varandra kommer de att påverkas av detta tryck- och strömningssystem. En interaktion mellan fartygens skrov uppstår. Om ett större fartyg på nära avstånd passerar ett mindre medgående fartyg på det mindre fartygets babords sida kommer det mindre fartyget först att påverkas av ett ökat vattentryck på babords låring som ger fartyget en tendens att gira babord, fig. 38).

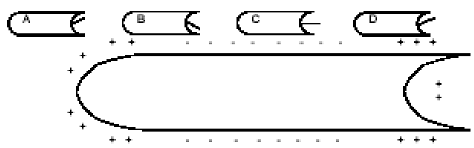


Fig 37

Vid fortsatt passage kommer det mindre fartyget att påverkas av ett undertryck på babords låring och ett övertryck på babords bog. Detta kommer att ge fartyget en kraftig tendens att gira styrbord.

Om det mindre fartyget kommer i läge som visas i figur 38c, sugs det i stort sett parallellt mot det större fartyget. Vattnets bärighet minskar på grund av den kraftiga vattenströmmen mellan skroven vilket förorsakar ett undertryck. Ju snabbare vattnet strömmar ju sämre bärighet har det. Det mindre fartyget kommer i detta läge också att tappa fart över grund på grund av strömmen runt det större fartyget.

Då omkörningen håller på att avslutas och det mindre fartyget befinner sig vid det större fartygets låring kommer babords låring återigen att träffas av ett övertryck samtidigt som babords bog fortfarande befinner sig i undertryck, fig. 38d).

Det mindre fartyget får åter igen en kraftig tendens att gira babord mot det större fartygets styrbords låring.

Storleken av det tryck som påverkar fartygen är mycket beroende på det omkörande fartygets fart. Om farten fördubblas kommer trycksystemet att förstärkas fyra gånger (proportionellt med kvadraten på hastigheten). Det är också känt att det trycksystem som finns runt ett fartyg förstärks många gånger om fartyget förflyttar sig från djupt till grunt vatten.

För att upphäva girtendenserna och i möjligaste mån behålla kursen måste rodret, i de olika momenten, läggas så som figur 38 visar. Om fartygen skulle få kontakt med varandra och bli liggande sida vid sida är det, på grund av mycket snabbt strömmande vatten mellan skroven med åtföljande undertryck, mycket svårt att köra sig ur en sådan situation. Enda sättet att komma fri är ibland att, med det mindre fartyget, backa sig ur situationen.
Iu 2002-11-19

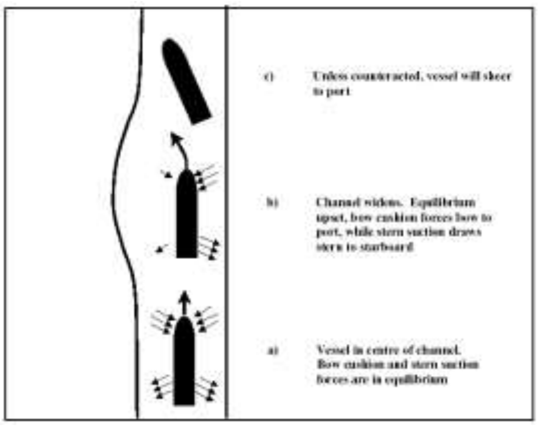


Fig 38 Bankeffek

8.7 DANGERS OF INTERACTION

Note to Owners, Masters, Pilots and Tug-Masters
This Note supersedes Merchant Shipping Notice No.930

Summary

This note draws attention to the effects of hydrodynamic interaction on vessel manoeuvrability and describes some incidents which illustrate the dangers.

Key Points:-

- Understand that sudden sheering may occur when passing another vessel at close range
- Appreciate the need to reduce speed in narrow channels
- Be aware of the dangerous effects on tugs when manoeuvring close to larger vessels
- Be aware that unexpected turning moments may result when stopping in shallow, confined basins
- Appreciate the need to make appropriate allowances for squat
- Note the results of laboratory work

1. Hydrodynamic interaction continues to be a major contributory factor in marine casualties and hazardous incidents. Typical situations involve larger vessels overtaking smaller ones in narrow channels where interaction has caused the vessels to collide and, in one case the capsize of the smaller vessel with loss of life.
2. Situations in which hydrodynamic interaction is involved fall into the following categories:-
(a) Vessels which are attempting to pass one another at very close range. This is usually due to their being confined to a narrow channel.
(b) Vessels which are manoeuvring in very close company for operational reasons, particularly when the larger vessel has a small under-keel clearance.
(c) Vessels with a small under-keel clearance which stop rapidly, when approaching an enclosed basin, resulting in unexpected sheering.
Included in this category is the reduced effect of accompanying tugs which may sometimes be experienced in these circumstances.

3. PASSING VESSELS

When vessels are passing there are two situations:
(i) overtaking and (ii) the head-on encounter.
(i) Overtaking: Interaction is most likely to prove dangerous when two vessels are involved in an overtaking manoeuvre. One possible outcome is that the vessel being overtaken may take a sheer into the path of the other. 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. This may also be accompanied by an overall strong attractive force between the two vessels due to the reduced pressure between the underwater portion of the hulls. There are other possibilities, but the effect of interaction on each vessel during the overtaking manoeuvre will depend on a number of factors including the size of one vessel relative to the other, the smaller of the two vessels feeling the greater effect.
(ii) The head-on encounter: In this situation interaction is less likely to have a dangerous effect as generally the bows of the two vessels will tend to repel each other as they approach. However, this can lead indirectly to a critical situation. It may increase any existing swing and also be complicated by secondary interaction such as bank-rejection from the edge of a channel.
In all cases it is essential to maximize the distance between the two vessels. The watch keeper on the larger vessel should bear in mind the effect on adjacent smaller vessels and take necessary care when manoeuvring.

4. INTERACTION IN NARROW CHANNELS

When vessels intend to pass in a narrow channel, whether on the same or opposing courses, it is important that the passing be carried out at a low speed. The speed should be sufficient to maintain control adequately but below maximum for the depth of water so that in an emergency extra power is available to aid the rudder if necessary.
If a reduction in speed is required it should be made in good time before the effects of interaction are felt. 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 both the vessel and the channel, speed may have to be restricted. When vessels are approaching each other at this limiting speed interaction effects will be magnified, therefore a further reduction in speed may be necessary. Those in charge of the handling of small vessels should appreciate that more action may be required on their part when passing large vessels which may be severely limited in the action they can take in a narrow channel. Regardless of the relative size of the vessels involved, an overtaking vessel should only commence an overtaking manoeuvre after the vessel to be overtaken has agreed to the manoeuvre.

5. MANOEUVRING AT CLOSE QUARTERS

When vessels are manoeuvring at close quarters for operational reasons, the greatest potential danger exists when there is a large difference in size between the two vessels and is most commonly experienced when a vessel is being attended by a tug. A dangerous situation is most likely when the tug, having been manoeuvring alongside the vessel, moves ahead to the bow to pass or take a towline. Due to changes in drag effect, especially in shallow water, the tug has first to exert appreciably more ahead power than she would use in open water to maintain the same speed and this effect is strongest when she is off the shoulder. At that point hydrodynamic forces also tend to deflect the tug's bow away from the vessel and attract her stern; but as she draws ahead the reverse occurs, the stern being strongly repulsed, and the increased drag largely disappears. There is thus a strong tendency to develop a sheer towards the vessel, and unless the helm (which will have been put towards the vessel to counter the previous effect) is immediately reversed and engine revolutions rapidly reduced, the tug may well drive herself under the vessel's bow. A further effect of interaction arises from the flow around the larger vessel acting on the underbody of the smaller vessel causing a consequent decrease in effective stability, and thus increasing the likelihood of capsize if the vessels come into contact with each other. Since it has been found that the strength of hydrodynamic interaction varies approximately as the square of the speed, this type of manoeuvre should always be carried out at very slow speed.
If vessels of dissimilar size are to work in close company at any higher speeds then it is essential that the smaller one keeps clear of the hazardous area off the other's bow.

6. STOPPING IN SHALLOW BASINS

A vessel in very shallow water drags a volume of water astern which can be as much as 40% of the displacement. When the vessel stops this entrained water continues moving and when it reaches the vessels stern it can produce a strong and unexpected turning moment, causing the vessel to begin to sheer unex-

pectedly. In such circumstances accompanying tugs towing on a short line may sometimes prove to be ineffective.
The reason for this is that the tug's thrust is reduced or even cancelled by the proximity of the vessel's hull and small underkeel clearance. This causes the tug's wash to be laterally deflected reducing or even nullifying the thrust. The resultant force on the hull caused by the hydrodynamic action of the deflected flow may also act opposite to the desired direction.

7. EFFECT ON THE RUDDER
It should be noted that in dealing with an interaction situation the control of the vessel depends on the rudder which in turn depends on the flow of water round it. The effectiveness of the rudder is therefore reduced if the engine is stopped, and putting the engine astern when a vessel is moving ahead can render the rudder ineffective at a critical time. In many cases a momentary increase of propeller revolutions when going ahead can materially improve control.

8. GENERAL
Situations involving hydrodynamic interaction between vessels vary. In dealing with a particular situation it should be appreciated that when a vessel is moving through the water there is a positive pressure field created at the bow, a smaller positive pressure field at the stern and a negative pressure field amidships. The effects of these pressure fields can be significantly increased where the flow of water round the vessel is influenced by the boundaries of a narrow or shallow channel and by sudden local constrictions (e.g. shoals), by the presence of another vessel or by an increase in vessel speed. An awareness of the nature of the pressure fields round a vessel moving through the water and an appreciation of the effect of speed and the importance of rudder action should enable a vessel handler to foresee the possibility of an interaction situation arising and to be in a better position to deal with it when it does arise. During passage planning depth contours and channel dimensions should be examined to identify areas where interaction may be experienced.

9. SQUAT
Squat is a serious problem for vessels which have to operate with small under-keel clearances, particularly when in a shallow channel confined by sandbanks or by the sides of a canal or river.
The "Mariners' Handbook" (NP 100) contains further information on squat. The Admiralty Sailing Directions also give specific advice for squat allowances for deep draught vessels in critical areas of the Dover Strait.

EXAMPLES OF ACCIDENTS CAUSED BY HYDRODYNAMIC EFFECTS
1. OVERTAKING IN A NARROW CHANNEL
This casualty concerns a fully loaded coaster of 500 GT which was being overtaken by a larger cargo vessel of about 13,500 GT. The channel in the area where the casualty occurred was about 150 metres wide and the lateral distance between the two vessels as the overtaking manoeuvre commenced was about 30 metres. The speeds of the two vessels were initially about 8 and 11 knots respectively. When the stem of the larger vessel was level with the stern of the smaller vessel the speed of the latter vessel was reduced. When the bow of the smaller vessel was level with the midlength point of the larger vessel the bow started to swing towards the larger vessel. The helm of the smaller vessel was put hard to starboard and speed further reduced. The rate of swing to port decreased and the engine was then put to full ahead but a few seconds later the port side of the smaller vessel, in way of the break of the foc'sle head, made contact with the starboard side of the larger vessel. The angle of impact was about 25° and the smaller vessel remained at about this angle to the larger vessel as she first heeled to an angle of about 20° to starboard and shortly afterwards rolled over and capsized, possibly also affected by the large stern wave carried by the larger vessel into which the smaller one entered, beam on, as she dropped back.

