Issued:	Enters into force:	Validity:
01.11.2021	15.11.2021	Until further notice

Legal basis:

Modification details:
Replaces the instructions "The channel depth practice in Finland - principles and implementation" (4955/1021/2011) of the Finnish Transport Agency.

Principles and application of channel depths in Finland

Foreword

The Finnish Transport and Communications Agency Traficom (later referred to as Traficom) publishes the following instructions on depth practices in waterways. The instructions present depth concepts related to channels as well as the principles of interpreting the concepts, estimating the needed gross underkeel clearance and indicating channel information

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1 General

According to the provisions of the Water Act (587/2011), a public channel is a channel designated as a public channel. Traficom confirms the design draught and the safe clearance depth for each public channel.

The design draught refers to the planned draught at which the channel's design vessel normally can use the channel; however, different draughts can be used if the conditions allow it. The design vessel refers to the size of vessel for which the channel has primarily been designed and which has the same draught when stationary (static draught) as the design draught of the channel. The safe clearance depth refers to the depth to which it has been secured that the channel is clear. The design draught and the safe clearance depth are determined from the reference level.

Channel information essential to navigation is presented on nautical charts and in nautical publications. More information in section 5 of the instructions.

Basic fairway concepts that are closely related to depth practice are defined in Annex 1.

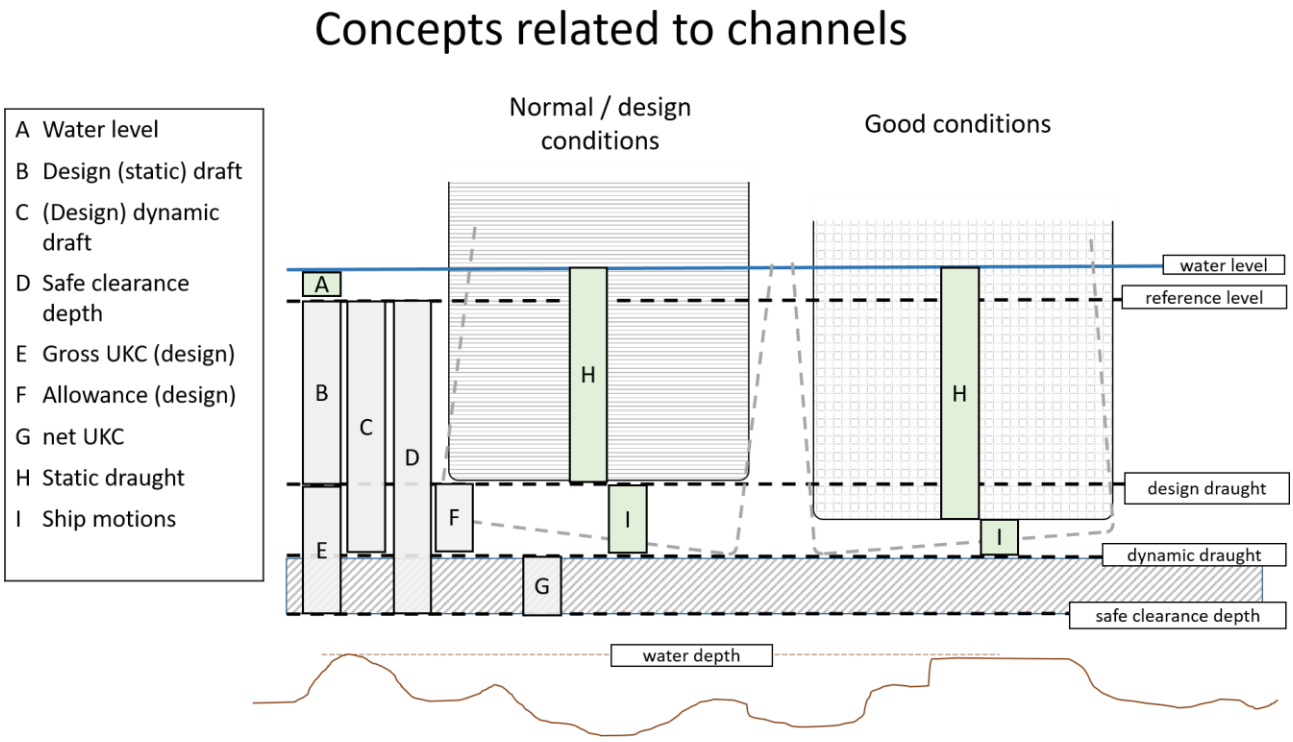
2 Interpreting channel depth in practice

