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INTRODUCTION

The purpose of a draught survey is to determine the amount of cargo loaded or discharged for the benefit of all the interested parties. A well-conducted draught survey of a large vessel should achieve accuracy to within 0.5%.

The survey must be conducted meticulously, taking into account all the prevailing circumstances. The final report should incorporate every aspect and difficulty which has been encountered in order to convey all aspects of the survey.

While draught surveys may be carried out by professional surveyors, the ship's officers should also perform a draught survey to the same degree of accuracy. It is hoped that this guide will assist in achieving the required standards.

DRAUGHT SURVEY

The draught survey is the "before and after" survey, which determines, by measurement, the vessel's displacement before and after loading or discharging. The difference between these two displacements is the weight of cargo loaded or discharged.

DEADWEIGHT SURVEY

Under certain circumstances, the surveyor or ship's officer may have no choice but be restricted to carrying out a deadweight survey. The weights of all measurable non-cargo elements on the vessel are determined; bunkers, fresh water, ballast, stores etc. These are then added to the light displacement (including any lightship constant). This total is then deducted from the present displacement to produce the approximate weight of cargo on board.

UN/ECE DRAUGHT SURVEY CODE FORMS

These forms have been included at the back of this book. They are the work of the United Nations Economic Commission for Europe, the Coal Working Party of the Energy Committee, which produced the Code of uniform standards and procedures for the performance of draught surveys of coal cargoes. The Working Party recommend the use of the forms in order to achieve uniformity and consistency in draught surveys, so avoiding the discrepancies which give rise to commercial disputes.

The forms have been freely given, so that all surveyors and ship's officers may photocopy and use them as a standard format throughout the industry.
PRACTICAL PROCEDURE

It is impossible to cover every conceivable problem likely to be encountered when carrying out a draught survey. Ships and ports vary so much that there will always be the unforeseen circumstances which will require an on-the-spot decision. These notes and steps to be taken, give only a broad approach to the subject. There is however, no substitute for experience.

An inaccurate survey may result in considerable expense to several parties, therefore it should be conducted carefully and accurately. Being well prepared and having sufficient time will allow the survey to be conducted correctly. It may not appear expedient to delay the ship in order to complete the draught survey properly, but it could save money in the long term. This decision must lie with the Master, however careful preparation could reduce these delays to a minimum.

All parties should work together for a unanimous result, the facts should be established by inspection and not by verbal agreement.

1. The ship and ship's staff must be prepared for the survey.
Shore surveyors must be ready for the ship's arrival.

Prior to arrival
The ship should be asked to prepare for the draught survey.

The ballast tanks should be adjusted to a level covered by the sounding tables.

It should be remembered that full tanks can be pressed up but still retain air pockets and also it can be difficult to establish that a tank is completely empty without visual inspection.

Ballast holds, (main cargo holds used for ballast) should be empty of ballast on arrival at the loading port, if possible.

The vessel should arrive with a safe trim, suitable for the navigation to enter port and within the limits of trim covered by the trim corrections of the sounding tables. The vessel should arrive in an upright condition.

Staff, documentation and equipment should be ready on the arrival of the ship. There should be no movement of ballast, fresh water, bunkers or cargo and hatches, cranes and moorings until all measurements are taken and agreed by surveyors and ship's officers. The prudent surveyor will have observed the shore side draughts before boarding as these can
2. Examine the ship's documentation and discuss the ship's present condition

**Documentation and information**
Surveyors and ship's officers should discuss documentation details and the location and state of all compartments. The instruction pages of the stability information book and calibration tables should be studied and a check made of the tank capacities with the capacity plan. It should be remembered that the port and starboard tanks may not be the same and consequently have separate calibration tables.

The base for measurement of vertical heights, the reference point for longitudinal measurements, the units and the sign conventions used in the tables must all be verified. The units used in the correction tables should also be carefully noted because there is sometimes a mixture of units and sign conventions contained within the same documentation. The whole survey should be conducted using the units of the ship and the final result changed to a suitable unit, if necessary. When feet and inches are the standard unit, convert to feet and decimals of a foot for the convenience of a calculator.

The full sounding depths of tanks, the summer draught and freeboard and the record of recent tank soundings should be noted.

If a bunker survey is *not* to be carried out, the chief engineer's bunker figures (fuel oil, diesel oil and lubrication oil) are required, also the daily port consumption quantities. Should any bunker or stores be delivered during the stay then the delivery notes must be sighted for the additional quantities to be included in the final survey. The draught survey is only interested in changes in the bunkers on board, that is consumption and deliveries.

The position of the anchors should be checked, should any alterations be proposed during the stay then the weight of the anchors and cables should be determined.

The ship's staff and surveyors should work together throughout.

See information check list on page 50.
3. Take accurate overboard water samples and draughts

**Density**
Using a sample bucket take samples from half draught depths from at least two positions on the offshore and the onshore side, avoiding the discharges, stagnant water between ship and jetty and outfall areas. Take samples of about one litre and do not mix the samples.

Rinse out the bucket and the sample jar with the first sample of water. Take the density readings promptly, protecting the sample jar from the wind and direct sunlight. Hold the hydrometer vertically by the top of the stem and gently lower into the sample until it floats freely. Take the hydrometer reading where the overall level liquid surface meets the graduated stem, not the top of the meniscus. Avoid parallax by filling to near the top of the sample jar and placing the eye in line with the liquid level. See photograph of a hydrometer reading 1.0165 on page 34. The bottom of the sample jar should have 25 mm clearance below the base of the hydrometer and have a minimum internal diameter of 50 mm.

If densities obtained show no major variation then calculate the average value, however if there are suspicious variations in the readings then additional samples should be taken and this factor included in the report. Measure the *apparent density* with a Zeal glass draught survey hydrometer and be aware of any tidal changes which may affect the sample density. See density section on pages 33 and 36.

**Draughts**
The draughts and densities should be obtained at nearly the same time if possible. Draughts and densities taken at slack water are the most accurate but this may not be practicable.

All the draughts should be read with great care and every effort made to read directly from ship's side using a boat, ladder or other available means. The figures should be written down as they are obtained to avoid mistakes of memory.

If required, the midships draughts can be obtained by measuring the freeboard from the waterline to the top of the deckline or to a convenient point above the deckline, when a correction must be applied. A tape with a float plate at the zero mark can be very usefully employed to achieve this measurement. See draught measurement section on pages 16 to 20.
4. Calculate the ship's underwater volume and displacement
   a) Correct the observed draughts to the centreline, i.e. the mean of the port and starboard draughts.
   b) Correct the centreline draughts to their value at the correct position of the perpendiculars.
   c) Allow for hog or sag and obtain the correct draught midships.
   d) Enter the hydrostatic tables with this corrected draught to obtain the uncorrected displacement.
   e) Correct this value of displacement for:
      - first trim correction
      - second trim correction list
      - (if necessary) density

   see the appropriate section for details of these calculations on pages 16 to 37.

5. Determine the quantity of deductibles

   Ballast and fresh water soundings
   Every compartment capable of carrying water should be carefully inspected and sounded, allowing sufficient time for fluctuations in levels due to the removal of the sounding caps. When at an exposed berth the movement of the vessel may create errors. To overcome this problem several soundings should be taken and the average value assumed to be the correct one.

   The sounding tape must be checked to ensure that it reaches the bottom of the tank. If the tape is marked at the ship's full depth it can act as a useful guide and the consistency of the depth of the different tanks can be checked. It should be remembered that the vertical tank height and the length of sounding pipe may be different. See photograph of sounding tape on page 35.

   Full tanks may have air pockets especially when the ship is trimmed. Topside tanks can be overflowed from forward and aft air pipes until a steady flow through both is unmistakable, the sounding pipe extension may prove useful for this operation. However care should be taken to ensure that the overflowing ballast water causes no other problems e.g.
wetting of cargo waiting to be loaded, soaking the electric power boxes on
the quayside or washing debris or other pollutants over the side.

For a stern trim the position of the forward air pipe relative to the
forward tank bulkhead should be checked to determine any possible
remaining void spaces and where necessary this factor should still be
allowed. Other full tanks should be sounded and the trim corrections
allowed.

The ballast discharged from tanks may leave residual liquid in pipes and
in areas of poor drainage. This water is difficult to detect and time
should be allowed for drainage purposes before taking soundings.

Empty tanks will probably have residual water even at zero soundings,
these indeterminable quantities can be ignored at both before and after
surveys, provided that all parties are satisfied that no changes have taken
place during the interval between surveys. In other circumstances it may
be necessary to assume a small percentage (1% or 2%) of the tanks total
capacity as additional weight to cover all remaining drainings.

If the ballast soundings are outside the maximum range of the calibration
tables then ballast should be run out until the level is suitable.

The duct keel, pipe tunnels, peak tanks and swimming pool should not
be forgotten and soundings taken as usual. The bilges should be checked
and any pumped out during the ship's stay must be recorded. When a
vessel loads a dry bulk cargo which has been wetted, a record of bilges
pumped during the whole voyage could prove very useful as evidence, to
explain any apparent loss of cargo between successive surveys.