2. MANOEUVRING WITH TUGS
The second category is illustrated by a casualty involving a 1,600 GT cargo vessel in ballast and a harbour tug which was to assist her to berth. The mean draughts of the vessel and the tug were 3 and 2 metres respectively. The tug was instructed to make fast on the starboard bow as the vessel was proceeding inwards, and to do this she first paralleled her course and then gradually drew ahead so that her towing deck was about 6 metres off, abeam of the vessel's forecastle. The speed of the two vessels was about 4 knots through the water, the vessel manoeuvring at slow speed and the tug, in order to counteract drag, at ¾ speed.

As the tow line was being passed the tug took a sheer to port and before this could be countered the two vessels touched, the vessel's stern striking the tug's port quarter. The impact was no more than a bump but even so the tug took an immediate starboard list, and within seconds capsized. One man was drowned.

3. STOPPING IN A SHALLOW BASIN

In the third category a VLCC was nearing an oil berth in an enclosed basin which was approached by a narrow channel. The VLCC stopped dead in the water off the berth while tugs made fast fore and aft. An appreciable time after stopping the VLCC began to turn to starboard without making any headway. The efforts of the tugs to prevent the swing proved fruitless and the starboard bow of the tanker struck the oil berth, totally demolishing it.

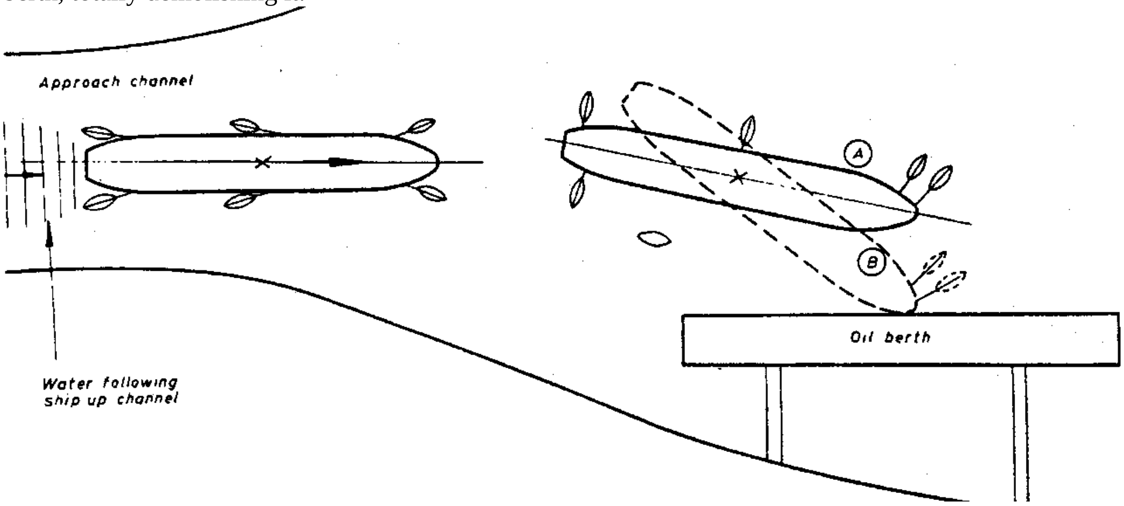


Fig. 39 Accident caused by a combination of; a)following water that turns the ship and b)tugs working on port bow causing a turn to starboard because of Coanda effect.

RESULTS OF LABORATORY WORK

1. Extensive laboratory work has been carried out on the combined effects of hydrodynamic interaction and shallow water (i.e. depth of water less than about twice the draught) and the following conclusions, which have been borne out by practical experience, are among those reached:

(a) The effects of interaction (and also of bank suction and rejection) are amplified in shallow water.

(b) The effectiveness of the rudder is reduced in shallow water, and depends very much on adequate propeller speed when going ahead. The minimum revolutions needed to maintain steerage way may therefore be higher than are required in deep water.

(c) However, relatively high speeds in very shallow water must be avoided due to the danger of grounding because of squat. An increase in draught of well over 10% has been observed at speeds of about 10 knots, but when speed is reduced squat rapidly diminishes. It has also been found that additional squat due to interaction can occur when two vessels are passing each other.

(d) The transverse thrust of the propeller changes in strength and may even act in the reverse sense to the normal in shallow water.

(e) Vessels may therefore experience quite marked changes in their manoeuvring characteristics as the depth of water under the keel changes. In particular, when the under-keel clearance is very small a marked loss of turning ability is likely.

(f) A large vessel with small under-keel clearance which stops in an enclosed basin can experience strong turning forces caused by the mass of entrained water following it up the approach channel.

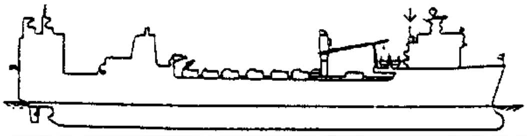
(g) The towing power of a tug can be reduced or even cancelled when assisting a larger vessel with small under-keel clearance on a short towline

MSAS(A)
Navigation & Communications
Marine Safety Agency

8.8 Motståndsökning på grunt vatten (Typfartyg F = Ro-Ro fartyg)

Från Sjötransporter, farleder och säkerhet, Transportforskningsdelegationen.

Lpp (m)	B (m)	T_A (m)	T_F (m)	Fart (knop)	AHK	X prop.	X roder	Roderyta A_r/LT	Bog prop. (hk)
155,0	25,5	8,0	8,0	20	20 980	2	2	0,012	1 000



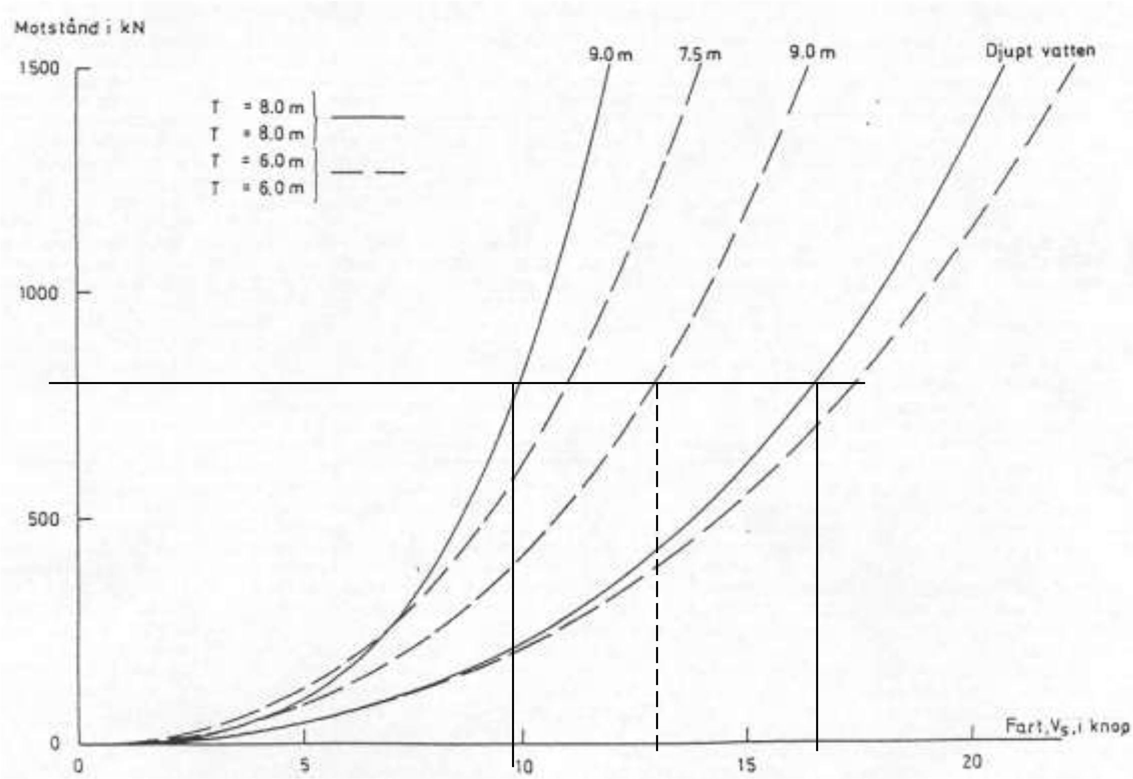


Fig 40 Motståndsökning på grunt vatten

Exempel: Fartygets motstånd på djupt vatten är ca 8000 kN vilket medför en fart på ca 17 knop i lastat tillstånd. När fartyget kommer in på grunt vatten och endast har en meter under köl är den fart det kan prestera vid" samma motstånd" endast ca 10 knop. Med 3 meter under köl kan fartyget prestera ca 13 knop.

8.9 Squat i kanal (Vänermax-fartyg)

Från Sjötransporter, farleder och säkerhet, Transportforskningsdelegationen.

Lpp (m)	B (m)	T_A (m)	T_F (m)	Fart (knop)	AHK	X prop.	X roder	Roderyta A_r/LT	Bog prop. (hk)
84,4	13,0	5,3	5,3	12,5	2 860	1	1	0,023	250