The design draught of the channel is a design value. The required gross underkeel clearance of the design vessel is estimated for normal circumstances and at such a speed that is sufficient in order to maintain the vessel's maneuverability in the channel in question. Normal circumstances refer to conditions of medium difficulty, but not extreme conditions.

These instructions are based on the principle that the actual water level at the time of navigation is taken into consideration as an increase or reduction in the channel's indicated safe

clearance depth and design draught. This principle is applied both for sea-areas and inland waterways. The position of the channel in relation to the location where the water level is measured as well as estimates of the rate and direction of change in the water level, if any, must also be taken into consideration.

In good conditions, the channel can also be used with a (static) draught exceeding the design draught corrected with the water level information (see figure below).



Maximum use can always be made of the motion allowance specified during channel design. For coastal merchant shipping lanes, nautical publications and fairway cards indicate the dynamic draught that includes the vessels' motion allowance and corresponds to the actual draught used by the vessel during its passage. When in motion, the keel of the vessel may reach this level regardless of the vessel's static draught.

When assessing the vertical motions of the vessel, the conditions, vessel properties, safe clearance depth and other available data must be taken into consideration. The depth of the channel can be used within the limits of the motion allowance when the vessel's vertical movement is smaller than the planned motion allowance.

The vessel's motion allowance shown in the figure can be used by the master so that at least an amount of water corresponding to net underkeel clearance remains under the keel of the vessel during its passage. Factors enabling the utilization of the vessel's motion allowance (space reserved for vertical movement) in relation to the dimensioning situation include low speed, calm and good conditions as well as vessel type and hull shape.

By assessing the actual need for motion allowance, the master might in certain situations also compensate for low water. For example, a vessel can in good conditions use a draught in accordance with the channel's design draught value if it reduces its speed, even if the water level at the time is slightly below the reference level.

Design of inland waterways does not allow for this kind of practical application, and dynamic draughts are not given for inland waterways. Inland waterways, and all channels for which detailed information is not published, should not be used with a (static) draught exceeding the design draught, corrected for current water level.

The design draught does not guarantee that a vessel could use the channel, in any conditions or at any speed, without risk of grounding, even if her draught does not exceed the design draught of the channel, corrected for current water level. This is because the channel design is based on conditions predefined within the planning process. Therefore, because of the prevailing conditions, the vertical movements of the vessel may be larger than the motion allowance planned for the channel. For this reason, the Channel Authority is only responsible for the safe clearance depth, not for the design draught stated for the channel. The master is always responsible for estimating and specifying the draught used by the vessel.

To summarize the above, the factors affecting the choice of the vessel's static draught include:

- Channel data presented on nautical charts and in nautical publications
- For merchant shipping lanes, additional information on the channel presented on fairway cards
- Motion allowance in the channel and in the harbor according to the dynamic draught of the channel
- Vessel characteristics and speed
- Weather and wind conditions, the state of the sea and ice conditions
- Available water level data and related uncertainty factors
- Other available channel data, if any.

3 Gross underkeel clearance and assessing the required motion allowance

3.1 Gross underkeel clearance

The channel's gross underkeel clearance (grossUKC) consists of the motion allowance reserved for the movement of the vessel and the net underkeel clearance always remaining under the vessel's keel (gross underkeel clearance = motion allowance + net underkeel clearance).

The average gross underkeel clearance is typically 15-20 % of the design draught in the channel and 10 % in the harbour (amounting to about 1.0-2.5 metres in the channel and 0.6-1.0 metres in the harbor). However, gross underkeel clearance is always specified separately in connection with the design of each channel, and it varies by channel. Under all circumstances, the minimum gross underkeel clearance should be at least 0.6 metres. In small craft routes and boating routes, the gross underkeel clearance varies between 0.2 and 0.6 metres depending on the design draught.