Ballast holds often cause problems due to poor tank calibrations and hull
deformation. These should be empty of ballast prior to arrival at the
loading port and visually inspected if possible.

Bunker tanks need not be inspected and sounded during a draught
survey, unless a bunker survey is also required.

See soundings and ullages section on pages 38 to 43.

**Ballast samples**
The water within the sounding pipe may not be properly mixed and
therefore not be representative of the liquid in the whole tank, if in doubt
the sample should be taken at the bottom of the pipe using a suitable
sampling can which can be opened at the appropriate depth.
Sufficient sample densities can be obtained from the tanks down one side of the ship only, unless major variations occur. Variations could be caused by the ballasting taking place at different times and locations. The ballast tank dipper or hand pump down the sounding pipe may be used to obtain a sample where the water is well mixed, as shown in the photograph on page 34. The sample jar should be rinsed out with the first sample and then the Zeal hydrometer used to obtain the apparent density of the water, as with the sea water density, a temperature correction is not necessary. A ballast hold should be sampled at different levels with the water sample bucket and checked for any major variations.

The measurement of density, the hydrometer to use and the reading obtained can cause problems, the density sections on pages 33, 36 and 53 should be read carefully to avoid these problems.

6. After completion of loading or discharging, repeat sections 3, 4 and 5 above, for the final survey

Final survey
Adequate preparation is required again for the final survey. The intended quantities of cargo, bunkers, fresh water and stores and the proposed finishing draught should be determined in advance of completion of cargo. If there is to be a final trim by the head then an intermediate survey of the ballast remaining on board, should be carried out while the trim is still by the stern. Accurate determination of the ballast on board remains a major issue and ensuring that the empty tanks are actually clear of ballast is a major cause of errors in the final calculations.

Invoice figures for the weights of all bunkers, spares and stores taken on board during the stay should be verified and a check made that nothing has been landed. Changes in the bilges, swimming pool, and other regions not directly associated with the working of the vessel should be determined.

Notes
All calculations contained in this guide should be carefully executed and agreed between parties. The same survey methods should be used at the loading and the discharging ports in order to achieve consistency of results.

The calculations should deal only with the acquired facts and not introduce any unsubstantiated constants. The constant often referred to with draught surveys is dealt with in the Lightship Constant section on pages 14 and 15 and its significance should be understood.
All circumstances that may influence the accuracy of the surveys should be recorded on the survey report.

**Conclusion**
Shortage claims on bulk cargoes are a major concern to the shipowner and their P&I clubs. They result in claims involving significant sums of money. Well maintained records when used as evidence, including accurate and comprehensively documented draught surveys from both the load and discharge ports, may enable these claims to be successfully defended.
INFORMATION REQUIRED

It is the Master's responsibility to ensure that the draught marks are clearly visible at a minimum of six positions on the hull, that is at:-

- the forward end,
- the aft end,
- midships,
- on both sides.

It is also the responsibility of the ship's Master to provide the surveyor with up-to-date and accurate information which has been certified by the ship's flag state. This information should contain details of the ship and its present condition.

For details of what should be included refer to the information check list on page 50.

The information may be in metric or imperial units.

The presentation and precision of the information will vary widely from ship to ship and the language may not be that of the surveyor.

Take great care when using this data. Read the stability information book introduction pages to determine the contents of each of the tables, and how they should be applied. Not all the information will be required for every draught survey.

DATA MANUAL FOR DRAUGHT SURVEYS

The United Nations recommends that every ship carrying bulk cargoes should be provided with a data manual for draught surveys, which should be certified by the ship's home administration or its classification society.

The language of the manual should be English or have English translations. The metric system of units should be used throughout.

Longitudinal measurements should be based upon midships.

Sign convention:
- measurements forward are negative (-), measurements aft are positive (+).
- Vertical measurements are to be taken from the bottom of the keel plate.
It is recommended that vessels longer than 200 metres Length Over All (LOA) should be marked at five points on each side: forward, midships and aft as usual and also at the mid points between these positions. This allows a more accurate assessment of any hogging or sagging effects.

The positions of the draught marks relative to the appropriate perpendicular should be included in the data manual.

Unfortunately this data manual is often not available.

HYDROSTATIC PARTICULARS

Information is calibrated against draught, usually for the even keel condition.

The displacement is the weight of the ship, derived from volume of water displaced by the ship x apparent density.

In the metric system, this displacement is often given in tonne of salt water at apparent density (weight in air) of 1.025 tonne/m³.

It is important to establish the exact weight to volume relationship.

DRAUGHT AND FREEBOARD

Forward draught
The distance from the bottom of the keel to the waterline on the forward perpendicular when the ship is upright.

Aft draught
The distance from the bottom of the keel to the waterline on the aft perpendicular when the ship is upright.

Freeboard
The distance from the waterline to the deck line, normally measured midships

Depth of ship
The distance from the bottom of the keel to the deck line. That is:

Depth = draught + freeboard
Arithmetic mean draught (AMD)
The arithmetical mean of the forward draught and the aft draught will equal the
draught midships if there is no hog or sag, this is called the arithmetic mean
draught.

But a ship trims about the longitudinal centre of flotation (LCF).

True mean draught (TMD)
When a ship trims due to shifting a weight, i.e. no change of displacement, the
only draught which does not change is the draught at the longitudinal centre of
flotation. It is this draught which will give the appropriate displacement on the
hydrostatic tables, and it is called the true mean draught. The position of the
LCF is therefore critical to a draught survey.

The difference between the true mean draught and the arithmetic mean draught
is known as the layer correction.

Trim factors
Some stability information books tabulate trim factors, forward and aft, but no
position for the longitudinal centre of flotation (LCF) forward of the aft perpendicular
(AP).

The LCF can be found from the trim factors by the following formula:

\[
\text{i}_{\text{rv fw, r, AP}} = \frac{\text{length between perpendiculars} \times \text{aft trim factor}}{\text{forward trim factor} + \text{aft trim factor}} - \text{length between perpendiculars}
\]

Trimmed hydrostatics
Some ships are supplied with ‘trimmed hydrostatics’. These normally consist of
several sets of hydrostatic data each one calculated for a particular trim. They
may be in 20 cm steps covering the range of trims over which the vessel is
expected to operate. Each set of hydrostatic data consists of displacements
tabulated against draught for a particular density. The densities may be in
increments of 0.005 from 1.000 to 1.025 and the draughts in 5 cm steps. Such
tables avoid the need for both the 1st and 2nd trim corrections and also the
density correction which are described within the chapter Assessment of underwater
volume on pages 16 to 37.

Trimmed hydrostatic tables need to be interpolated for draught, density and
trim in order to find the correct displacement. This interpolation is fairly
difficult and needs careful thought in order to achieve an accurate result.

Check the use of trimmed hydrostatics in the introduction to the stability
information book.
DEADWEIGHT OR DISPLACEMENT SCALE

The displacement, deadweight, tonnes per centimetre immersion (TPC) and moment to change trim per centimetre (MCTC) for salt water are shown against the true mean draught (TMD) in the deadweight or displacement scale. It may also show the same for fresh water.

If only salt water values are given then the scale should be entered with the TMD in actual observed density. Calculations should be carried out with these figures as the density correction will take care of the adjustments at a later stage.

The scale will also show summer load draught and the lightship draught. It will relate the final TMD to the final displacement. Study it carefully to make certain of the weight to volume relationship.

CAPACITY PLAN AND TABLES

The capacity plan shows all the cargo compartments, ballast spaces and bunker tanks on the ship.

Capacity tables list every space in the ship which may be used for cargo, ballast, stores, fuel, lubricating oil and fresh water.

The position of each space is indicated by the number of the ship's frames at each extremity of the space.

The volume of each space, in cubic metres, is listed for:

- Grain space - the gross volume measured to the ship's side plating.
- Bale space - the nett volume measured to the inside of the frames or spar ceiling (cargo battens).

Spaces for liquid only are tabulated in either cubic metres or the number of tonnes of the liquid which the tank normally holds, specifying the density used to calculate those tonnes. If the tables give cubic metres then these must be multiplied by the observed density to find tonnes. If the tables give tonnes then they must be divided by the density of the table and multiplied by the observed density.
SOUNDING TABLES

Sounding tables are separate tables, often found in the care of the chief officer and/or the chief engineer.

The tables may be calibrated with either soundings or ullages.

The calibrations may use cubic metres (i.e. tonnes of fresh water) or the average density of the liquid which is normally carried in the tank and give tonnes of that liquid.

For accurate assessment of the quantity of liquid in any tank, the actual density of the liquid should be determined and the quantity re-calculated.

CORRECTION TABLES AND DIAGRAMS

Sounding correction tables
The sounding tables will have been calculated for the ship on an even keel.

Correction tables should accompany any sounding table of a tank for which the sounding pipe is not at the longitudinal centre of the tank.

The table should give the correction for any sounding and for each metre of trim of the ship over the normal operating range of trims and require interpolation for the actual trim. In the absence of such tables, calculations will have to be made from the original plans.

Trim correction
The stability information book may include a table to apply the corrections for trim. Investigate carefully whether this includes both the 1st. and 2nd. trim corrections. See pages 30 to 33.