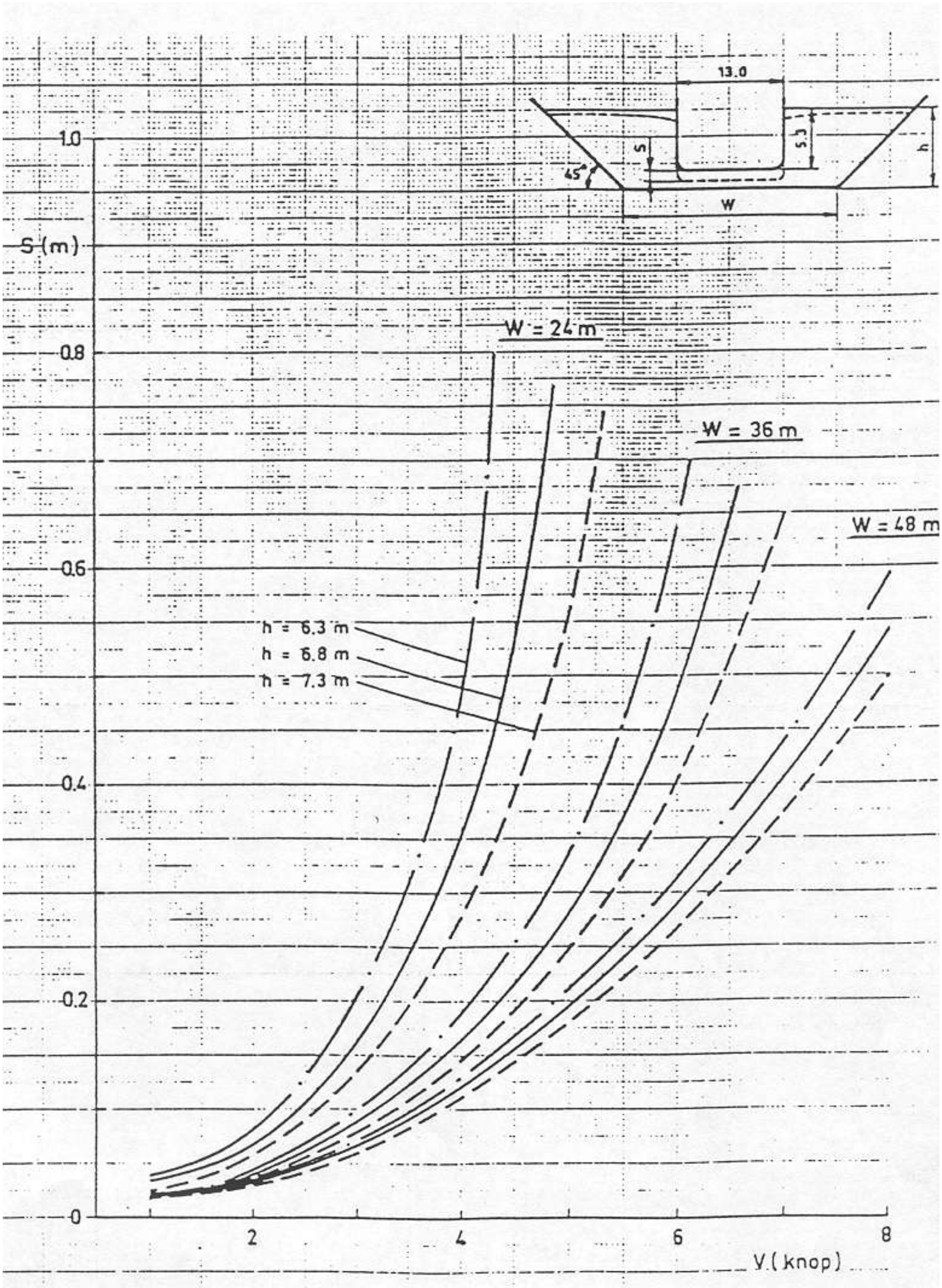


Fig.41 Diagram för avläsning av Squat/nedsänkning

8.10 Samband mellan bankavstånd och stöttningsroder vid gång parallellt med bank (Typfartyg I = tankfartyg 60.000 TDW)

Från Sjötransporter, farleder och säkerhet, Transportforskningsdelegationen.

Lpp (m)	B (m)	T_A (m)	T_F (m)	Fart (knop)	AHK	X prop.	X roder	Roderyta A_r/LT	Bog prop. (hk)
201,2	32,2	11,0	11,0	17	20 500	1	1	0,019	-

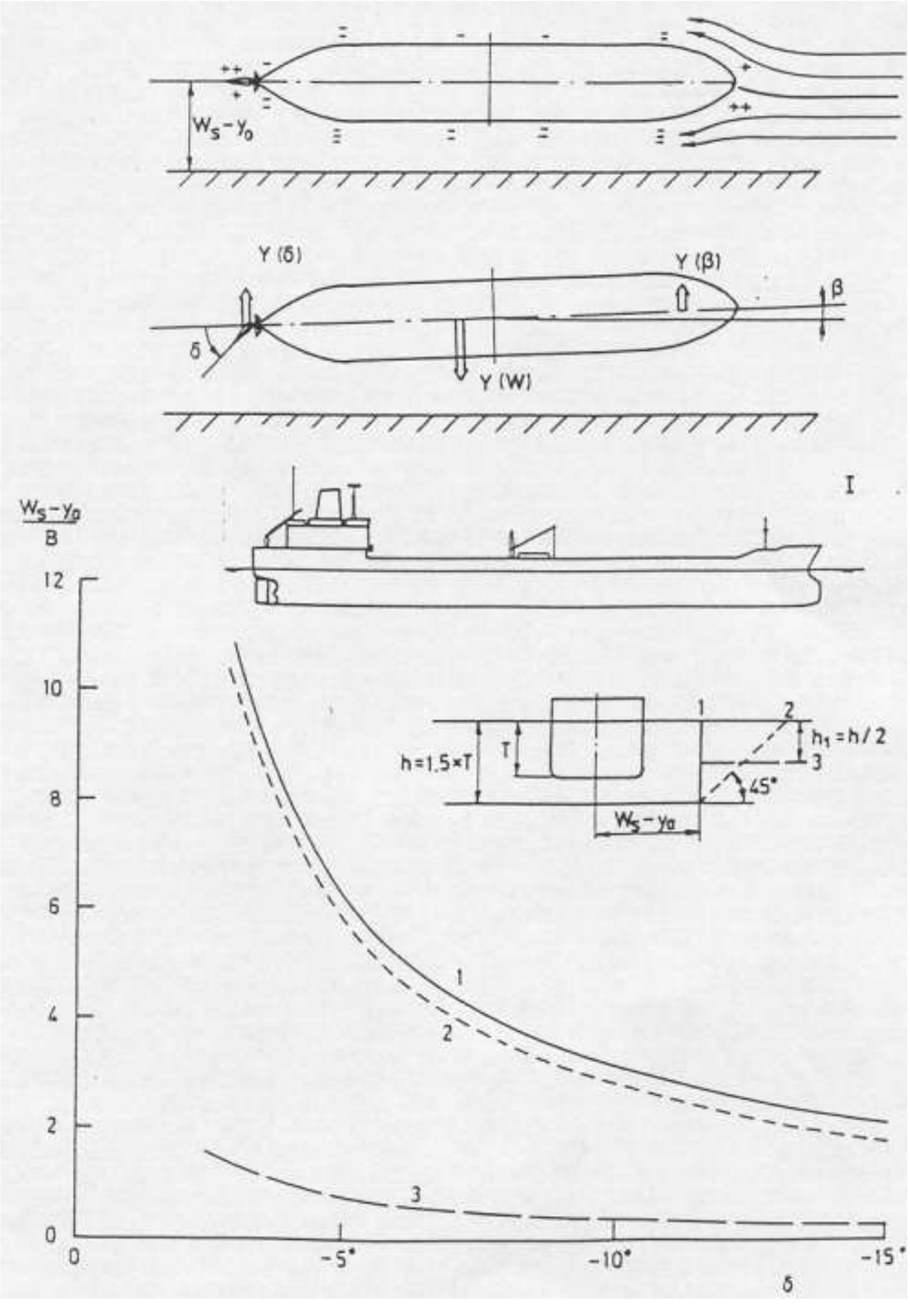


Fig 42. Diagram för avläsning av den rodervinkel som krävs för att balansera den kraft som orsakas av bankeffekt.

9. Helicopter ship guide

9.1 APPLICATION

This code shall apply to all routine transfers of personnel or goods by helicopter to or from ships while under way or at anchor. It does not apply to fixed or floating structures, or vessels employed in the off-shore oil or gas industry.

9.2 DEFINITIONS

helicopter landing officer
is the ship's officer in charge of, and forming part of, the helicopter landing party.

helicopter landing site (HLS)
is an area of deck which may be used as an aerodrome by helicopters for landing or taking-off by day or night (touch-down zone, clear zone and manoeuvring zone are defined in Appendix 1).

helicopter winching area (HWA)
is an area of deck which may be used for winching up or down of personnel or goods from or to a ship by a helicopter at hover.

hover
means to remain stationary at low altitude.

hover-taxi
means a slow (walking-pace) horizontal movement from one hover position to another.

overall length
of a helicopter is the horizontal distance with rotors turning from the foremost position of the main rotor blade tips to the aftermost position of the tail rotor blade tips of a single rotor helicopter or other extremity of aircraft structure; or the horizontal distance from the foremost position of the forward rotor blade tips to the aftermost position of the after rotor blade tips of a tandem-rotor helicopter. This is the dimension referred to as 'D' in Appendix 1.

Helicopter VMC
conditions of visibility as defined in the Aeronautical Information Publication (AIP) (horizontal visibility of not less than 800 metres for operations below 700 feet, clear of cloud and outside controlled airspace)

9.3 SITE

(a) Helicopter-ship operations may be either by landing or winching. In the case of landing operations, the helicopter landing site (HLS) may be amidships (in the fore-and-aft line), shipside, or at bow or stern. An HLS or a helicopter winching area (HWA) shall be of the shape and dimensions, and shall be marked as shown in Appendix 1, except as provided in 4 and 11.4.

(b) Before an area of deck is designated and marked as an HLS, it is necessary to ascertain that the ship's structure under the proposed HLS is of sufficient strength to withstand the static and dynamic loads imposed on it by a helicopter landing; these stresses can significantly exceed those associated with supporting the gross weight of the helicopter.

As a guide, the HLS must be able to support an impact load of 1.5 x maximum take off weight (MTOW) for a heavy normal landing. For an emergency landing an impact load of 2.5 x MTOW should be supported in any position on the HLS.

(i) load distribution - for the purpose of design, it is to be assumed that a single main rotor helicopter will land on the wheels of the two main undercarriages or skids if fitted.

(ii) the maximum take-off weight and undercarriage centres for which the HLS has been designed should be stated in the

Operations Manual for the helideck and the maximum size and weight of helicopter for which the helideck is suitable should be marked on the helideck.

(c) The HLS should have a non-slip surface.

(d) Rope netting should be laid to aid the landing of wheeled helicopters in adverse weather conditions. Such netting may be prohibited for skidded helicopters.

9.4 PILOT TRANSFER

Helicopter-ship operations solely for the purpose of affecting the transfer of a marine pilot may be exempted from the provisions of 3, subject to the following:

(i) a clear area of deck exists which must be no less than twice the main rotor diameter and preferably 2D wherever possible.

(ii) the helicopter pilot brings the aircraft to a hover clear of the ship's side and then hover-taxis to the landing position or the ship's master and the helicopter pilot agree that the landing may be safely made in another manner.

(iii) sea and weather conditions are such that the ship's master and the helicopter pilot agree that the operation may be carried out safely and in accordance with flight rules, Civil Aviation Regulations and the flight operations manual.

Fig. 43 Pilot transfer, ingen lämplig placering – ingen märkning

9.5 COMMUNICATIONS

The notice periods in (a) and (b) below are for guidance only, mariners should ensure they are familiar with the requirements of the particular transfer service or port with respect to notice of arrival.

(a) At least 12 hours prior to arrival, the master shall advise the helicopter operator, through the ship's agent:

(i) the ETA at the rendezvous and the anticipated true (groundorientated) course and speed.