3.2 Motion allowance

A certain amount of motion allowance has been specified for the channel for the vessel's vertical movements. The planned amount of motion allowance is always available to vessels. However, because the vertical movements of the vessel depend on the conditions and the speed of the vessel, the motion allowance required by the vessel at a given moment must be estimated on a case-by-case basis to ensure that the required net underkeel clearance is realized.

The motion allowance required by the vessel is affected by changes in draught due to the vessel's movement and motions. These motions consist of the following factors:

- squat

- wave response
- trim and heel

The vessel's squat increases as its speed increases and again as the water depth (amount of water under the keel) is reduced. There are several methods and applications available for calculating the squat. The Finnish Transport Infrastructure Agency provides tools for estimating the approximate squat, based on the Huuska-Guliev method. https://fiho.fi/lnk/fwtools/en

The provided tools are suitable for squat estimation by vessels using the coastal merchant shipping lanes. The tools are based on channel design guideline principles. When using the tools, users must naturally also take into account the principles and requirements of their own safety management system (UKC-policy). The master of the vessel is always responsible for maneuvering of the vessel and the used draught, also when the vessel participates in the Vessel Traffic Service or follows the instructions by a pilot. National practices related to calculation of motion allowance will be further specified and maintained in maritime publications.

The determination of the motion allowance of the vessel for each channel is based on the channel design guidelines and planning practices. The motion allowance may vary in different sections of the channel: It is generally greater at open sea than in more sheltered channel areas. In sheltered ports, where speeds are low, less motion allowance is usually required than in the entrance.

3.3 Net underkeel clearance

The net underkeel clearance (net UKC) refers to the underkeel clearance that must remain under the vessel's keel at all times, when the increased draught caused by the vessel's motions is deducted from the gross underkeel clearance (net underkeel clearance = gross underkeel clearance - motion allowance). The net underkeel clearance also corresponds to the difference between the safe clearance depth and dynamic draught. The minimum net underkeel clearance on coastal merchant shipping lanes is 0.5 m.

4 Water depth reference level (chart datum)

Currently, two different systems are used in Finnish coastal waters as the reference level for depth information in nautical charts and the prevailing water level (chart datum): the mean sea level (MSL) system and the N2000 system (BSCD2000). The MSL system will be gradually replaced by the N2000 system region by region from 2021 to 2026. In inland waters, the reference level is based on the low water of the navigation season; its level values will be converted to the N2000 system. Information on the regional progress of the system change will be published separately.

4.1 Sea areas

4.1.1 The old mean water level system (MSL)

In the old system, the reference level for sea areas is the mean sea level. The water level data is reported tied to the 0 level of each year's mean water level.

In Finnish coastal waters, one of the factors influencing the difference between the mean sea level and the sea bed changes is the land uplift phenomenon. The annual mean sea level is determined by the Finnish Meteorological Institute. It publishes the results as theoretical mean water (MW), also known as theoretical mean sea level (MSL) at the observation sites, which is tied to the national height system (13 mareographs). The theoretical mean sea level is always linked to the mean water level of a specific year (epoch year), e.g. MW2010. In Kemi, the water level is sinking by 6.2 mm/year in relation to the Earth's surface, while in Hamina the water level is rising by 1.4 mm/year.

In the mean water level system, channel information is presented in Finnish nautical charts and nautical publications without information about the epoch year. Because the water level observations are given according to the MSL level of the current year, over the years the designed gross underkeel clearance diminish slightly in the Gulf of Bothnia owing to the land uplift, which causes depths to be reduced.

4.1.2 The new N2000 system (BSCD2000)

In the new N2000 system tied to the Earth's crust, the reference level is the level 0 of the system. The effect of land uplift is taken into account in the water level observations. The changes in water level compared to the reference level are taken into account as corresponding changes in the design draught, dynamic draught and safe clearance depth of the channel. Water level values stated in accordance with the N2000 system must be used in the N2000 system.

4.2 Inland water areas

4.2.1 Old system

In inland waterways, the reference level is the level determined for the water area in the national height system. It is chosen separately for each basin so that it generally represents the low water level of the navigation season (NWnav). The levels are usually reported using the NN system.