Position of marks
The stability information book may provide a correction to apply to the appropriate draught readings to correct the reading, to the value it would have had, at the correct position. See pages 21 to 26.

Hull deflection
The stability information book may provide a special means of calculating the vessel's hull distortion correction when calculating an accurate underwater volume. See pages 26 to 30.
Hydrometer certificate
British Standards Institute (BSI), International Standards Organisation (ISO) or the Zeal certificate of conformity, provides the appropriate correction to apply to the hydrometer.

By kind permission of G H Zeal Ltd.

Hydrometer and certificates


PLANS

General arrangement plan
The general arrangement plan shows the layout of the ship and indicates all the spaces within it. It gives the position of all the spaces, their use and capacity.

Other plans
More detailed plans of ballast tanks and bunker tanks may be necessary.

If the vessel is trimmed it may be important to know the horizontal surface area of liquid in the tank and the relative position of the sounding pipe in order to assess the quantity of liquid in the tank accurately.

LIGHT-SHIP

The lightship weight is that which has been determined during an inclining experiment.

It includes:

the ship and its full equipment, engine room spares, water in the boilers to working level and lubricating oil in the engines.

It does not include:

personnel, cargo, fuel, stores and water.

Growth of lightship
The inclining experiment may have been performed a considerable time ago, but, over a period of years, the lightship weight will increase. This is due to the changes in the equipment, the build up of paint over the ship, the storage of old equipment, mud in the ballast tanks, the accumulation of dunnage etc. This phenomenon is known as the growth of lightship and is thought to amount to about 0.2% of the light displacement per annum. This growth is accounted for in the lightship constant.

Lightship Constant
Vessels which regularly assess their lightship weight find that the weight from their calculations differs from the tabulated value in the stability information.
book. This difference is named the lightship constant at that particular draught survey.

A record should be kept of the lightship constant at each draught survey. It may not be a constant value since it is the result of inaccuracies of calibrations, accumulations of sludge, unsymmetrical hull distortion and many other factors. It can only be used for a guide to the consistency of results and the variations experienced on previous surveys.

When carrying out a deadweight survey the value of the lightship constant may become more significant and a record of previous values is then important.
ASSESSMENT OF UNDERWATER VOLUME

The underwater volume of the ship, and ultimately its displacement, is normally found by carefully reading and analysing the draught marks and by carefully establishing the density of water in which the vessel is floating.

The corrected mean draught is used to enter the hydrostatic tables in the stability information book and to find the appropriate displacement equivalent to this draught and density. This value must then be corrected to determine the precise weight of the ship in its present circumstances.

GENERAL DRAUGHT MEASUREMENT

The draught survey is based upon the accurate reading of the draught marks, therefore no effort should be spared to achieve accuracy. Draughts should be measured to two decimal places, that is to the nearest centimetre.

Before cargo operations commence, the water density and all six draught marks should be read, recorded and comments made on the prevailing conditions. During the time that the readings are being made, no transfer or discharge of liquid of any sort, or movement of any weight within the ship, should be allowed.

The draughts and density should be taken again on the completion of the loading or discharging operation.

Measuring the draughts in a swell

In turbulent conditions there may be waves, swell, pitching and rolling to take into account. In these conditions, the wave pattern should be studied to establish the wave cycle. During a series of average waves the mean of the highest and lowest draught readings should be recorded.

A total of 12 mean readings should be obtained. The highest and lowest means should be rejected and then the average of the remaining ten will give the most accurate reading possible under the circumstances.

The forward, aft and midships draught measurements should all be found in a similar fashion.
QUESTION 1:
The following are mean draught readings (in metres) over an observed cycle of waves. Calculate the appropriate draught.

<table>
<thead>
<tr>
<th>Reading 1</th>
<th>Reading 2</th>
<th>Reading 3</th>
<th>Reading 4</th>
<th>Reading 5</th>
<th>Reading 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.25</td>
<td>9.80</td>
<td>11.40</td>
<td>9.70</td>
<td>11.35</td>
<td>9.75</td>
</tr>
<tr>
<td>11.30</td>
<td>9.60</td>
<td>11.00</td>
<td>9.90</td>
<td>11.25</td>
<td>9.70</td>
</tr>
</tbody>
</table>

ANSWER:
Reject 11.40 and 9.60 m. Add remainder = 105.
Estimated draught reading = 105/10 = 10.50 m.

DRAUGHT MEASURING EQUIPMENT
A measuring device may be used to improve the accuracy of the draught measurement.

Such devices are based on the principle that the turbulence on the surface of the water does not extend down to any great depth. They use a long, flexible, open ended, weighted hose projecting downwards to below the turbulence.
The device is held directly in front of the draught marks and, after allowing a few seconds for the tubes to fill with water, the mean water level is indicated by the float.

The float may have a small rise and fall, but this will be minimal compared with the wave motion.

![Diagram of draught reading device](image)

The device is difficult to use at the bow and the stern. It should be held close enough to the draught marks under the overhang of the bow and the stern to avoid parallax. The device may be attached to the hull by a strong magnet.

A statement describing the prevailing sea conditions should be included in the survey report to avoid a dispute later.

**DRAUGHT READING ON OUTBOARD SIDE**

Every attempt should be made to read the draughts on the offshore side of the vessel although, in some situations, this may prove to be impractical or even dangerous. In such an event, the onshore marks should be read and the other side calculated with the help of a manometer.
The manometer should comprise of a short length of clear, rigid, plastic tube fitted to each end of a hose, to facilitate the measuring of the water levels. If possible the hose should stretch the full beam of the vessel and the measurements should be taken at the extreme breadth. The outboard reading is found by adding or subtracting the manometer reading (2d) to the inboard draught.

When this proves impossible, then the mean draught at the centreline, may be calculated using similar triangles.

The levels must be measured from the same base line, and taken at equal distances from the centreline on both sides of the vessel.

All air must be excluded from the hose and the water levels in both tubes kept at a height which is higher than the deck at the centreline.

The heights of water levels, on both sides of the ship, are measured above the deckline (h) or some other fixed level. The difference between the two heights
is then halved and the result (d) is added to, or subtracted from, the one draught reading to obtain the mean draught at the centreline.

**QUESTION 2:**
The port draught midships = 8.00 m. The starboard side is to be found by manometer, where the readings are taken at 8.50 m on either side of the centre line.
The vessel's full beam = 20.85 m. Calculate the midships mean draught (i.e. centreline draught) if there is a difference of 25 cm between the two readings of the manometer and the starboard reading is the higher.

**ANSWER:**
Effective beam = 8.50 x 2 = 17.00 m.
By similar triangles 0.25/17 = d / 20.85
\[ d = \frac{20.85 \times 0.25}{17} = 0.307 \text{ m full beam difference.} \]
Half beam difference =0.307/2 = 0.153 m.
Centreline draught = 0.153 + 8.00 = 8.153 m.

Note: It may be more practical in some situations to measure the midships freeboard and from this calculate the midships draught.

**DRAUGHT GAUGES**
Draught gauges may be very helpful as a check, but should never replace the reading of draughts using the fixed draught marks on the ship's hull.

**SQUAT**
While measuring the draught, when there is a strong current running and there is water depths of less than twice the draught of the vessel, the draught readings may be misleading, due to the effects of squat.
The survey report should include reference to possible squat effects, even if a suitable correction to the draught readings cannot be determined.
CORRECTION OF DRAUGHTS TO PERPENDICULARS AND MIDSHIPS

Firstly, correct observed draughts, forward, aft and midships, for the effect of any list or heel by calculating the mean of port and starboard in each case.

Note; see notes on page 26, as there may also be a list correction (in tonnes) to apply to the displacement.

Secondly, when the vessel is trimmed and the vessel's draught marks are not sited at the correct position on the perpendiculars; corrections to the observed draughts must be applied. This incorrect positioning of the draught marks may be termed *misplacement of marks*, it is shown in the photographs on pages 22 and 23.

\[
\begin{align*}
\text{AP} & \quad \text{aft perpendicular} \\
\text{FP} & \quad \text{forward perpendicular} \\
\text{LBP} & \quad \text{length between perpendiculars} \\
\text{DAP} & \quad \text{draught at aft perpendicular} \\
\text{Da} & \quad \text{draught at aft draught marks} \\
\text{DM} & \quad \text{draught at midships} \\
\text{Dm} & \quad \text{draught at midships draught marks} \\
\text{DFP} & \quad \text{draught at forward perpendicular} \\
\text{Df} & \quad \text{draught at forward draught marks}
\end{align*}
\]
Misplacement of marks midships

Misplacement of marks aft
Paul Coombs

Misplacement of marks forward
Forward correction = \( \text{apparent trim} \times \frac{\text{distance DFP to Df}}{\text{distance Da to Df}} \)

Aft correction = \( \text{apparent trim} \times \frac{\text{distance DAP to Da}}{\text{distance Da to Df}} \)

Midships correction = \( \text{apparent trim} \times \frac{\text{distance Dm to Dm}}{\text{distance Da to Dt}} \)

Where:

\( \text{apparent trim} \) the difference between Da and Df

Sign convention:
If the direction of misplacement of the draught mark from the perpendicular (or midships position) is the same as the direction of the trim, then the correction is negative (-) when applied to the observed draught.