(ii) the diameter and location of the HLS or HWA clear zone ; the maximum weight of the helicopter for which the HLS is designed; the VHF frequencies to be used (if different from standard) and
the frequency, number and type of any locating aids (such as a Non Directional Beacon) on board.

(b) At least six hours prior to arrival, the master shall:

(i) confirm or amend the ETA.

(ii) advise anticipated conditions of sea and spray, and the amount the vessel is pitching, rolling and heaving.

(c) When VHF contact is established between ship and helicopter, the master shall provide the helicopter pilot with the name of the ship, the true (ground-orientated) course and speed, the relative direction and speed of wind, an update on the pitch, roll and heave conditions and his authority to commence final approach and land. VHF contact is to be maintained until the helicopter is finally clear of the ship.

(d) If the helicopter pilot is satisfied that it is safe to do so, he will confirm that he is commencing final approach. He may request the master to alter his course or speed to facilitate his approach, and if it is safe to do so, the master should accede to such a request. Once the course and speed have been agreed, these shall be maintained by the ship until the helicopter is finally clear of the ship. The master shall also comply with any request from the helicopter pilot to switch on or off any deck or accommodation lighting.

(e) The master shall advise the helicopter landing officer by portable radio when the helicopter commences final approach, and the helicopter landing officer shall remain in radio contact with the bridge thereafter in readiness to signal the helicopter pilot to abort his approach if the master so orders.

(f) The helicopter landing officer shall if necessary signal the helicopter pilot visually by:

(i) moving arms repeatedly upward and backward beckoning onward, or by night flashing a green light, to indicate that the landing site is clear for final approach.

(ii) crossing and uncrossing arms repeatedly above head, or by night flashing a red light, to indicate that the helicopter pilot should abort final approach. This red light should be flashed directly at the aircraft.

9.6 AUTHORITY

Authority to commence helicopter-ship operations shall only be given by the master, and must be confirmed by the helicopter pilot. The master remains at all times responsible for the safety of the ship and the helicopter pilot remains at all times responsible for the safety of the helicopter.
Both include a general responsibility to avoid any act or omission which might endanger life or limb, property, or the marine environment.
Authority to commence helicopter-ship operations shall only be given by the master and confirmed by the helicopter pilot if:
(a) Helicopter VMC exists. The assessment of this rests solely with the helicopter pilot in command in accordance with flight rules, Civil Aviation Regulations and the flight operations manual.
(b) Two-way VHF communication between ship and helicopter has been established (Initial contact normally made on channel 16).
(c) The ship is neither rolling nor pitching more than 5o either side, nor heaving more than 5 metres. Chocks should be used if the pitch and/or roll exceeds 1.5o.
(d) The HLS or HWA, as appropriate, has been prepared as prescribed in 7 and marked as prescribed in 3.
(e) Landing party prescribed in 8 is standing-by with equipment ready as prescribed in 7.
(f) The use of single-engine helicopters for passenger carrying operations is not normally permitted by CAA regulations:
(i) for charter operations offshore, unless there is a suitable landing site overflown within 50 nm of the previous site.
(ii) for charter operations during the hours of darkness unless exempted for pilot transfer.
(iii) for offshore winching operations by day or night.

9.7 PREPARATION OF LANDING SITE

Before either landing or winching operations are authorised to commence:
(a) All loose objects within and adjacent to the manoeuvring zone shall be secured or removed.
(b) All aerials and standing or running rigging above or in the vicinity of the manoeuvring zone shall be lowered or secured.
(c) A pennant or windsock shall be hoisted where it can be clearly seen by the helicopter pilot, and brightly illuminated during the hours of darkness; this is not necessary if the ship can confirm the relative wind.
(d) Where necessary the decks should be washed down to avoid dust being raised by the down-draught from the helicopter rotors.
(e) A fire line consisting of two hoses coupled together, fitted with the foam generating nozzle and set up to make foam should be rigged and the fire main pressurised. This fireline should be near to but well clear of the clear zone ; up-wind and with the nozzle directed away from the area in case of inadvertent discharge; at least one 20 litre container of foam compound with eductor and dip-stick should be provided (unless the area is covered by a fixed foam fire control installation). The system shall be capable of delivering 1.5 m3 of foam per minute.
(f) Other fire-fighting equipment to be in readiness near to but clear of the clear zone:
- 6 x 20 litre spare containers of foam compound.
- 1 fireman's outfit complying with 20.1 of Marine Orders Part 15.
- 1 x 9 kg dry powder extinguisher.
(g) Other emergency equipment to be in readiness at the stand-by zone includes axe, crowbar, hacksaw, bolt-cutters and a small ladder. (For use if the helicopter falls on its side)
NOTE: equipment prescribed in (f) and (g) may remain in a dedicated locker provided that it is adjacent to the clear zone and readily accessible.
(h) All personnel other than landing party shall be ordered well clear of the manoeuvring zone.
(i) At night all marking lights switched on and checked; all available deck and accommodation lights in the vicinity of the operating area switched on; deck and accommodation lights which could impair the vision of the helicopter pilot shall be appropriately shielded.

9.8 HELICOPTER LANDING PARTY

Shall consist of a minimum of one officer and two ratings.

(a) The officer in charge (OIC) of the landing party shall be equipped with a portable radio to maintain communication with the bridge, and at night a red and green emergency/signalling torch. The OIC is to remain in visual contact with the helicopter pilot at all times the helicopter is on board.

(b) All members of the landing party shall wear protective clothing consisting of:

(i) flame-retardant overalls and leather or similar material gloves.

(ii) a brightly coloured tabard (waistcoat) unless the overalls themselves are brightly coloured. In either case, these should be fitted with retro-reflective tape for night operations.

(iii) a protective helmet with a face visor and with the chin-strap
securely fastened.

(iv) industrial boots to AS 2210.

(v) ear protection.

(vi) one member of the helicopter landing party shall be fully dressed in the fireman's suit.

(c) The hook-handler (if any) shall, in addition, wear rubber boots and heavy-duty rubber gloves.

(d) It is the master's responsibility to ensure that all crew members in the helicopter landing party have received adequate training as prescribed in Appendix 2.

(e) All members of the helicopter landing party shall, so far as their duties permit, remain throughout the operation in a sheltered position upwind out of the manoeuvring zone where they are protected from the possible danger from flying fragments of rotor blades shattered by contact with the ship's structure, or the intense heat radiated in the case of a fire. This position shall be no less than 25 metres from the clear zone and shall be known as the stand-by zone.

9.9 PROCEDURE DURING LANDING OPERATIONS

(a) After preparation of the manoeuvring zone as above, the helicopter landing party shall stand-by the designated fire appliances in the standby zone until the helicopter has landed.

(b) The master shall advise the helicopter landing officer by portable radio when the helicopter commences final approach, and the helicopter landing officer shall remain in radio contact with the bridge thereafter in readiness to signal the helicopter pilot to abort his approach if the master so orders.

(c) After landing, one member of the helicopter landing party shall, if required and signalled to do so by the helicopter pilot, approach the helicopter to assist personnel to embark or disembark.

Personnel approaching or leaving the aircraft shall only do so in the direction indicated by the pilot. Under no circumstances whatsoever shall a helicopter be approached from the rear.

(d) The helicopter landing party shall stand-by at the stand-by zone with the fire fighting appliances during take-off and remain there until the helicopter has safely cleared the manoeuvring area.

9.10 PROCEDURE DURING WINCHING OPERATIONS

(a) After preparation of the operating area as above, the helicopter landing party shall stand-by the designated fire appliances in the stand-by zone.

(b) The master shall advise the helicopter landing officer by portable radio when the helicopter commences final approach, and the helicopter landing officer shall remain in radio contact with the bridge thereafter in readiness to signal the helicopter pilot to abort his approach if the master so orders.

(c) As soon as the helicopter is at hover over the winching area, the hook handler shall be ready to assist in unhooking or hooking-on, but shall otherwise remain clear of the winching area during winching operations.

(d) **It is imperative that the hook and winch-wire must not be attached to any part of the ship's structure.**

(e) The helicopter landing party shall move back to the stand-by zone and stand-by the fire appliances after the operation has concluded and remain there until the helicopter has safely cleared the manoeuvring area.

9.11 PROCEDURE IN EMERGENCY SITUATIONS

9.11.1 Emergency shut-down

(a) The helicopter will not normally shut-down while landed on a ship's deck except in an emergency.

(b) The helicopter landing party should be aware that the rotor blades will be subject to flexing while slowing, and that they must not approach the helicopter until the rotors have stopped turning, and then only when signalled to do so by the pilot.
(c) The helicopter landing officer shall confer with the helicopter pilot regarding the need for lashing the helicopter in position.

9.11.2 Crashing on deck
(a) The master shall immediately sound the emergency muster signal, and advise crew of the nature of the emergency by the public address system.
(b) The fire support party shall assist the helicopter landing party.
(c) The master shall advise local authorities and MRCC Canberra by radio.

9.11.3 Ditching
(a) The master shall immediately sound the emergency muster signal, and advise crew of the nature of the emergency by the public address system.
(b) The ship should, if practicable and appropriate, commence the execution of a Williamson turn as quickly as possible.
(c) Rescue boat crew and launching party shall stand-by to carry out master's orders.
(d) The master shall transmit an Urgency signal (prefix "Pan-panpan"), and advise local authorities and MRCC Canberra by radio.

9.11.4 Medevac or other emergency
When it is necessary, due to medical or other emergency, either to evacuate a patient requiring urgent medical attention or to embark medical or other emergency personnel, the ship's master and the pilot in command of the helicopter may exercise their professional judgement in varying the recommendations in this document, always ensuring that safety is not compromised.

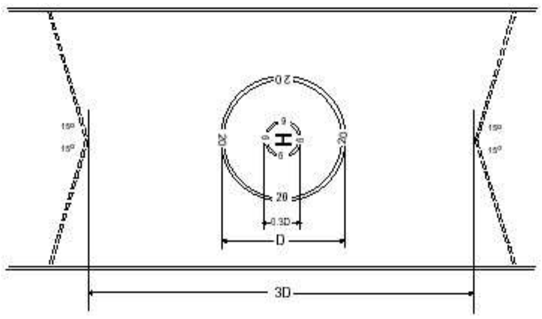
9.12 APPENDIX 1 LANDING SITES AND WINCHING AREAS

General
Dimensions quoted below are in terms of D, the overall length of the helicopter. It is recommended that the landing site or winching area should be laid out for D = 20 metres. This may be reduced to a figure not less than 12 metres if the former dimension is impracticable, but helicopter-ship operations shall be restricted to those aircraft whose overall length does not exceed the latter figure.