4.2.2 The new N2000 system (BSCD2000)

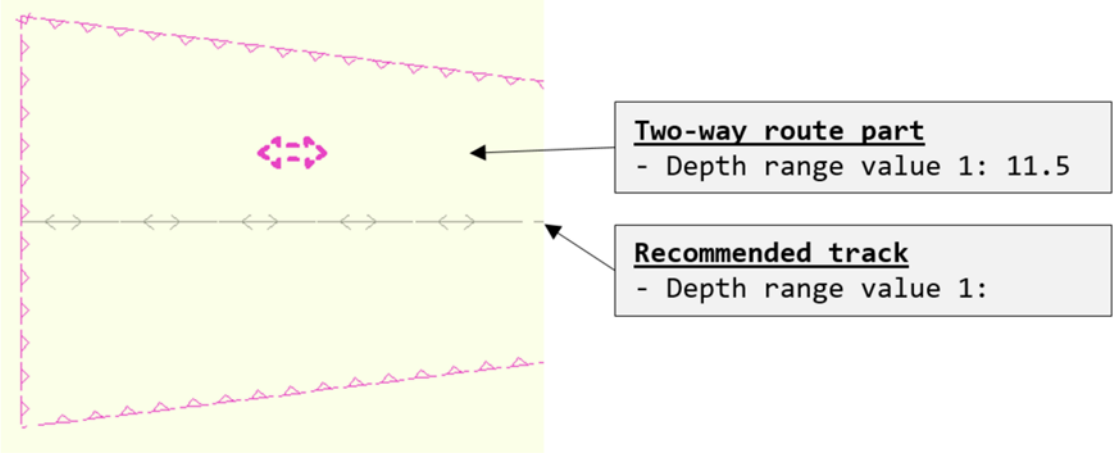
The low water level of the navigation season (NWnav) is still used as the reference level for inland waters, but its old values presented using the NN level system are converted to the corresponding values in the N2000 system. This means that the reference level is the low water level during the navigation season (NWnav) stated in accordance with the N2000 system. Water level values stated in accordance with the N2000 system must be used in the N2000 system. The changes in water level compared to the reference level are taken into account as corresponding changes in the design draught and safe clearance depth of the channel.

5 Channel information in nautical charts and nautical publications

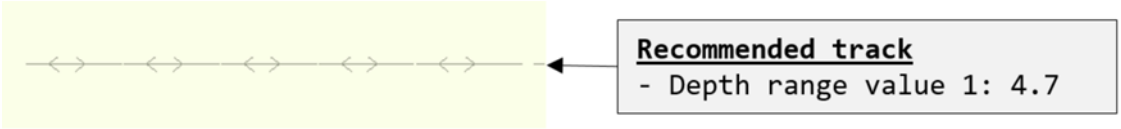
Depending on the channel, either the design draught or the safe clearance depth is shown on nautical charts. Other channel information is presented in nautical publications. The information (channel´s design draughts, safe clearance depths and the motion allowance derived from them) indicated on nautical charts and in nautical publications is confirmed by Traficom's decision.

For coastal merchant shipping lanes (channel categories 1 and 2), the safe clearance depth of the fairway area is usually indicated on the nautical chart. For other channels, nautical charts usually indicate the design draught of the channel.

On an electronic nautical chart (ENC), the safe clearance depth of the channel is indicated as the Depth range value 1 (DRVAL1) of the Two-way route part (TWRTPT) object used to indicate the fairway area. Correspondingly, the design draught is indicated as the Depth range value 1 (DRVAL1) of the Recommended track (RECTRC) object used to indicate the line of the track. For both the TWRTPT and the RECTRC objects, the international meaning of the DRVAL1 value is the minimum depth, but in Finland these values should nevertheless be understood as the safe clearance depth or design draught in accordance with these instructions.