Note; even keel would not require the above corrections to be applied.

**QUESTION 3:**
With reference to the following particulars, calculate the correct draughts, forward, aft, and midships, if the observed draughts are:

- forward 6.35 m
- aft 7.88 m
- midships 7.12 m

Position of draught marks:

- Forward: 0.15 m aft of line of stem at summer load line (SLL).
- Rake of stem = 22°. summer load draught = 10.471 m.
- Aft: 6.00 m forward of AP.

LBP = 170 m.

**ANSWER:**

\[
\begin{align*}
\text{Apparent trim} & = 7.88 - 6.35 = 1.53 \text{ m} \\
\text{Arithmetical mean draught} & = 7.115 \text{ m} \\
\text{Midships draught} & = 7.12
\end{align*}
\]

Vessel not suffering from hog or sag
Distance from SLL 10.471 - 6.350 = 4.121 m
By simple trigonometry Tan 22° x 4.121 = 1.665 m
Distance from FP 1.665 + 0.15 = 1.815 m
Length between marks = 170 - (6.0 + 1.815) = 162.185 m
Correction forward = 1.53 x 1.815 / 162.185 = -0.017 m
Draught forward = 6.350 - 0.017 = 6.333 m
Correction aft. = 1.53 x 6.00 / 162.185 = +0.057 m
Draught aft. = 7.88 + 0.057 = 7.937 m

CORRECTIONS WITH HULL DEFLECTION
The corrections to the perpendiculars and midships assume that the keel of the vessel is straight. When the vessel is hogged or sagged, these corrections may no longer be correct. The tabulated corrections in the stability information book, or the formulae on the previous page, must be corrected to the particular circumstances.

The easiest method to find these corrections would be to use the trim between the midships mark and the particular end draught then calculate using this half length trim, the half length and the distance of the misplacement.

Repeat this procedure at the other end draught mark with the similarly modified trim, the half length and the distance of misplacement.

EXAMPLE: Observed draughts forward 6.00 m midships 6.40 m aft 7.40 m.
Distance of forward mark from FP = 2.0 m aft
Distance of aft mark from AP = 5.0 m forward. LBP =100m
Total trim = 1.40 m AMD = 6.70 m. Therefore the vessel is hogged.
Trim forward to midships = 0.40 m
Forward correction = 2 x 0.4 / (50 - 2) = -0.017 m
Forward draught = 5.983 m
Trim aft to midships = 1.0m
Aft correction = 5.0x1.07(50-5) = +0.111 m
Aft draught = 7.511 m

CORRECTION FOR LIST

When a vessel lists, it often rises in the water. This means that the mean of the side draughts is a centreline draught which is less than the actual draught that would have been observed, had the vessel been upright. This may be ignored for small angles of list, however, if the draught survey is to be carried out on a vessel which has suffered a cargo shift or is lying at a large angle of list, then it should be calculated.

The correction, in tonnes, to be applied to the displacement, is by the formula:

\[ \text{Correction for list} = 6 \left( \text{TPC}_2 - \text{TPC}_1 \right) x (d_1 - d_2) \text{ tonnes} \]

Where:
- \( d_1 \) and \( d_2 \) = midship draughts on each side.
- \( \text{TPC}_1 \) = the TPC equivalent to the draught \( d_1 \)
- \( \text{TPC}_2 \) = the TPC equivalent to the draught \( d_2 \)

Sign convention: Always positive (+).

QUESTION 4:

Vessel is listed 5\(^\circ\). The draughts midships are:
- Port 6.00 m (equivalent TPC 32)
- Starboard 8.00 m (equivalent TPC 34)

ANSWER:

Correction = \( 6(34 - 32)(8.00 - 6.00) \) = 24 tonnes positive (+).

Note; it will normally be a small correction.

HULL DEFLECTION OR HOG AND SAG

When the observed draughts have been corrected for list and displacement of marks, an arithmetical mean of the forward and aft draughts must be calculated, ie. the arithmetical mean draught (AMD).
Compare the AMD with the corrected midships draught to establish whether the hull is distorted. The AMD should equal the draught midships if the ship is neither hogged or sagged.

If the actual draught is less than AMD then the vessel is **hogged**. If the actual draught is greater than AMD then the vessel is **sagged**.

**METHODS USED TO CALCULATE THE EFFECTS OF HULL DEFLECTION**

Every effort should be made, taking into account the information available, to determine the appropriate correction for hull deflection. The ultimate accuracy of the survey results are normally dependant on this correction.

It is difficult to establish the ship's distorted shape precisely but the following factors should be taken into account:

- Residual deformation
- Cargo distribution
- Bunkers/ballast distribution
- Daily variation.

Larger vessels can be liable to daily variations in the amount of hull deflection. By day, the sun heats the upper parts of the vessel, resulting in a hogged condition. The same vessel may suffer sagging when the upper portion loses its heat at night.
The assessment of the vessel's shape will establish the appropriate draught to enter the hydrostatic data, in the stability information book. This will determine the displacement for that particular instant.

METHODS

There are several methods of calculating the correction for hog or sag. Agreement on the use of one of these alternatives must be made before the proposed voyage begins and adhered to until the voyage ends. These methods only take into account hull deformation or deflection.

**Method 1.**

Some ship's stability information books have a table of corrections to apply to the extracted displacement. When this table or graph is used, then this fact should be stated on the report so that it can be used throughout.

**Method 2. (The most common and simplest method)**

Assume that the deformed shape of the vessel follows a regular mathematical curve.

This correction is dependant on the block coefficient, (i)

For finer lined vessels:

\[
\text{Mean Adjusted Draught} = \frac{(6 \times D_M) + D_{FP} + D_{AP}}{8}
\]

This is often referred to as "the mean of mean of means".

(ii) For fuller form vessels, and box-shaped vessels:

\[
\text{Mean Adjusted Draught} = \frac{(4 \times D_M) H - D_{FP} + D_{AP}}{2}
\]

Where;

Mean Adjusted draught = Draught midships corrected for hog and sag.

DM = Draught midships.

D FP = Draught at forward perpendicular.

DAP = Draught at aft perpendicular.
**QUESTION 5:**
The vessel has a sleek form for a fast passage, but is suffering from hull deflection.

The draughts at the perpendiculars are forward 5.64 m aft 6.42 m
The draught midships is 6.11 m.
What is the true mean draught, taking into account the distortion of the hull.

**ANSWER:**
Mean adjusted draught = \((6 \times 6.11) + 5.64 + 6.42\) = 6.09 m

**Method 3.**
This correction is dependent on the coefficient of fineness (waterplane coefficient).
The coefficient is used to enter the graph (included in some stability information books) to obtain a “factor”.

![Waterplane Coefficient Graph](image)

Then:

Mean adjusted draught = AMD + factor(D M - AMD)

**QUESTION 6:**
A vessel is floating at the following draughts:
forward 5.80 m aft 6.20 m midships 6.18 m
Note: These draughts have been corrected to the perpendiculars, and midships marks.
Calculate the true mean draught taking into account the distortion of the hull using the waterplane coefficient table. The waterplane coefficient tabulated in the stability information book = 0.60

**ANSWER:**

Extracted factor = 0.76

A.M.D. = \((5.80 + 6.20) / 2\) = 6.00 m

Mean adjusted draught = 6.00 + 0.76(6.18 - 6.00) = 6.137 m

**Method 3 alternative 1.**
The extracted factor can be used directly to determine a correction in tonnes to apply to the final displacement.

\[
\text{Correction (tonne)} = \text{factor} \times \text{TPC} \times \text{hog/sag (cm)}
\]

Where: \(\text{hog/sag (cm)} = (\text{DM} - \text{AMD}) \times 100\)

**Method 3 alternative 2.**
The graph or table itself may be adapted to give a correction table directly in tonnes (i.e. factor x TPC) for each centimetre of hog or sag. This would give a correction to apply to the *Final displacement by entering the table with the AMD and the hog/sag in cms.*

**Other alternative methods**
These require additional draught/freeboard measurements at points other than perpendiculurs and midships, along the vessels length. This is very difficult to establish. See *Data manual for draught surveys*, pages 8 and 9.

**CORRECTIONS FOR TRIM**

There may be a total trim correction table included in the stability information book. This will normally combine the following 1st. and 2nd. corrections. Find out what it includes, and examine the ships stability data carefully before conducting a survey.

**FIRST TRIM CORRECTION (CORRECTION FOR LAYER)**
The displacement scale is normally calculated on the assumption that the vessel is lying on an even keel. The first trim correction is to correct the draught midships to the true mean draught, at the centre of flotation.
This correction is known as the correction for layer (or layer correction).