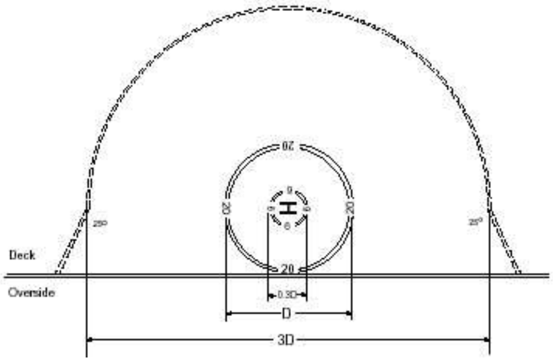
Helicopter landing sites consist of 3 zones
(a) Touch-down zone, which is the area in which the undercarriage is in contact after landing. The minimum area is the undercarriage contact area plus 1 metre all round.
Circumference marked by a continuous white or yellow line at least 0.01D wide, broken at 90º intervals to show figures indicating diameter. Centre marked by white or yellow capital H measuring 0.2D x 0.1D formed of lines 0.02D wide.
Entire remaining area painted a contrasting colour to ship's deck and superstructure. Shall not contain obstacles more than 10 cm high, but tiedown points may be fitted.
The touch-down zone shall be 0.3D in diameter.
(b) Clear zone, which is the area required for safe rotation of the rotor blades.
Minimum is a circle of diameter equal to the overall length of the helicopter. Circumference marked by continuous white or yellow line at least 0.01D wide, broken at 90º intervals to show figures indicating diameter.
Entire area painted a contrasting colour to ship's deck and superstructure. Should not contain obstacles more than 25 cm high. The clear zone shall be D in diameter.
(c) Manoeuvring zone, which is the extra area necessary to allow for such things as sudden up-draughts or cross-draughts due to ground-effect or turbulence caused by proximity to superstructure.
Outer limit marked by hatched white or yellow line at least 20 cm wide.
Minimum width is three times the overall length of the helicopter. Should not contain obstacles higher than a gradient of 1:5 (amidships HLS) or 1:3 (shipside HLS) from inner to outer limit.
The closest point of the outer limit of the manoeuvring zone shall be D away from the circumference of the clear zone.
All paint used within the limit of the clear zone of an HLS or the manoeuvring zone of an HWA should be such as to provide a non-skid surface whether wet or dry.

An HLS or an HWA shall be of the shape, dimensions and markings as shown below

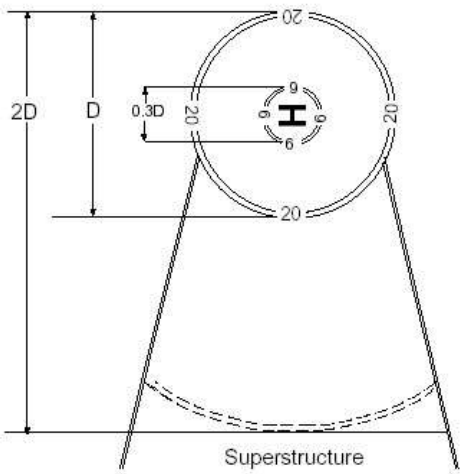
Amidships HLS
Clear zone shall be a circle D in diameter centred on fore-and-aft line.
Manoeuvring zone shall be 3D wide on the fore-and-aft line on the same centre as the clear zone, increasing towards the ship's side at an angle of 15º to athwartships.



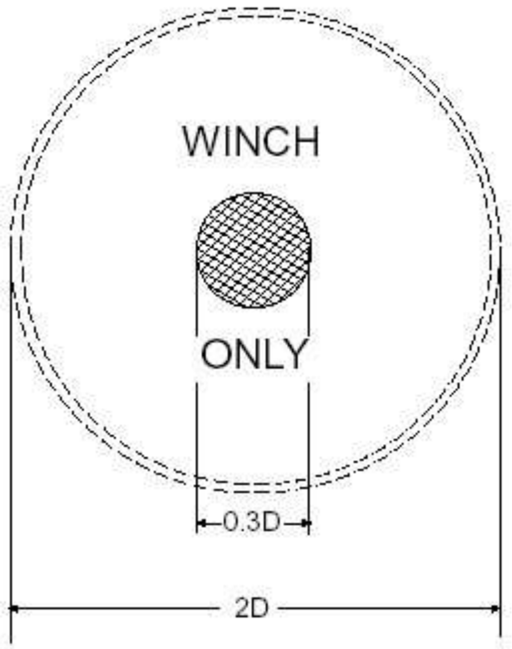
Shipside HLS
Clear zone shall be a circle D in diameter with ship's side tangential.
Manoeuvring zone shall be a semicircle 3D on a diameter parallel to the ship's side through the same centre as the clear zone; from the ends of the diameter the limits shall increase towards the ship's side at an angle of 25º to athwartships.



Bow or stern HLS
Clear zone shall be a circle D in diameter.
Manoeuvring zone shall be such that the nearest superstructure or other obstruction having a height extending above a gradient of 1:3 from the circumference of the clear zone is at least D away from the circumference of the clear zone.



Helicopter winching area (HWA)
A winching zone 0.3D in diameter painted white or yellow surrounded by a concentric manoeuvring zone 2D in diameter with the circumference marked by a hatched white or yellow line at least 0.01D wide.
The words "WINCH ONLY" should be marked within the manoeuvring zone in white or yellow capital letters 0.2D high in such a manner as to be clearly visible to the helicopter pilot.



9.13 APPENDIX 2 TRAINING OF HELICOPTER LANDING PARTY
It is the master's responsibility to ensure that no crew member forms part of a helicopter landing party unless he/she has received adequate training in the following:
1 Basic fire fighting and in the case of the HLS, helicopter fire fighting.
2 Preparation of helicopter landing site or winching area in accordance with part 7 of this code.
3 The provisions for a helicopter landing party in accordance with part 8 of this code.
4 Procedure for:
(i) landing operations in accordance with part 9 of this code.
(ii) winching operation in accordance with part 10 of this code.
(iii) emergency situations in accordance with part 11 of this code.
5 Awareness of:
(i) the requirement never to approach the helicopter from astern.
(ii) the possible effect of down-draught from the rotors.
(iii) the possible effect on the helicopter's flight path of ground-effect and turbulence round superstructure.
(iv) the danger of rotor blades flexing during shut-down as stated in 1(b) of part 11.
(v) the danger of shattered fragments of rotor blade flying like shrapnel following a mishap.
(vi) the fine line between an explosion, which is unlikely following a crash, and a flash fire or fire-ball, which is more likely, and which can radiate sufficient heat to cause secondary burns at a range of 15 or 20 metres.
(vii) the danger of a 'running liquid fire' caused by ignited leaking fuel spreading rapidly.
(viii) the dangers associated with the discharge of static electricity if the winch-wire comes into contact with any part of the ship's structure, or any person standing on the ship's deck.
(ix) the precautions normally taken to prevent the discharge of static electricity as in (viii).
(x) the absolute necessity to avoid the winch-wire becoming attached, either intentionally or accidentally, to any part of the ship's structure; the dangers associated therewith.
(xi) the dangers associated with fire hoses which are not pressurised with water lying on deck within the manoeuvring zone.
From Australian Maritime Safety Authority and Merchant shipping notice No 1506, Department of Transport.

10. Vind strömbelastning på fartyg.

10.1 MANÖVRERING

"Manövern är en Vettenskap, som lär att, med eller utan seglens och vindens tillhjelp, med fördel regera ett ensamt skepp vid förefallande händelser till fart, vändningar eller stillaliggande; och förekomma härvid många handarbeten, hvilkas tillämpning inbegripes under namnet Sjömanskap.
Manöver kallas äfven hvar och en särskild rörelse som verkställes med ett skepp; manövrist är den som verkställer".
(Konungens stabsadjutants och riddarens Fabian Casimir Rosvalls försök till Hjelpreda för Nybegynnare i Skepps-manövern, Stockholm 1803)

Fartygsmanövrering handlar huvudsakligen om att ha kontroll på de krafter och moment som påverkar fartyget, i synnerhet vid manövrering i låga farter. Dessa krafter kan vara av oss kontrollerade eller externa - okontrollerade.

Av oss kontrollerade	Okontrollerade
Huvudmaskin Roder Förtöjningar Ankare Bogserbåtar Hjälputrustning, t ex bogpropeller	Vind Ström Is Hydrodynamiska effekter orsakade av grunt vatten Vågor dyning

En förståelse för dessa krafter och hur de verkar ger oss större möjligheter att lyckas med den manöver som vi avser göra. Nedanstående exempel är endast till för att belysa omfattning och storlek på dessa krafter.

Hur ett fartyg som ligger fritt uppför sig bestäms av de krafter som verkar på det. Några av dessa krafter kan kontrolleras av navigatören medan andra, yttre krafter, ej kan kontrolleras. För att uppnå en önskad manöver hos fartyget måste navigatören använda de, av honom, kontrollerbara krafterna på ett sådant sätt att de icke kontrollerbara krafterna övervinns och den önskade manövern kan genomföras.

Om de okontrollerade krafterna ej beaktas i tillräcklig grad eller att de verkar starkare på fartyget än de kontrollerbara, kan den önskade manövern ej genomföras eventuellt saboteras. Det är därför nödvändigt att navigatören beaktar dessa yttre okontrollerbara krafter så att man inte påbörjar en manöver som ej går att genomföra/fullfölja.

Den som manövrerar fartyget bedömer normalt verkningarna av de olika krafterna genom att iaktta fartygets rörelse, medan krafterna verkar. Blir manövern inte den förväntade genomförs lämpliga förändringar, t ex ökat varvtal, större rodervinkel etc, så att manövern kan genomföras. Antalet korrektioner under en manöver bestäms i hög grad av navigatörens erfarenhet- skicklighet. Emellertid är det som påpekats många krafter som samtidigt verkar på fartyget och det kan ta lång tid att erfarenhetsmässigt uppnå tillräcklig säkerhet i manövreringen. Det är därför önskvärt och nödvändigt att ha viss teoretisk kunskap om de relativa storleksförhållandena av dessa krafter och om det sätt som de verkar på fartyget.

Med kunskap kan det vara möjligt att utnyttja de yttre krafterna, för den önskade manövern, istället för att kämpa mot dessa. I det följande skall vi här helt kort försöka belysa de effekter som vind och ström har på fartyget, speciellt vid manövrering i låga farter och i trånga områden.

Vinden är kanske den av de yttre faktorerna som har störst påverkan på fartygen, hur stor denna kraft (K_v) blir är beroende av bl a:

- Vindstyrkan (se bilaga)
- Vindriktningen (angreppsvinkel)
- Fartygets exponerade vindyta (se bilaga)
- Fartygets läge i förhållande till vindriktningen

■ Fartygets fart.

Hur ett stoppat, stillaliggande fartyg lägger sig vid påverkan av vind är beroende av vindens resulterande kraft (K_v) och den resulterande strömkraften (K_S).

Vid kännedom om vindkraften kan man beräkna avdrifthastigheten, eftersom:

$K_v = K_s$

EXEMPEL:

Vindarea = 4.400 m^2
Vindhastighet = 10 m/s
Undervattensarea = 1.800 m^2

K_v blir ca 23 ton

Detta ger

Vs =1,2 - 1,3 knop

När vattendjupet minskar kommer dock vattenströmmen att öka vilket vilket medför att avdriftshastigheten minskar. Vid ett vattendjup på 2 ggr djupgåendet är strömkraften ca 2,3 gånger större och vid 1,5 ggr djupgåendet är strömkraften ca 3 gånger större.