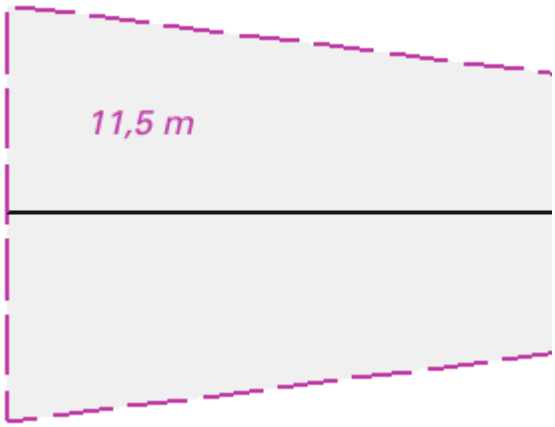


Navigation line and fairway area on an ENC chart. The safe clearance depth of the fairway area is stated as the Depth range value 1 (DRVAL1). (The presentation method on an ECDIS device may differ from the example.)

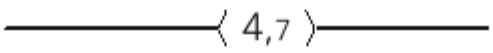


Navigation line on an ENC chart. The design draught of the channel is stated as the Depth range value 1 (DRVAL1). (The presentation method on an ECDIS device may differ from the example.)

On a printed nautical chart, the safe clearance depth of the channel is shown using the international chart symbol indicating the minimum depth of the fairway area, and the design draught is shown using the international symbol indicating the maximum authorized draught linked to the line of the track. However, in Finland the latter in particular must be understood as the design draught in accordance with these instructions.



Line of the track, fairway area and the safe clearance depth of the fairway area, shown as the international symbol of minimum depth on a printed chart.



Line of the track and design draught, shown as the international symbol of maximum authorized draught on a printed chart.

The information on ENC charts is maintained with data updates, which are usually included in the chart subscription. The information on printed nautical charts and nautical publications is updated by publishing any changes in the publication Notices to Mariners. In addition to channel information, the aim of nautical charts is also to present sufficient information on the topography of the seabed in the fairway area and its immediate surroundings.

6 Responsibilities and instructions

6.1 Channel Authority

The Channel Authority is responsible for the channel and the safe clearance depths (swept depths) as well as for submitting information on channels to the authority in charge of waterway supervision (Traficom). Seafarers and the authorities are immediately informed about any spots detected as shallower than the safe clearance depth, and appropriate measures for their elimination or marking will be taken.

6.2 Regulating authority

As the regulating authority, in charge of waterway supervision, Traficom is responsible for confirming the channel information as well as general guidelines and principles related to channels and their use.

6.3 The Hydrographic Office

Traficom's Hydrographic Office is responsible for ensuring that channel information and instructions essential to navigation are published in nautical charts and nautical publications, taking into account international standards and the marine cartography obligations of the State of Finland.

6.4 Finnish Transport Infrastructure Agency

The Finnish Transport Infrastructure Agency is the Channel Authority for the state channels; it is responsible for the maintenance and development of state channels and providing instructions for channel design in general. The Finnish Transport Infrastructure Agency publishes fairway cards, on which it states the dimensions of the coastal merchant shipping lanes it maintains as well as information on the design vessels used in designing channels.

6.5 Channel users

The master of a vessel is responsible for ensuring that the vessel is operated and maneuvered in accordance with good seamanship and that it always has a sufficient net underkeel clearance. The master is also responsible for ensuring the vessel's sufficient net underkeel clearance when the master is following the instructions of a pilot. Therefore, the master of the vessel is responsible for determining the draught of the vessel, taking into consideration the available information of the channel and current water level. The master of the vessel is responsible for ensuring that the vessel uses channels suitable for the vessel, taking into account the horizontal dimensions, geometry of the channel and turning characteristics of the vessel.

If the vessel has a draught greater than the design draught corrected with the water level, during its passage, UKC- calculations should be done to estimate the actual motion allowance needed by the vessel. The initial values and methods used in the calculation should be presented in the route plan.

6.6 Vessel Traffic Service (VTS)

The master of the vessel is responsible for maneuvering of the vessel and the used draught when the vessel participates in the Vessel Traffic Service. VTS monitors vessel traffic within the VTS- area and provides information on matters related to safe marine traffic and navigation assistance. Upon request, the VTS provides information for the vessels on issues such as the current water level in the area, the design draught and safe clearance depth of channels, as well as information on the up-to-date instructions and publications related to the use of the channel.