### Definitions

- **AP**: aft perpendicular
- **FP**: forward perpendicular
- **TMD**: true mean draught
- **AMD**: arithmetical mean draught corrected for hog or sag
- **LCF**: longitudinal centre of flotation
- **LBP**: length between perpendiculars

### Layer Correction

**Layer correction (metres)** = \( \frac{\text{(distance LCF to midships)} \times \text{trim}}{\text{LBP}} \)

then \( \text{TMD} = \text{AMD} \pm \text{layer correction} \)

1st trim correction (tonnes) = layer correction \( \times \) TPC \( \times \) 100

### Metric

1st trim correction (tonnes) = \( \frac{\text{(distance LCF to midships)} \times \text{TPC x trim(cm)}}{\text{LBP}} \)

### Imperial

1st trim correction (tons) = \( \frac{\text{(distance LCF to midships)} \times \text{TPI x trim(inches)}}{\text{LBP}} \)

### Actual Displacement

Actual displacement = tabulated displacement \( \pm \) 1st trim correction

### Sign Convention

<table>
<thead>
<tr>
<th>Trim</th>
<th>LCF forward of midships</th>
<th>LCF aft of midships</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aft</td>
<td>negative (-)</td>
<td>positive (+)</td>
</tr>
<tr>
<td>Forward</td>
<td>positive (+)</td>
<td>negative (-)</td>
</tr>
</tbody>
</table>
QUESTION 7:
A vessel of LBP 150 m has the following draughts: forward 6.85 m aft 7.25 m.
The LCF is situated at a position 70 m forward of the AP. TPC = 40.
Calculate the first trim correction in tonnes.

ANSWER:
1st trim correction \[ = \frac{5 \times 40 \times Q'^{10} \times 10Q}{150} = \pm 53 \text{ tonnes} \]

SECOND TRIM CORRECTION
This is a correction for the shift of the centre of flotation (LCF) which occurs as
the vessel changes its trim. The position of the LCF, as specified in the
hydrostatic particulars, is normally for the even keel condition.
The draught at the final position of LCF is required.

Metric
\[ 2\text{nd trim correction (in metres)} = \frac{\text{trim}(m) \times (\text{MCTC}_2 - \text{MCTC}_1)}{\text{LBP}} \times (\text{trim}(m) - 1) \]
Where: \( \text{MCTC}_2 = \) MCTC for the draught at the AP
and \( \text{MCTC}_1 = \) MCTC for the draught at the FP
or vice versa when trimmed by the head.
However the 2nd trim correction is normally calculated in tonnes as follows:
\[ 2\text{nd trim correction (in tonnes)} = \frac{50 \times \text{trim}(m)^2 \times (\text{MCTC}_2 - \text{MCTC}_1)}{\text{LBP}} \]
Where: \( \text{MCTC}_2 = \) MCTC for mean adjusted draught + 50 cm
and \( \text{MCTC}_1 = \) MCTC for mean adjusted draught - 50 cm

Imperial
\[ 2\text{nd trim correction (in tons)} = \frac{6 \times \text{trim}(\text{ft})^2 \times (\text{MCTC}_2 - \text{MCTC}_1)}{\text{LBP}} \]
Where: \( \text{MCTC}_2 = \) MCTC for mean adjusted draught + 6 in
and \( \text{MCTC}_1 = \) MCTC for mean adjusted draught - 6 in
Sign convention: Always positive (+)
**QUESTION 8:**
A vessel is floating in salt water with an AMD of 6.10 m corrected for deflection and a trim of 1.4 m by the stern.

Extracted values from hydrostatics:
- MCTC for 5.60 = 310.0
- MCTC for 6.60 = 322.9
- LBP = 170 m

Calculate the second trim correction in tonnes for the vessel in this condition.

**ANSWER:**
- Trim = 1.40 m
- 2nd trim correction = \[
\frac{50 \times 1.4 \times (322.9 - 310)}{170} \] ^ \wedge ^ \wedge ^ \wedge + 74 \text{ tonnes}

**DENSITY**

Determine the water density at the time of taking the draughts using a glass hydrometer, designed for draught surveys, and marked:

1. Medium surface tension
2. Apparent density in kg/l scale range between 0.990 to 1.040
   - Note: 1.000 kg/l = 1.000 t/m³
3. Instrumental standard 15°C

The instrument should be provided with a certificate of conformity with a maximum error not exceeding "x" kg/l tested against a national standard. See photograph on page 13.

If the hydrometer used is graduated with a different scale to that quoted above then it is not the standard type so additional corrections may be required, see conversion details for *Alternative Hydrometers* on page 53.

**CORRECTION FOR DENSITY**

Actual displacement = \[
\frac{\text{tabulated displacement} \times \text{density 1}}{\text{density 2}}
\]

Where:
- density 1 = average density of water sampled.
- density 2 = density specified in the hydrostatic information.
Taking a ballast sample

Hydrometer showing meniscus using a mirror for the rear view
The sounding tape

The tools of the draught surveyor
Note:

1: Do apply the hydrometer index error, if any. It is quoted on the certificate.

2: Do not apply any correction for temperature.

3: Do not adjust the draught for the density, but do correct the displacement instead.

4: Do enter the hydrostatic tables with the actual TMD, irrespective of density, and then convert the extracted value to the correct density at the final calculation. See check list page 51. It is wrong to convert the TMD to a salt water TMD and then enter the hydrostatics.

5: Do extract MCTC, LCF etc. for the actual TMD and use these extracted values to calculate the 1st and 2nd trim corrections.

6: The stability information book should quote some form of relationship between weight and volume: -

- 1 cubic metre of fresh water = 1.000 tonnes
- 1 cubic metre of salt water = 1.025 tonnes

or similar figures. This example gives apparent density in the same units used by the Zeal draught survey hydrometer.

**QUESTION 9:**
The extracted hydrographic displacement equivalent to the observed draught of 5.30 m = 15250 tonne for salt water where 1m³ of salt water = 1.025 tonnes.

Find: true displacement if the average observed apparent density = 1.015 t/m³.

**ANSWER:**
Actual displacement = $15250 \times 1.015/1.025 = 15101.2$ tonnes
ASSESSMENT SUMMARY

The corrections in this chapter may be applied to the observed draughts to convert them to a draught that can be used to enter the ship's hydrostatic particulars in order to determine the correct displacement.

Some of the corrections may be calculated in tonnes or in metres. Experience and speed of calculation has shown that the latter corrections should be calculated in tonnes (instead of metres), and used to correct a value of displacement extracted from the hydrostatic particulars in the stability information book.

The observed draughts are corrected to the perpendiculars and midships, the hull deflection found and the hydrostatics entered with the corrected arithmetical mean draught (AMD). The displacement extracted is then adjusted with the 1st and 2nd trim corrections and the correction for density, all in tonnes.

See corrections check list on page 51.
DEDUCTIBLES

The deductibles are the components of the ship's total weight, which must be deducted from the calculated displacement in order to determine the weight of cargo on board.

The total weight of the ship will be made up of:-

- Light displacement, (remember, components may be missing e.g., anchors out).
- Cargo
- Ballast
- Fuel and fresh water
- Swimming pool water and other easily forgotten weights on board
- Stores and Provisions
- Crew and effects

Stores, provisions, crew and their effects are likely to be constant during a draught survey, and could be added on to the light displacement.

Preparations
Examine the relevant basic ship's plans showing the layout of pipes and tanks, including the location of their sounding pipes.

Make a note of the tank dimensions, reference heights and obtain the authorised calibration tables for these tanks.

Remember that automatic gauge readings (if fitted), should be noted for comparison against the manual readings.

SOUNDINGS AND ULLAGES

The liquid quantities of ballast, fuel and fresh water, must be very carefully measured as soon as possible after the draughts have been read.

A sounding is the measurement from the striker plate on the base of the tank below the sounding pipe to the top of the liquid. See photograph on page 35.

When taking a sounding, always check the tape is at the bottom of the tank, by checking the full measurement from the striker plate to the top of the sounding pipe.

An ullage is the measurement from the surface of the liquid to a fixed datum point, usually the top of the sounding pipe.

Measure and record soundings (or ullages) for every tank in the ship.
Check the bilges for any liquid.

Some tanks may have two sounding pipes, check both, particularly if the ship is trimmed.

The sounding tables should be part of the ship's approved documentation, they are produced when the vessel is built and therefore may have become less accurate, with the passage of time.

**SAMPLING**

By sounding a tank and using the sounding tables, the volume of liquid is found. With the apparent density of the liquid, its mass can be determined.

\[
\text{Mass} = \text{volume} \times \text{apparent density}
\]

It is most important that each tank should be sampled for density as well as being sounded for volume. See photograph on page 34.

Apply the temperature correction to the density reading before using it to calculate the quantity of bunkers in the tank, when doing a bunker tank survey. It is *not* normal to apply a temperature correction when determining ballast quantities.

**TRIM CORRECTIONS**

The sounding pipe should be positioned at a point within the tank where it will always provide the correct sounding applicable to the sounding tables, regardless of the ship's trim. However, this position is not always possible to achieve and correction tables for trim should then be available to use with the sounding tables. These corrections should be calibrated for every half metre of trim, by the head and by the stern, over the operational range of trims. Alternatively, sounding tables for different trims may be provided.
If no corrections are available, it may be necessary to calculate them. Appropriate measurements can be taken from the plans of the tank.

\[
\text{Correction to sounding } \ (x) = \frac{dx}{LBP} \text{LBP}
\]

where \( d \) is the distance from the sounding pipe to the tank centre.