För att ge samma Vs som ovan krävs det en vindstyrka på ca 16 m/s om vattendjupet är 2 ggr djupgåendet.

I övriga bilagor visas effekt av vind på fartyget vid olika "angreppsvinklar (materialet hämtat från "Sjötransporter, farleder och säkerhet" Transportforskningsdelegationen 1983:4).

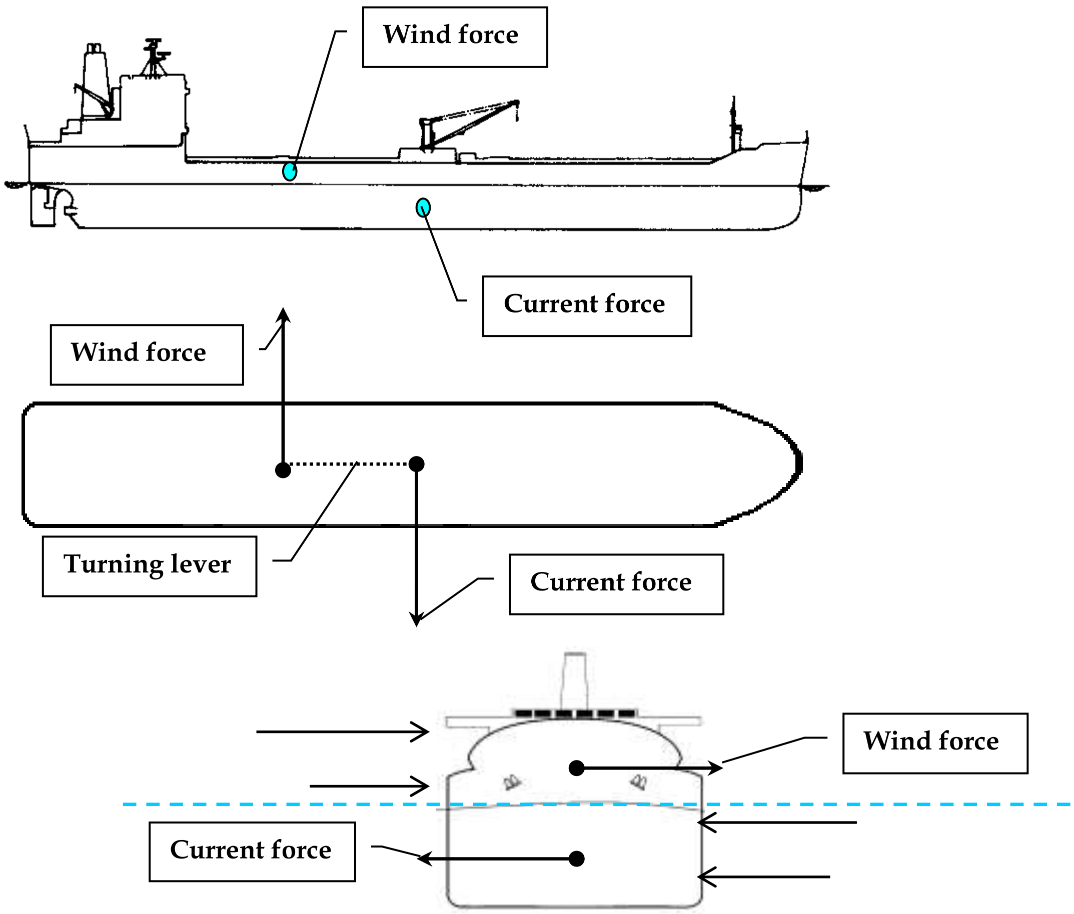


Fig. 44 De resulterande vind och strömkrafterna angriper fartyget på olika platser varför ett stillaliggande fartyg vill inta ett nytt jämviktsläge.

Krafterna kan beräknas enligt följande:

To calculate the current and wind drag typical drag formulas can be used.

$$\mathbf{D = \frac{1}{2}\rho V^2 AC_D}$$

$$\mathbf{\frac{kg \times m^2 m^2}{m^3 \times s^2} = \frac{kg \times m}{s^2} = N}$$

$$D = \frac{1{,}2 \times V^2 \times A \times 0{,}85}{2 \times 1000 \times 9{,}81}$$

$$D = \frac{0{,}52 \times V^2 \times A}{10000} = (ton)$$

$$D = \frac{1025 \times V^2 \times A \times 0{,}65}{2 \times 1000 \times 9{,}81}$$

$$D = 0{,}034 \times V^2 \times A \times f = (ton)$$

where: D = the drag due to the current or wind (N)

ρ = the density of water or air (kg/m^3)

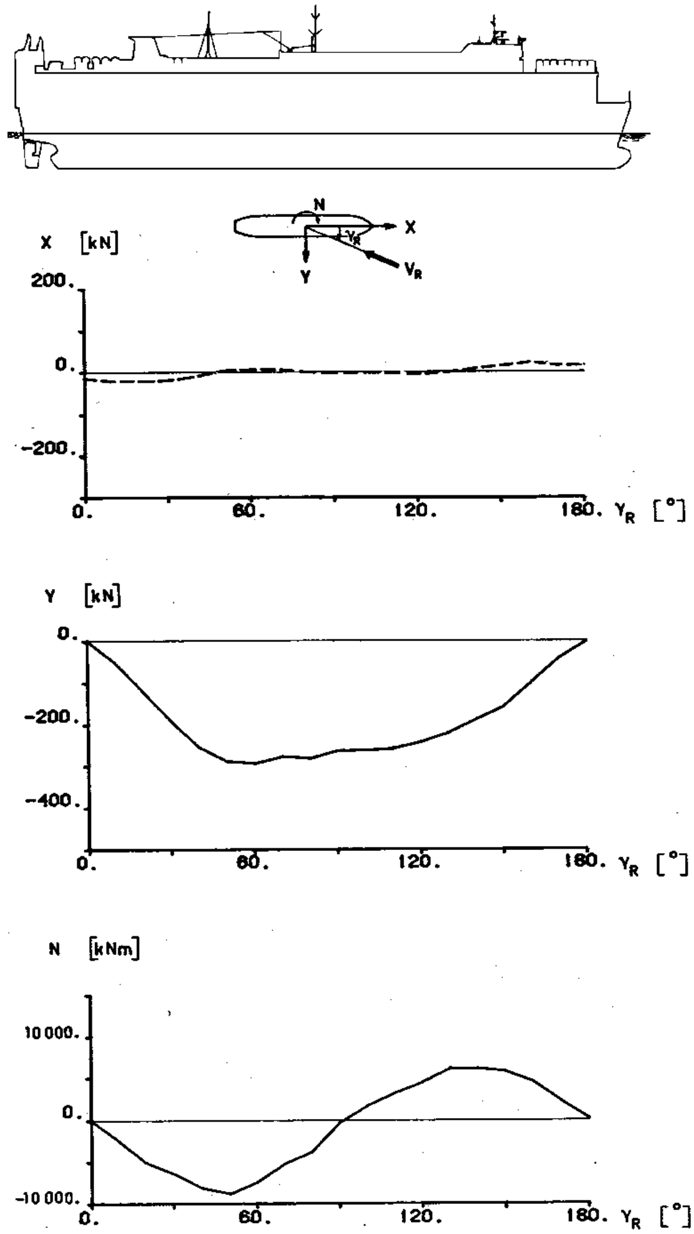
V = the speed of the current or wind (m/s)

A = the area affected by the current or wind (m^2)

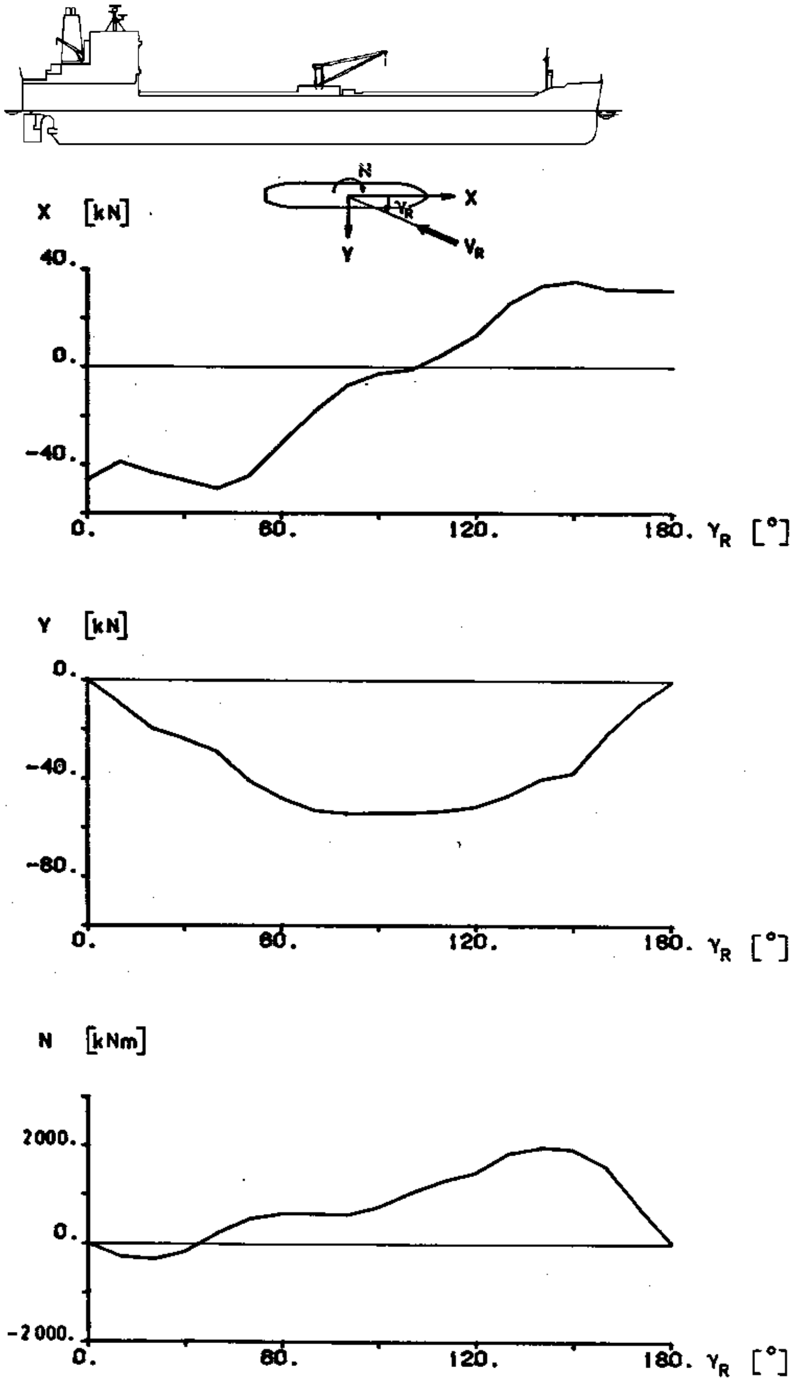
C_D = the coefficient of drag (0,8-0,9 for ship structure in air, 0,6 - 0,7 for ship structure in water)

f = factor depending of depth under keel, for depth 5 – 6 times the draft, f = 1. f increases when water depth decreases, depth 2 times the draft f = 2

In the Det Norske Veritas rules the values of C_D should be found from model tests.