6.7 Pilotage

The pilot is responsible for pilotage, which refers to operations related to the navigation of ships in which the pilot acts as an advisor to the master of the ship and as an expert on the local waters and their navigation. In this role, pilots can impose their own boundary conditions on the piloted vessel concerning the implementation of pilotage.

7 Harbour areas, harbor basins and canals

The limit of responsibility for the maintenance of the channel and the harbor area is marked on the fairway card. This limit may differ from the border of the harbor shown on the nautical chart, which indicates the administrative border of the harbor. The depths of harbor basin sections and quays are indicated as swept depths (safe clearance depth). The draught used at each quay is to be considered and decided by the harbor authority and the vessel's master and pilot.

In order to avoid operational conflicts, the design draught of the approach channel and the depths in the harbour area and at quays are to be mutually compatible.

The swept depths in the fairway sections of harbor areas, in harbor basins, and at quays are confirmed by Traficom’s decision. The swept depths of these areas are included in special harbor charts and possibly in other publications.

Channel authorities might establish additional requirements for vessels in canals. These requirements might include restrictions in draught and size of the vessel.

The Finnish Transport and Communications Agency 1.11.2021

Janina Tapia-Cotrino Head of Team

Stefan Engström Senior Inspector

Additional information;

vesivaylat@traficom.fi

Annex 1, Channel depth concepts

DESIGN DRAUGHT

The design draught of a channel refers to the planned draught at which the design vessel can normally use the channel. The design draught is determined from the reference level. The difference between the actual water level and the reference level is taken into account as an increase or reduction in the design draught indicated for the channel.

In the old mean water level system, the reference level is the Mean Sea Level of a certain year (MSL), and in the new N2000 system it is the system's 0 level. In inland waters, the reference level is generally the low water level of the navigation season (LWnav).

The design draught does not guarantee that any vessel in any circumstances and conditions could use the channel without risk of grounding, even if her draught, does not exceed the design draught of the channel, corrected for current water-level. Correspondingly, a vessel may, under certain circumstances and when taking into consideration the conditions, vessel properties, safe clearance depth of the channel and the vessel's dynamic draught as well as other available data, use the channel when her draught exceeds the stated design draught of the channel, corrected for current water level.

The design draught of a public channel is confirmed by Traficom's decision.

For shallow channels, the design draught is indicated on nautical charts with a depth figure in connection with the navigation line. For coastal merchant shipping lanes, the design draught is given in other nautical publications and on fairway cards.

GROSS UNDERKEEL CLEARANCE

The gross underkeel clearance (grossUKC) of a channel refers to the additional depth planned for the channel in addition to its design draught.

The gross underkeel clearance is necessary in order to compensate for the vertical movements of a vessel underway as well as to maintain the maneuverability of the vessel and avoid groundings.

The gross underkeel clearance of the channel is the sum of the motion allowance planned for the channel and the net underkeel clearance. Correspondingly, gross underkeel clearance is the difference between the channel's safe clearance depth and its design draught. The gross underkeel clearance may vary in different sections of the channel.

The gross underkeel clearance values of merchant shipping lanes are presented in certain nautical publications as well as on fairway cards.

SAFE CLEARANCE DEPTH

The safe clearance depth of a channel refers to the depth to which it has been secured that the channel is clear.

The safe clearance depth is determined as the sum of the channel's design depth, the motion allowance of the vessel and the net underkeel clearance. The safe clearance depth may vary in different sections of the channel depending on the motion allowance specified for the channel, even if the design draught in the channel remains the same.

The determination of the safe clearance depth is based on the reference level, which in sea areas in the old mean water level system is the Mean Sea Level of a certain year (MSL) and in

the new N2000 system the 0 level of the system. In inland waters, the reference level is generally the low water level of the navigation season (LWnav).

The safe clearance depth of a channel is confirmed by Traficom's decision.

In coastal merchant shipping lanes, the safe clearance depth is presented on nautical charts and in other nautical publications as well as on the fairway cards of the channels.