Sign convention:

<table>
<thead>
<tr>
<th>TRIM</th>
<th>Sounding forward of tank centre</th>
<th>Sounding aft of centre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward</td>
<td>Negative (-)</td>
<td>Positive (+)</td>
</tr>
<tr>
<td>Aft</td>
<td>Positive (+)</td>
<td>Negative (-)</td>
</tr>
</tbody>
</table>

**Note:** the accuracy of this formula is acceptable, provided the bottom of the tank is covered with liquid, and the tank is approximately rectangular.

**QUESTION 10:**

A ship, LBP 120 m, has a trim of 2.0 m by the stern. A sounding was taken in a rectangular double bottom tank, and found to be 1.05 m. If the tank measured length 24.0 m, breadth 8.2 m, and the sounding pipe was 3.0 m forward of the aft bulkhead, find the volume of liquid in the tank.

**ANSWER.**

\[
\text{Correction to sounding } \ = \frac{dx}{LBP} \text{LBP} = \frac{9.0 \times 2.0}{120} = 0.15 \text{ m}
\]

Observed sounding = 1.05 m

Even keel sounding = 0.90 m

Volume of liquid = 24.0 \times 8.2 \times 0.90 = 177.1 \text{ m}^3
When a vessel is trimmed a tank may appear full but have a large void space immediately forward of the sounding or ullage point.

Alternatively, a tank may have no soundings and appear empty, but still have a considerable quantity of liquid remaining in it.

**LIQUID SLOP TANKS**

Where small quantities of ballast water remain in a ballast hold, on a trimmed ship, this quantity must be included in the assessment.

It is possible to calculate the volume of this wedge of liquid, from one sounding, using the wedge formula.

The wedge formula was developed in order to determine small volumes of cargo "remaining on board".

The formula assumes a free flowing liquid on an upright, but trimmed vessel, and also it assumes a rectangular tank where the sounding is not constrained by a sounding pipe.

The wedge formula is:

\[
\text{Wedge volume} = \frac{LBP \times \text{breadth of tank} \times (\text{corrected sounding})}{2 \times \text{vessel's trim}}
\]

The corrected sounding can be calculated by the following approximate formula:
Corrected sounding \( (P) = \text{observed sounding} \ (P_j) + \text{distance}} \ (y) \times r^{-\frac{y}{LBP}} \)

Where the distance "y" is the distance from the sounding position to the end bulkhead.

**QUESTION 11:**
From the following information, find the volume of oil remaining in a tank where the sounding was 0.2 m.

LBP 150 m, trim 2.0 m by the stern, breadth of tank 12.5 m, sounding position 6.0 m forward of aft bulkhead.

**ANSWER:**

Corrected sounding = sounding + distance \times \text{trim/LBP}

\[ = 0.2 + \frac{6 \times 2}{150} = 0.2 + 0.08 = 0.28 \text{m} \]

Net volume = \( \frac{\text{LBP} \times \text{breadth} \times \text{corrected sounding}^2}{\text{trim} \times 2} \)

\[ = \frac{150 \times 12.5 \times 0.28^2}{2.0 \times 2} \]

\[ = 36.75 \text{ m}^3 \]

**MIXTURES**

When conducting a bunker survey and the vessel loads bunkers, this could be mixed with bunkers already on board. The relative density (RD), or density, of the mixture must be used to calculate the total quantity of the oil in the tank.

The final RD of the mixture can be found by the following formula:

RD of mixture

\[ = \frac{\text{(original volume} \times \text{original RD}) + (\text{loaded volume} \times \text{loaded RD})}{\text{original volume} + \text{loaded volume}} \]

**RESIDUE IN COMPARTMENTS**

Tanks for liquids, particularly ballast tanks, are subject to the build up of residues and scale. The quantity of sediment is difficult to assess without entering the tank.
The effect on the ballast calculations can be minimized by leaving a measurable quantity of water in the tank instead of pumping it completely dry. The calculations then use a known amount of water which can be deducted from the displacement. The error due to the unknown weight of sediment is reduced to the difference between the density of water and the density of the sediment. This accumulation of sediment will reduce the deadweight capacity of the vessel and therefore should not be allowed to accrue indefinitely.

Inspect ballast tanks if in any doubt about the quantity of sediments. There are patent chemicals available to put the mud into suspension, so that it may be disposed of with the water in an appropriate and safe manner, when a suitable opportunity allows. However, these may not always be effective; when a hard crust has developed on the top of the mud, it can sometimes only be removed by hand.

ANCHORS AND CABLES

The anchors may be in the housed position, where they contribute to the lightship, or they may have been used in the mooring of the ship. Then the anchors will be on the sea bed along with a given length of cable. The loss of weight due to its removal is weight taken from the light displacement, this amount should therefore be added to the quantity of cargo. There should be information available on board to enable the surveyor to establish the weight of the missing anchor and cable.

In the case of the chain cable, it can be calculated with reasonable accuracy by the following formula:

\[
\text{Weight per shackle (tonne)} = 15 \times (\text{link diameter} \, \text{cm})^{0.8} \]

The link diameter is the diameter of the steel rod which makes up each individual link. In the case of the anchor itself, this will vary from ship to ship, but this information should be available on board. This anchor weight should be rounded to the nearest half tonne.
ADDITIONAL FACTORS

1. It should be appreciated that the cargo may change its characteristics over a period of time. The moisture content varies with the atmospheric conditions, and liquid drains into the bilges. The removal of bilge water between the two surveys should be noted. This is also important during a voyage when a wetted cargo may lose its moisture content and later cause a dispute over cargo quantities.

2. The changes in the condition of the vessel such as the accumulation of rain water, ice or snow, could be significant and should be accounted for in the calculations.

3. The swimming pool can hold considerable quantities of water, which could cause a discrepancy if the pool is emptied, or filled, during the period between the before and after draught surveys. In this case a correction must be applied to the results.

4. All spaces should be inspected to ensure they are the same at both initial and final surveys, not forgetting spaces such as the duct keel, peaks, cofferdams, etc.

REMEMBER: The accuracy of the survey depends on diligence!
### GLOSSARY

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLOCK COEFFICIENT (Cb):</td>
<td>The ratio of the underwater volume of the vessel to the volume of a rectangular block of the same overall dimensions.</td>
</tr>
<tr>
<td>BREADTH (BEAM):</td>
<td>Maximum width of the ship.</td>
</tr>
<tr>
<td>Moulded Breadth:</td>
<td>Width of the ship amidships, measured inside the shell plating.</td>
</tr>
<tr>
<td>CENTRE OF FLotation (CF):</td>
<td>The centroid of the waterplane area. It is the point about which the ship trims, heels and lists.</td>
</tr>
<tr>
<td>Longitudinal Centre of Flotation (LCF):</td>
<td>The distance of the centre of flotation from midships or the aft perpendicular.</td>
</tr>
<tr>
<td>DEADWEIGHT:</td>
<td>The difference between the light displacement and the loaded displacement. It is the carrying capacity of the ship and includes the weight of cargo, ballast, fuel, water, stores, crew and effects.</td>
</tr>
<tr>
<td>DENSITY:</td>
<td>The mass per unit volume.</td>
</tr>
<tr>
<td>Apparent Density:</td>
<td>The weight in air of a unit volume.</td>
</tr>
<tr>
<td>True Density:</td>
<td>The weight in a vacuum of a unit volume.</td>
</tr>
<tr>
<td>Relative Density (RD):</td>
<td>The ratio of the weight of a substance to the weight of an equal volume of fresh water. RD of fresh water: 1.000 at 4°C RD of salt water: 1.025 at 4°C The term specific gravity, previously used in place of RD, is no longer used with SI units.</td>
</tr>
<tr>
<td>DEPTH:</td>
<td>Distance from the top of the deck plating at the side of the ship to the bottom of the keel.</td>
</tr>
<tr>
<td>Moulded Depth:</td>
<td>Distance from the keel to the deck at the ship's side, measured inside of the shell plating.</td>
</tr>
<tr>
<td>Term</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>DISPLACEMENT:</strong></td>
<td>The mass of water displaced by the ship. It represents the total weight of the ship and is calculated by: volume of displacement x density of water.</td>
</tr>
<tr>
<td>Light Displacement:</td>
<td>The displacement of the ship and superstructure with all fixed equipment plus engine room spares and with water in the boilers to working level. Also referred to as <em>Lightship</em> or <em>Lightweight</em>.</td>
</tr>
<tr>
<td>Summer Load Displacement:</td>
<td>The displacement of the ship when loaded to her summer load line.</td>
</tr>
<tr>
<td><strong>DRAUGHT:</strong></td>
<td>The distance from the bottom of the keel to the waterline. Sometimes spelled <em>draft</em>.</td>
</tr>
<tr>
<td>Aft Draught:</td>
<td>The distance from the bottom of the keel to the waterline on the aft perpendicular when the ship is upright.</td>
</tr>
<tr>
<td>Midships Draught:</td>
<td>The distance from the bottom of the keel to the waterline at a position midway between the perpendiculars.</td>
</tr>
<tr>
<td>Forward Draught:</td>
<td>The distance from the bottom of the keel to the waterline on the forward perpendicular when the ship is upright.</td>
</tr>
<tr>
<td>Arithmetical Mean Draught (AMD):</td>
<td>The arithmetical mean of the forward draught and the aft draught.</td>
</tr>
<tr>
<td>True Mean Draught (TMD):</td>
<td>The draught at the centre of flotation.</td>
</tr>
<tr>
<td><strong>EVEN KEEL:</strong></td>
<td>When the forward and aft draughts are the same. The ship is said to be on an even keel. The ship's hydrostatic data is calculated for this condition.</td>
</tr>
<tr>
<td><strong>FREEBOARD:</strong></td>
<td>The distance from the waterline to the upper surface of the freeboard deck at the ship's side.</td>
</tr>
<tr>
<td>Term</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Assigned Summer Freeboard:</td>
<td>The distance from the upper edge of the summer load line to the upper edge of the deck line.</td>
</tr>
<tr>
<td>FRESH WATER ALLOWANCE (FWA):</td>
<td>The amount by which the summer load line may be submerged in fresh water.</td>
</tr>
<tr>
<td>HEEL:</td>
<td>The ship is heeled when inclined by an external force.</td>
</tr>
<tr>
<td>HOG:</td>
<td>The condition of a ship when it is deformed so that the forward and aft draughts are deeper than the midships draught. It is referred to as a <em>hull draft</em>.</td>
</tr>
<tr>
<td>LENGTH BETWEEN PERPENDICULARS (LBP):</td>
<td>Distance from the forward perpendicular to the aft perpendicular.</td>
</tr>
<tr>
<td>Aft Perpendicular (AP):</td>
<td>A perpendicular drawn to the waterline at die point where the aft side of the rudder post meets the summer load line. Where no rudder post is fitted it is taken as the centre line of the rudder stock.</td>
</tr>
<tr>
<td>Forward Perpendicular (FP):</td>
<td>A perpendicular drawn to the waterline at the point where the foreside of the stem meets the summer load line (or load water line LWL).</td>
</tr>
<tr>
<td>LENGTH OVERALL (L or LOA):</td>
<td>Maximum length of the ship.</td>
</tr>
<tr>
<td>LIST:</td>
<td>The ship is listed when inclined by weights within the ship.</td>
</tr>
<tr>
<td>MASS:</td>
<td>The mass of an object is the quantity of matter it contains and is calculated by: volume \times\text{density}</td>
</tr>
<tr>
<td>MIDSHIPS:</td>
<td>The point midway between the forward and aft perpendiculars. The centre of the load line circle should indicate this position.</td>
</tr>
</tbody>
</table>
MOMENT TO CHANGE TRIM PER CENTIMETRE (MCTC or MCT 1 cm):
The moment of the weight (i.e. weight x distance) required to change the trim of the ship by 1 cm.