Carcarrier under the influence of wind 10m/s



Tanker (loaded) under the influence of wind 10m/s

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Ref. T1/2.04

MSC.1/Circ.1228
11 January 2007

REVISED GUIDANCE TO THE MASTER FOR AVOIDING DANGEROUS SITUATIONS IN ADVERSE WEATHER AND SEA CONDITIONS

1 The Maritime Safety Committee, at its eighty-second session (29 November to 8 December 2006), approved the Revised Guidance to the master for avoiding dangerous situations in adverse weather and sea conditions, set out in the annex, with a view to providing masters with a basis for decision making on ship handling in adverse weather and sea conditions, thus assisting them to avoid dangerous phenomena that they may encounter in such circumstances.

2 Member Governments are invited to bring the annexed Revised Guidance to the attention of interested parties as they deem appropriate.

3 This Revised Guidance supersedes the Guidance to the master for avoiding dangerous situations in following and quartering seas (MSC/Circ.707).

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ANNEX

REVISED GUIDANCE TO THE MASTER FOR AVOIDING DANGEROUS SITUATIONS IN ADVERSE WEATHER AND SEA CONDITIONS

1 GENERAL

1.1 Adverse weather conditions, for the purpose of the following guidelines, include wind induced waves or heavy swell. Some combinations of wave length and wave height under certain operation conditions may lead to dangerous situations for ships complying with the IS Code. However, description of adverse weather conditions below shall not preclude a ship master from taking reasonable action in less severe conditions if it appears necessary.

1.2 When sailing in adverse weather conditions, a ship is likely to encounter various kinds of dangerous phenomena, which may lead to capsizing or severe roll motions causing damage to cargo, equipment and persons on board. The sensitivity of a ship to dangerous phenomena will depend on the actual stability parameters, hull geometry, ship size and ship speed. This implies that the vulnerability to dangerous responses, including capsizing, and its probability of occurrence in a particular sea state may differ for each ship.

1.3 On ships which are equipped with an on-board computer for stability evaluations, and which use specially developed software which takes into account the main particulars, actual stability and dynamic characteristics of the individual ship in the real voyage conditions, such software should be approved by the Administration. Results derived from such calculations should only be regarded as a supporting tool during the decision making process.

1.4 Waves should be observed regularly. In particular, the wave period T_W should be measured by means of a stop watch as the time span between the generation of a foam patch by a breaking wave and its reappearance after passing the wave trough. The wave length λ is determined either by visual observation in comparison with the ship length or by reading the mean distance between successive wave crests on the radar images of waves.

1.5 The wave period and the wave length λ are related as follows:

$$\lambda = 1.56 \cdot T_W^2 \text{ [m] or } T_W = 0.8\sqrt{\lambda} \text{ [s]}$$

1.6 The period of encounter T_E could be either measured as the period of pitching by using stop watch or calculated by the formula:

$$T_E = \frac{3T_W^2}{3T_W + V\cos(\alpha)} \text{ [s]}$$

where V = ship's speed [knots]; and
α = angle between keel direction and wave direction (α = 0° means head sea)

1.7 The diagram in figure 1 may as well be used for the determination of the period of encounter.

1.8 The height of significant waves should also be estimated.

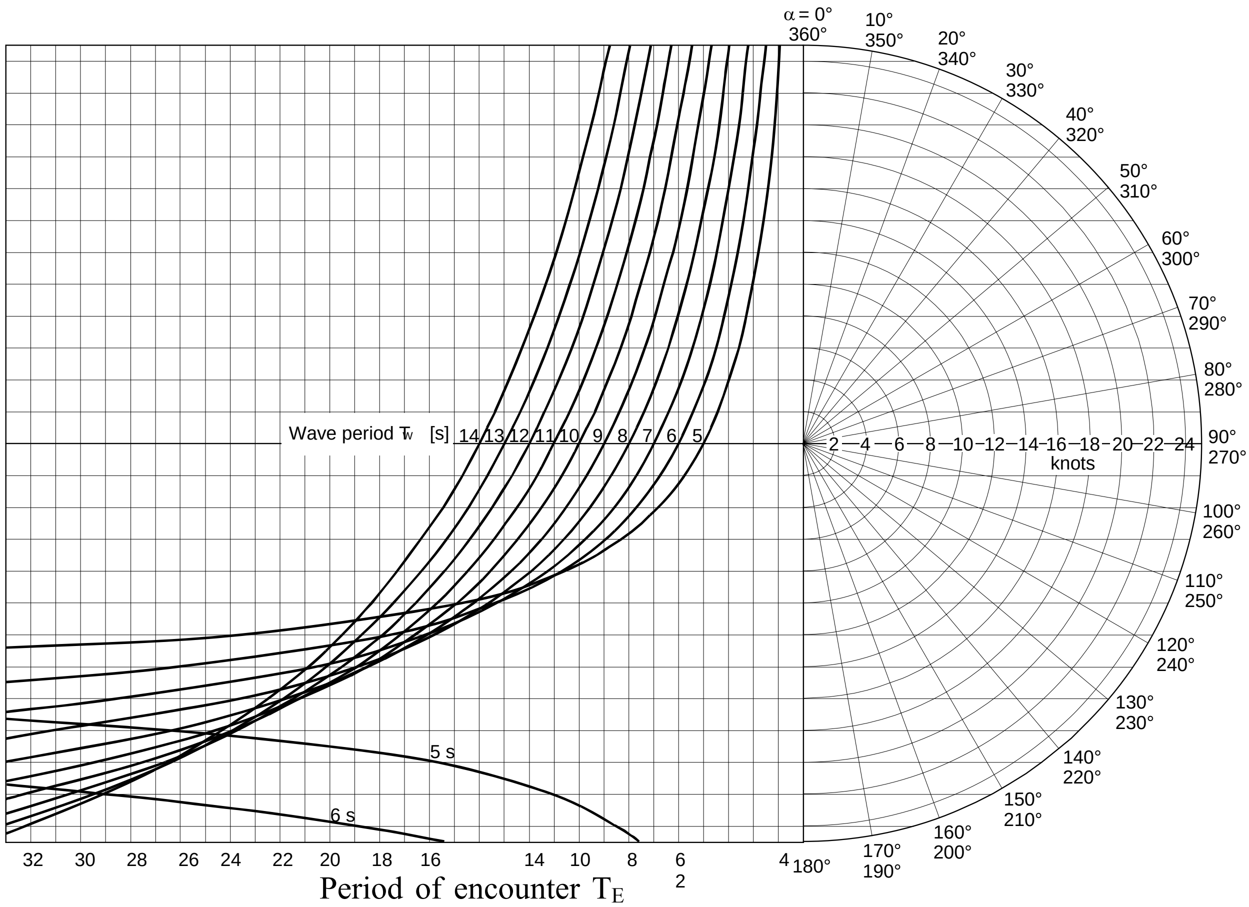

Figure 1: Determination of the period of encounter T_E

2 CAUTIONS

2.1 It should be noted that this guidance to the master has been designed to accommodate for all types of merchant ships. Therefore, being of a general nature, the guidance may be too restrictive for certain ships with more favourable dynamic properties, or too generous for certain other ships. A ship could be unsafe even outside the dangerous zones defined in this guidance if the stability of the ship is insufficient. Masters are requested to use this guidance with fair observation of the particular features of the ship and her behaviour in heavy weather.

2.2 It should further be noted that this guidance is restricted to hazards in adverse weather conditions that may cause capsizing of the vessel or heavy rolling with a risk of damage. Other hazards and risks in adverse weather conditions, like damage through slamming, longitudinal or torsional stresses, special effects of waves in shallow water or current, risk of collision or stranding, are not addressed in this guidance and must be additionally considered when deciding on an appropriate course and speed in adverse weather conditions.

2.3 The master should ascertain that his ship complies with the stability criteria specified in the IS Code or an equivalent thereto. Appropriate measures should be taken to assure the ship's watertight integrity. Securing of cargo and equipment should be re-checked. The ship's natural period of roll T_R should be estimated by observing roll motions in calm sea.

3 DANGEROUS PHENOMENA

3.1 Phenomena occurring in following and quartering seas

A ship sailing in following or stern quartering seas encounters the waves with a longer period than in beam, head or bow waves, and principal dangers caused in such situation are as follows:

3.1.1 Surf-riding and broaching-to

When a ship is situated on the steep forefront of a high wave in following or quartering sea conditions, the ship can be accelerated to ride on the wave. This is known as surf-riding. In this situation the so-called broaching-to phenomenon may occur, which endangers the ship to capsizing as a result of a sudden change of the ship's heading and unexpected large heeling.

3.1.2 Reduction of intact stability when riding a wave crest amidships

When a ship is riding on the wave crest, the intact stability can be decreased substantially according to changes of the submerged hull form. This stability reduction may become critical for wave lengths within the range of 0.6 L up to 2.3 L, where L is the ship's length in metres. Within this range the amount of stability reduction is nearly proportional to the wave height. This situation is particularly dangerous in following and quartering seas, because the duration of riding on the wave crest, which corresponds to the time interval of reduced stability, becomes longer.

3.2 Synchronous rolling motion

Large rolling motions may be excited when the natural rolling period of a ship coincides with the encounter wave period. In case of navigation in following and quartering seas this may happen when the transverse stability of the ship is marginal and therefore the natural roll period becomes longer.

3.3 Parametric roll motions

3.3.1 Parametric roll motions with large and dangerous roll amplitudes in waves are due to the variation of stability between the position on the wave crest and the position in the wave trough. Parametric rolling may occur in two different situations:

.1 The stability varies with an encounter period T_E that is about equal to the roll period T_R of the ship (encounter ratio 1:1). The stability attains a minimum once during each roll period. This situation is characterized by asymmetric rolling, i.e. the amplitude with the wave crest amidships is much greater than the amplitude to the other side. Due to the tendency of retarded up-righting from the large amplitude, the roll period T_R may adapt to the encounter period to a certain extent, so that this kind of parametric rolling may occur with a wide bandwidth of encounter periods. In quartering seas a transition to harmonic resonance may become noticeable.