MOTION ALLOWANCE

The motion allowance of a channel refers to the planned additional depth of the channel in addition to the design draught, reserved for vessel motion. Motion allowance is necessary in order to compensate for the vertical movements of a vessel underway. The motion allowance of a channel is the difference between its gross and net underkeel clearance. The motion allowance may vary in different sections of the channel. The values of motion allowance for merchant shipping lanes are presented in certain nautical publications as well as on fairway cards.

DYNAMIC DRAUGHT

The dynamic draught of a channel refers to the level the vessel's keel may reach when the vessel moves in the channel.

The dynamic depth is the sum of the channel's design draught and the motion allowance reserved for the vessel in the channel. The dynamic draught is specified for merchant shipping lanes in connection with channel design. The dynamic draught may vary in different sections of the channel.

The values of dynamic draught in coastal merchant shipping lanes are presented in certain nautical publications as well as on fairway cards.

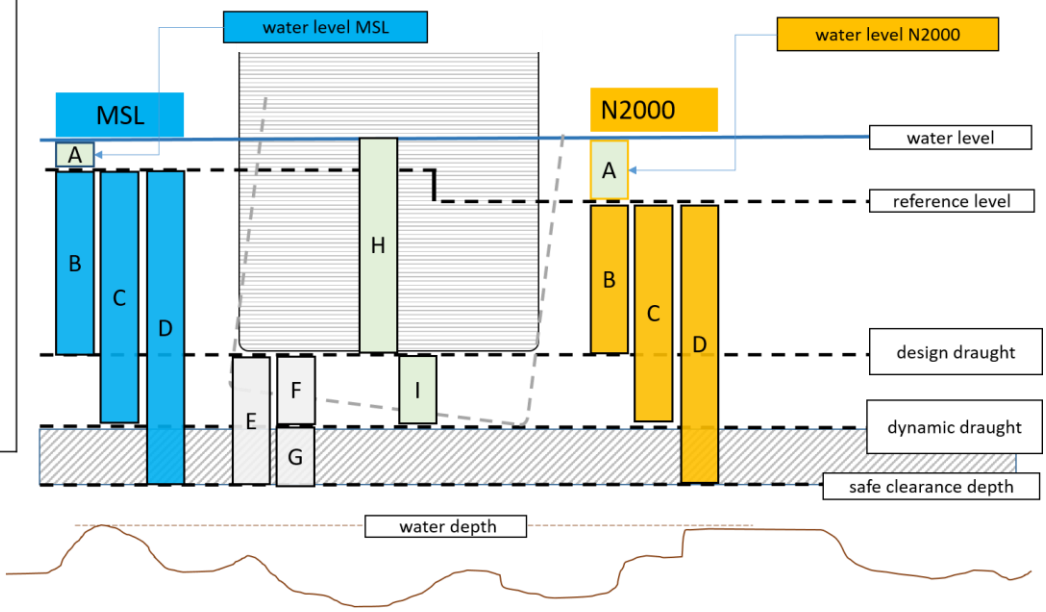
NET UNDERKEEL CLEARANCE

Net underkeel clearance (netUKC) refers to the minimum distance between the vessel's keel and the channel's safe clearance depth that should always remain under the vessel's keel while the vessel is underway.

The net underkeel clearance is the difference between the channel's safe clearance depth and the dynamic draught. The net underkeel clearance is specified for merchant shipping lanes in connection with channel design. The minimum value of net underkeel clearance in coastal merchant shipping lanes is 0.5 m, and in the merchant shipping lanes in inland waters and in shallow channels, it is 0.3 m.

Channel concepts MSL / N2000

A Water level
B Design (static) draft
C (Design) dynamic draft
D Safe clearance depth
E Gross UKC (design)
F Allowance (design)
G net UKC
H Static draught
I Ship motions



Annex 2, Instructions on how to estimate a safe draught

Instructions for merchant shipping on how to estimate the safe draught of a vessel

Calculated from the safe clearance depth of the channel

1. Check the reference level of the channel and depth information from an up-to-date nautical chart (the old MSL system or the new N2000 system, BSCD2000).
2. Find out the current water level at the nearest mareograph in the corresponding height system from the Finnish Meteorological Institute. https://fiho.fi/lnk/sealev/en
3. Combine the value of the channel's safe clearance depth stated on the nautical chart and the current or forecast water level (taking the + and - water into account), which will give you the value of the channel's safe clearance depth corrected with the water level information.
4. Based on the principles of sections 2 and 3 of these instructions, estimate the motion allowance needed by the vessel depending on the conditions and deduct this motion allowance as well as a net underkeel clearance of 0.5 m from the value of the safe clearance depth corrected with the water level information. This will give you the value for the vessel's available safe static draught.