SAG: The condition of a ship when it is deformed so that the midships draught is deeper than the forward and aft draughts. It is referred to as a hull deflection.

SOUNDING: The distance from the bottom of a tank to the top of the liquid within it.

TONNES PER CENTIMETRE IMMERSION (TPC): The weight which must be loaded or discharged to change the ship's mean draught by 1 cm.

TRIM: The difference between the forward and aft draughts.

Apparent Trim: The difference between the draughts observed at the forward and aft draught marks.

True Trim: The difference between the draughts at the forward and aft perpendiculars.

ULLAGE: The distance above a liquid, within a tank, to the measuring point at the top of the tank.

VOLUME OF DISPLACEMENT: The volume of water displaced by the ship and is calculated by:
length x breadth x draught x Cb.

WATERPLANE COEFFICIENT (Cw): The ratio of the area of the ship's waterplane to a rectangle of the same extreme dimensions. Also known as the coefficient of fineness.

WEIGHT: The weight of an object is the force it exerts on anything which freely supports it.
APPENDICES

EQUIPMENT CHECK LIST

Sample jar and water sample bucket with line Ballast tank dipper
with line Small hand pump with hose for taking samples Draught
survey hydrometer with certificate Steel sounding tape with
graduations in metres and feet Water finding paste
Draught/freeboard measuring device
Manometer if some draughts are impossible to read, plus a long
measuring tape
Plastic tube with plug, to act as sounding pipe extension Boat
available to read inaccessible draughts Pilot ladder on board ready
for obtaining draughts Documentation Pocket computer with
draught survey program or calculator

CHECK LIST OF RESERVATIONS

(Not an exhaustive list) Height of waves / swell
Clarity of draught marks State of tide - underkeel clearance
Squat effects Variations in density Daytime /
night-time Anchors moved, in or out Ice / snow on
deck Quantity of bilges pumped Residue in tanks
Suspect calibrations Ship movements
### INFORMATION CHECK LIST GENERAL INFORMATION

<table>
<thead>
<tr>
<th>Ship's name</th>
<th>Call letters</th>
<th>Port of registry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flag</td>
<td>Year built</td>
<td>Master Owners</td>
</tr>
<tr>
<td>Owner's address</td>
<td>Owner's agent Manager/operator</td>
<td></td>
</tr>
<tr>
<td>Charterer</td>
<td>Charterer's agent Shipper</td>
<td></td>
</tr>
<tr>
<td>Chief Officer</td>
<td>Chief Engineer Surveyor/s</td>
<td></td>
</tr>
<tr>
<td>p&amp;I correspondent</td>
<td>Ship's location Survey requested by:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type of cargo Weather conditions</td>
<td></td>
</tr>
<tr>
<td>Date and time of arrival</td>
<td>THE STABILITY INFORMATION BOOK</td>
<td></td>
</tr>
</tbody>
</table>

- Length between perpendiculars
- Extreme and moulded breadth
- Overall and moulded depth
- Summer draught and freeboard
- Summer displacement and deadweight
- Misplacement of draught marks from perpendiculars and midships
- Lightship displacement with lightship constant
- Hydrostatic particulars: Displacement, TPC, MCTC, LCB, LCF
- Capacity plans and tables
- Correction tables: Trim Position of marks List
- Hull deflection
- General arrangement plan
- Profile plan indicating each space in the ship

### OTHER SOURCES
- Sounding tables and corrections for trim
- Quantity of bunkers
CORRECTIONS CHECK LIST

OBSERVED DRAUGHTS;
Forward...? & S aft...P & S midships...? & S
Mean values, ie. draughts at centreline, forward, aft and midships.
Correct from marks to perpendicular and midships positions.

Misplacement opposite to trim, then positive (+) Misplacement same as trim, then negative (-) Hog/sag correction (mean of mean of means, or similar).

negative (-) for hog positive (+) for sag
CORRECTED MEAN DRAUGHT ... to enter hydrostatic tables.
Displacement from displacement table.
First trim correction or Correction for layer (in tonnes). LCF same as trim, then positive (+)

LCF opposite to trim, then negative (-) Second trim correction (in tonnes).
Always positive (+) List correction (in tonnes). Always positive (+)
Correction for density. Less than salt water density, then negative (-)
CORRECTED DISPLACEMENT.
### METRIC/IMPERIAL CONVERSIONS

<table>
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<tr>
<th>Unit Conversion</th>
<th>Metric/Imperial Units</th>
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</thead>
<tbody>
<tr>
<td>1 Foot</td>
<td>= 0.3048 Metres</td>
</tr>
<tr>
<td>1 Foot</td>
<td>= 30.48 Centimetres</td>
</tr>
<tr>
<td>1 Inch</td>
<td>= 2.54 Centimetres</td>
</tr>
<tr>
<td>1 Metre</td>
<td>= 39.37 Inches</td>
</tr>
<tr>
<td>1 Metre</td>
<td>= 3.28 Feet</td>
</tr>
<tr>
<td>1 Centimetre</td>
<td>= 0.3937 Inches</td>
</tr>
<tr>
<td>1 Cu.Foot</td>
<td>= 0.028317 Cu.Metres</td>
</tr>
<tr>
<td>1 Cu.Foot</td>
<td>= 7.4805 U.S.Gallons</td>
</tr>
<tr>
<td>1 Cu.Foot</td>
<td>= 6.2324 Imp. Gallons</td>
</tr>
<tr>
<td>1 Cu.Metre</td>
<td>= 35.3148 Cu.Feet</td>
</tr>
<tr>
<td>1 Cu.Metre</td>
<td>= 264.167 U.S.Gallons</td>
</tr>
<tr>
<td>1 Cu.Metre</td>
<td>= 6.2898 U.S.Barrels</td>
</tr>
<tr>
<td>1 Cu.Metre</td>
<td>= 220.0 Imp. Gallons</td>
</tr>
<tr>
<td>1 Long Ton</td>
<td>= 1.016047 Metric Tonnes</td>
</tr>
<tr>
<td>1 Metric Tonne</td>
<td>= 0.9842064 Long Tons</td>
</tr>
<tr>
<td>1 Metric Tonne</td>
<td>= 2204.6223 Pounds</td>
</tr>
<tr>
<td>1 Metric Tonne</td>
<td>= 6.2898 U.S.Barrels</td>
</tr>
<tr>
<td>1 U.S.Gallon</td>
<td>= 0.13368 Cu.Feet</td>
</tr>
<tr>
<td>1 U.S.Gallon</td>
<td>= 231 Cu.Inches</td>
</tr>
<tr>
<td>1 U.S.Gallon</td>
<td>= 8.33 Pounds of fresh water</td>
</tr>
<tr>
<td>1 U.S.Gallon</td>
<td>= 0.833 Imp. Gallons</td>
</tr>
</tbody>
</table>
1 Imp.Gallon ................... = 277.3 Cu.Inches
1 Imp.Gallon .................... = 0.16045 Cu.Feet
1 Imp.Gallon .................... = 10.0 Pounds of fresh water