.2 The stability varies with an encounter period T_E that is approximately equal to half the roll period T_R of the ship (encounter ratio 1:0.5). The stability attains a minimum twice during each roll period. In following or quartering seas, where the encounter period becomes larger than the wave period, this may only occur with very large roll periods T_R, indicating a marginal intact stability. The result is symmetric rolling with large amplitudes, again with the tendency of adapting the ship response to the period of encounter due to reduction of stability on the wave crest. Parametric rolling with encounter ratio 1:0.5 may also occur in head and bow seas.

3.3.2 Other than in following or quartering seas, where the variation of stability is solely effected by the waves passing along the vessel, the frequently heavy heaving and/or pitching in head or bow seas may contribute to the magnitude of the stability variation, in particular due to the periodical immersion and emersion of the flared stern frames and bow flare of modern ships. This may lead to severe parametric roll motions even with small wave induced stability variations.

3.3.3 The ship's pitching and heaving periods usually equals the encounter period with the waves. How much the pitching motion contributes to the parametric roll motion depends on the timing (coupling) between the pitching and rolling motion.

3.4 Combination of various dangerous phenomena

The dynamic behaviour of a ship in following and quartering seas is very complex. Ship motion is three-dimensional and various detrimental factors or dangerous phenomena like additional heeling moments due to deck-edge submerging, water shipping and trapping on deck or cargo shift due to large roll motions may occur in combination with the above mentioned phenomena, simultaneously or consecutively. This may create extremely dangerous combinations, which may cause ship capsize.

4 OPERATIONAL GUIDANCE

The shipmaster is recommended to take the following procedures of ship handling to avoid the dangerous situations when navigating in severe weather conditions.

4.1 Ship condition

This guidance is applicable to all types of conventional ships navigating in rough seas, provided the stability criteria specified in resolution A.749(18), as amended by resolution MSC.75(69), are satisfied.

4.2 How to avoid dangerous conditions

4.2.1 For surf-riding and broaching-to

Surf-riding and broaching-to may occur when the angle of encounter is in the range 135°<α<225° and the ship speed is higher than $\left(1.8\sqrt{L}\right)/\cos\left(180-\alpha\right)$ (knots). To avoid surf riding, and possible broaching the ship speed, the course or both should be taken outside the dangerous region reported in figure 2.

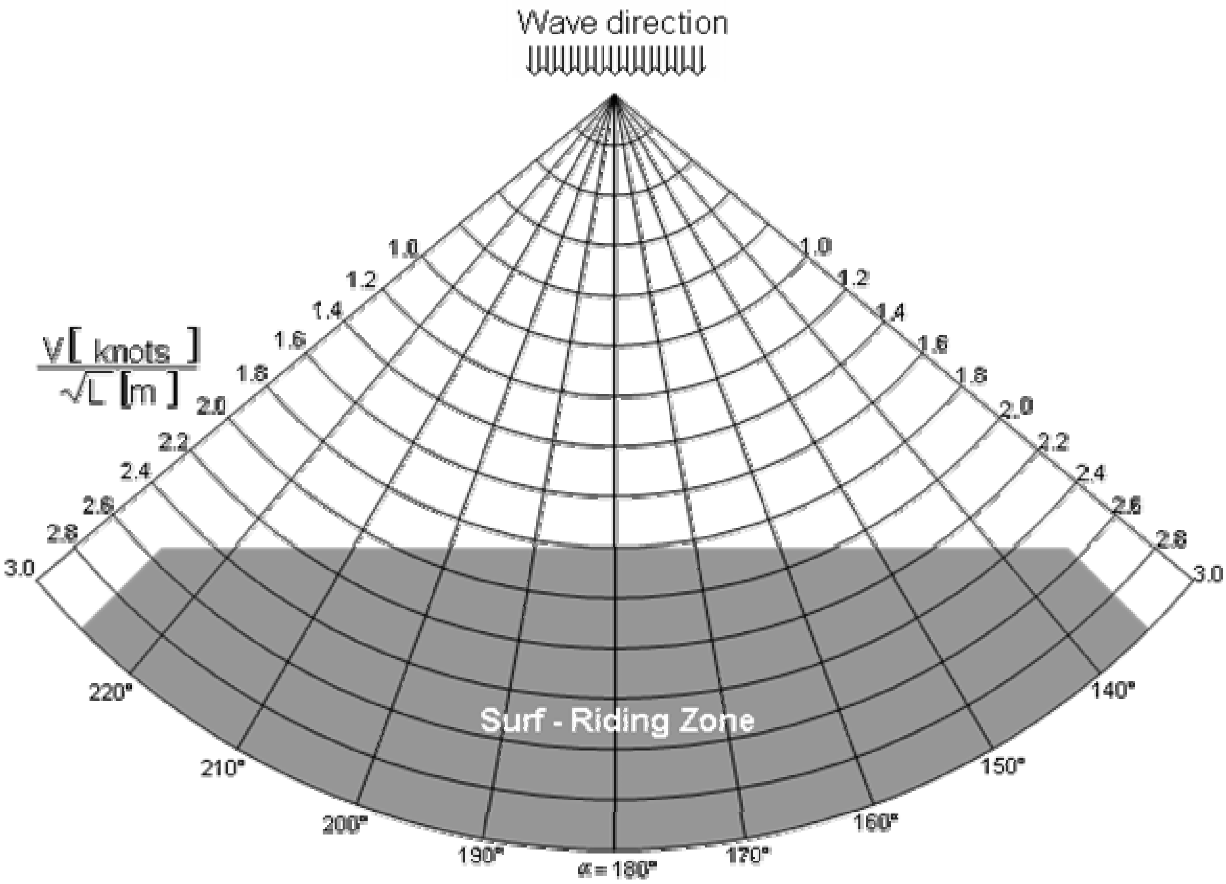

Figure 2: Risk of surf-riding in following or quartering seas

4.2.2 For successive high-wave attack

4.2.2.1 When the average wave length is larger than 0.8 L and the significant wave height is larger than 0.04 L, and at the same time some indices of dangerous behaviour of the ship can be clearly seen, the master should pay attention not to enter in the dangerous zone as indicated in figure 3. When the ship is situated in this dangerous zone, the ship speed should be reduced or the ship course should be changed to prevent successive attack of high waves, which could induce the danger due to the reduction of intact stability, synchronous rolling motions, parametric rolling motions or combination of various phenomena.

4.2.2.2 The dangerous zone indicated in figure 3 corresponds to such conditions for which the encounter wave period (T_E) is nearly equal to double (i.e., about 1.8-3.0 times) of the wave period (T_W) (according to figure 1 or paragraph 1.4).

4.2.3 For synchronous rolling and parametric rolling motions

4.2.3.1 The master should prevent a synchronous rolling motion which will occur when the encounter wave period T_E is nearly equal to the natural rolling period of ship T_R.

4.2.3.2 For avoiding parametric rolling in following, quartering, head, bow or beam seas the course and speed of the ship should be selected in a way to avoid conditions for which the encounter period is close to the ship roll period ($T_E \approx T_R$) or the encounter period is close to one half of the ship roll period ($T_E \approx 0.5 \cdot T_R$).

4.2.3.3 The period of encounter T_E may be determined from figure 1 by entering with the ship's speed in knots, the encounter angle α and the wave period T_W.

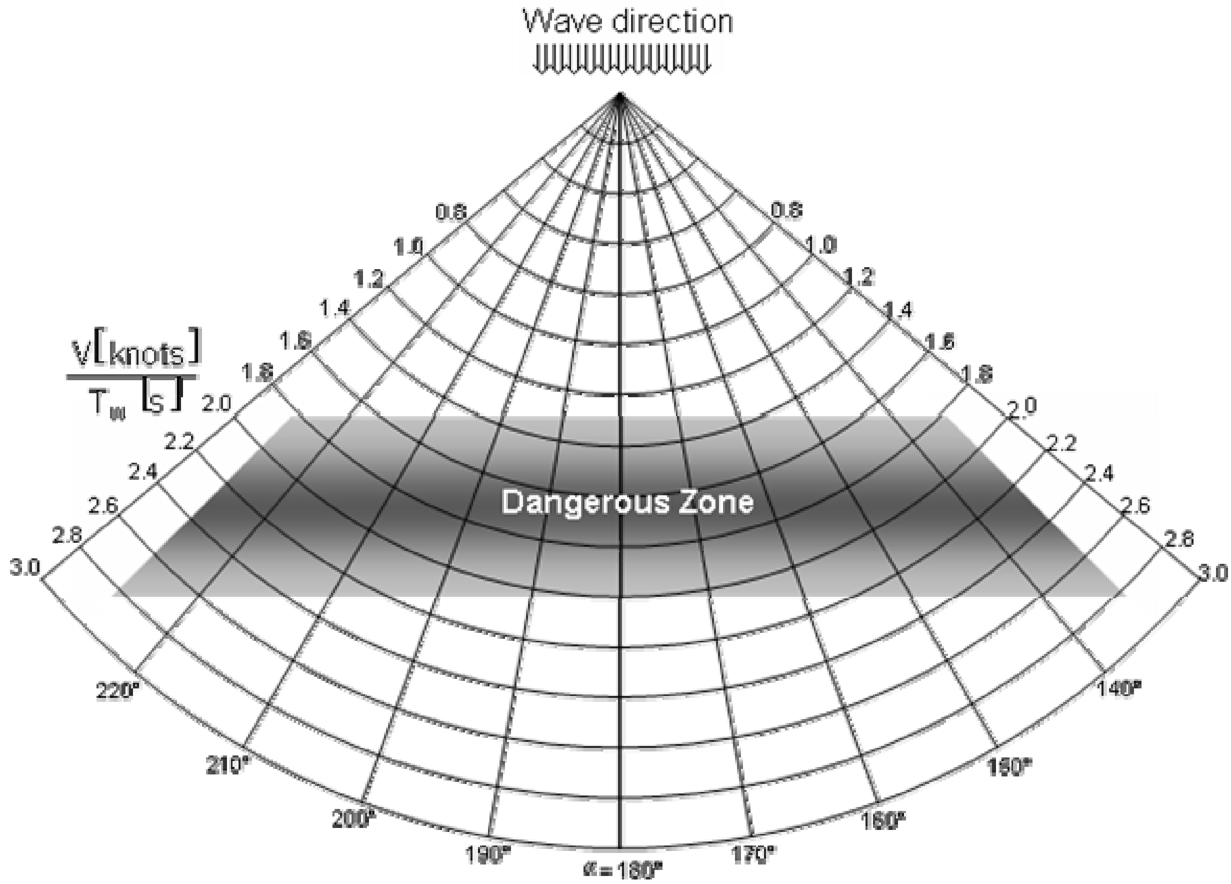

Figure 3: Risk of successive high wave attack in following and quartering seas

Abbreviations and symbols

Symbols	Explanation	Units
T_W	wave period	s
λ	wave length	m
T_E	encounter period with waves	s
α	angle of encounter (α = 0° in head sea, α = 90° for sea from starboard side)	degrees
V	ship's speed	knots
T_R	natural period of roll of ship	s
L	length of ship (between perpendiculars)	m