To estimate the squat, you can use the tools provided by the Finnish Transport Infrastructure Agency. https://fiho.fi/lnk/fwtools/en

Calculated from the design draught of the channel

1. Check the reference level of channel and depth information from an up-to-date nautical chart (the old MW system or the new N2000 system, BSCD2000).
2. Find out the current water level at the nearest mareograph in the corresponding height system from the Finnish Meteorological Institute. https://fiho.fi/lnk/sealev/en
3. Combine the value of the channel's design draught stated on the fairway card and in nautical publications and the current or forecast water level (taking the + and - water into account), which will give you the value of the channel's design draught corrected with the water level information.
4. Check the design speed of the channel on the fairway card and in nautical publications. Do not exceed the stated design speed. If the conditions allow passage at a speed lower than the design speed, you can use the channel with a draught that exceeds the design draught, corrected with water level information, by a measure corresponding to the lower squat.

To estimate the squat, you can use the tools provided by the Finnish Transport Infrastructure Agency. https://fiho.fi/lnk/fwtools/en

Calculated from the dynamic draught of the channel

1. Check the reference level of channel and depth information from an up-to-date nautical chart (the old MW system or the new N2000 system, BSCD2000).
2. Find out the current water level at the nearest mareograph in the corresponding height system from the Finnish Meteorological Institute. https://fiho.fi/lnk/sealev/en
3. Combine the value of the channel's dynamic draught stated on the fairway card and in nautical publications (design draught + motion allowance) and the current or forecast water level (taking the + and - water into account), which will give you the value of the channel's dynamic draught corrected with the water level information.
4. Based on the principles of sections 2 and 3 of these instructions, estimate the motion allowance needed by the vessel depending on the conditions and deduct this motion allowance from the value of the dynamic draught corrected with the water level information. This will give you the value for the vessel's available safe static draught.

To estimate the squat, you can use the tools provided by the Finnish Transport Infrastructure Agency. https://fiho.fi/lnk/fwtools/en

Instructions for boaters on how to ensure safe channel depth in sea areas

1. Find out the draught of your boat while it is stationary in calm water.
2. Check the reference level of the channel and depth information from an up-to-date nautical chart (the old MW system or the new N2000 system, BSCD2000).
3. Find out the current water level at the nearest mareograph in the corresponding height system from the Finnish Meteorological Institute. https://fiho.fi/lnk/sealev/en
4. Combine the value of the channel's design draught stated on the nautical chart and the current water level (taking the + and - water into account), which will give you the value of the channel's design draught corrected with the water level information.

You can use the boat on channels where the design draught determined according to point 4 above is at least as great as the draught of your boat.

Instructions on how to ensure a safe draught and channel depth in inland waters

1. Find out the draught of the boat/vessel.
2. Check the reference level of channel and depth information from an up-to-date nautical chart (the old NN system or the new N2000 system).
3. Find out the current water level of the lake basin, in relation to the low water level of the navigation season in the corresponding height system.
   3.1. Information is available from the Finnish Environment Institute (SYKE) website. https://fiho.fi/lnk/watlev/en
   3.2. Upon request, also VTS provides information on the current water level, in areas covered by the vessel traffic service.
4. Compare the water level information to the low water level of the navigation season, and calculate whether the water level is higher or lower than the low water level of the navigation season.

High water can be utilized as a corresponding increase in draught, compared to the design draught of the fairway. If the value is lower, deduct the difference from the channel depth and design draught values given. If the route of the vessel includes a canal passage, also the maximum draught requirement for the canal must be considered (Saimaa canal 4.35m).