WATER
1 Long Ton fresh water ... = 35.9 Cubic Feet
1 Long Ton salt water...... = 35.0 Cubic Feet

FUEL OIL (RD 0.944)
1 Long Ton........................ = 6.77 U.S.Barrels
1 U.S.Gallon..................... = 7.88 Pounds

DIESEL OIL (RD 0.85)
1 Long Ton........................ = 319 U.S.Gallons
1 Metric Tonne ................ = 311 U.S.Gallons
1 U.S.Gallon..................... = 7.09 Pounds

LUB. OIL (RD 0.90)
1 Long Ton ........................ = 298 U.S.Gallons
1 Metric Tonne .................. = 294 U.S.Gallons
1 U.S.Gallon..................... = 7.51 Pounds

**ALTERNATIVE HYDROMETERS**

To correct to Apparent Density (density in air) from a hydrometer calibrated in:-

- True Density (density in vacuo) minus (-) 0.0011 g/ml
- Relative Density (15°C/4°C) minus (-) 0.0011
- Relative Density (15°C/15°C) minus (-) 0.002

Note: g/ml = kg/l = t/m³ Refer to pages 6, 33 and 36.
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DRAUGHT SURVEYING
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AND SHIP'S OFFICERS

This book contains the mathematical proofs and derivation of all the
formula likely to be required in any draught survey. It deals more
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The book ranges from the basic physics to the most complex corrections,
in simple language and with examples and illustrations, for easy
understanding. It is suitable for the new and the experienced
surveyor who seeks a mastery of the subject, or the Master Mariner
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with full tutorial guidance and support. The work is divided into
sections, each of which has examples to study and questions to
answer. Each section is completed with an exercise which is to be
returned to the tutor for assessment.

For further details contact:
MID-C Consultancy,
39, Cleadon Lea,
Cleadon,
Tyne&Wear. SR6 7TQ. UK.
Fax: +44 (0)191 536 0891
Email: peter@mid-c.demon.co.uk
# U.N. • ECE • DRAUGHT SURVEY CODE

## DRAUGHT SURVEY REPORT OF CARGO IN BULK

### Form "A"

<table>
<thead>
<tr>
<th>LOADED</th>
<th>UNLOADED</th>
</tr>
</thead>
</table>

**Corporate identification:**

**Office of the surveyor at:**

**Telephone no:**

**Fax no:**

**Telex no:**

**Vessel M/V:**

**Call letters:**

**Survey no:**

**Vessel previous name/s:**

**Registry:**

**Built year:**

**Flag:**

**Survey requested by:**

**On the account of:**

**Attended also by:**

- **as:** joint surveyor
- **as:** umpire
- **as:** monitoring

---

This is to certify that the undersigned did, in bona fide, attend on board the subject vessel as she lay afloat at the port of: ________________________ for the purpose of determining by draught computations the amount of ________________________ loaded, unloaded (holds no. ________________________) and having followed the rules as set by the U.N. / F.C.F. Uniform Code of Standards and Procedures for the Performance of Draught Surveys have the following to report:

### STARTING SURVEY

<table>
<thead>
<tr>
<th>Name of surveyor/s</th>
<th>Master</th>
<th>Chief Officer</th>
<th>Chief Engineer</th>
<th>Witness draughts</th>
<th>Witness tank sounding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attending the surveys</td>
<td>date:</td>
<td>hours: from:</td>
<td>to:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### FINISHING SURVEY

<table>
<thead>
<tr>
<th>Ship's location</th>
<th>Weather temperature</th>
<th>Sea condition</th>
<th>Heading of ship</th>
<th>Direction wind</th>
<th>Stream speed Km/h</th>
<th>Tide</th>
<th>Ice</th>
</tr>
</thead>
<tbody>
<tr>
<td>date:</td>
<td>hours: from:</td>
<td>to:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Cargo handling equipment T. brought on board:**

**Missing ship's equipment:**
U.N. • ECE • DRAUGHT SURVEY CODE

DRAUGHT SURVEY REPORT OF CARGO IN BULK

<table>
<thead>
<tr>
<th>LOADED</th>
<th>UNLOADED</th>
<th>FORM &quot;B&quot;</th>
</tr>
</thead>
</table>

Corporate identification:

Vessel MV: Survey no:

General remarks by the surveyor/s
- Correction for stem and stern obtained by: [ ] calculation [ ] tables
- Correction for trim (1) obtained by: [ ] calculation [ ] tables
- Correction for trim (2) obtained by: [ ] calculation [ ] tables
- Correction due to trim for liquid applied at: [ ] soundings [ ] volumes
- Correction due to trim for liquid obtained by: [ ] calculation [ ] tables

Ship's approved hydrostatic tables and lightship information issued by and dated:

Degree of tank calibration complies with code: [ ] Yes [ ] No

Range of trim correction tables available:

Shipyard no.: Hull no.: Dated at:

Surveyor remarks on ship's documents:

<table>
<thead>
<tr>
<th>Length overall</th>
<th>Length between p.p.</th>
<th>Extreme breadth</th>
<th>Moulded breadth</th>
<th>Depth overall incl. keel plate</th>
<th>Moulded depth</th>
<th>Summer draught</th>
<th>Summer freeboard</th>
</tr>
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<tbody>
<tr>
<td>metres</td>
<td>metres</td>
<td>metres</td>
<td>metres</td>
<td>metres</td>
<td>metres</td>
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<table>
<thead>
<tr>
<th>Constant declared</th>
<th>Constant calculated</th>
<th>Light displacement</th>
<th>Light shipweight (plan)</th>
<th>Summer displacement</th>
<th>Summer deadweight</th>
<th>Net register tons</th>
<th>Gross register Tons</th>
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<tbody>
<tr>
<td>metric tonnes</td>
<td>metric tonnes</td>
<td>metric tonnes</td>
<td>metric tonnes</td>
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<td>metric tonnes</td>
<td>metric tonnes</td>
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<table>
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<td>Longitudinal Centre of Flotation</td>
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<td>Distance marks forward pp. (forward - aft)</td>
<td></td>
</tr>
<tr>
<td>Distance marks after pp. (forward - aft)</td>
<td></td>
</tr>
<tr>
<td>Distance marks midship pp. (forward - aft)</td>
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<td>Moment to Trim One Centimetre +50</td>
<td></td>
</tr>
<tr>
<td>Moment to Trim One Centimetre -50</td>
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</tr>
<tr>
<td>Working order of gauges</td>
<td></td>
</tr>
<tr>
<td>Legibility of draught marks</td>
<td></td>
</tr>
</tbody>
</table>

This form should be filled with pertinent shipyard-registry data by the Master in advance of survey start to reduce time/inconvenience.
## DRAUGHT SURVEY REPORT OF CARGO IN BULK

### DRAUGHT STATEMENT

<table>
<thead>
<tr>
<th>DRAUGHT READINGS HOURS</th>
<th>STARTING SURVEY</th>
<th>FINISHING SURVEY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FROM:</td>
<td>TO:</td>
</tr>
<tr>
<td></td>
<td>metres</td>
<td>metres</td>
</tr>
<tr>
<td>Draft forward port</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draft forward starboard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draft forward mean</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stem correction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draft forward (corrected to fore .pp.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draft after port</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draft after starboard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draft after mean</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stem correction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draft after (corrected to after pp.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draft fore &amp; after mean</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draft midship port</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draft midship starboard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draft midship mean</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Midship correction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draft midship (corrected to midship pp.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sag (+) Hog (-)</td>
<td></td>
<td>Kg/m³</td>
</tr>
<tr>
<td>Mean of means</td>
<td></td>
<td>Kg/m³</td>
</tr>
<tr>
<td>Draft extreme corrected for hog/sag</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correction (+) for keel thickness if applicable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draft moulded corrected for hog/sag (Note: Utilize line 152 or line 154)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trim: fwd (-) aft (+)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

|                                                   | Kg/m³           | Kg/m³           |
| Observed density                                 |                 |                 |
| (Ship's tables density Kg/m³ )                   |                 |                 |
| (Hydrometer no. )                                 |                 |                 |

| Displacement (at Kg/m³ density)                   |                 |                 |
|                                                   | Metric tonnes   | Metric tonnes   |
|                                                   |                 |                 |
|                                                   |                 |                 |
|                                                   |                 |                 |
|                                                   |                 |                 |
|                                                   |                 |                 |

Draughts, densities, fresh water and ballast soundings witnessed and agreed to by the Chief Officer. Fuel oil soundings witnessed and agreed to by the Chief Engineer unless otherwise stated in form "A"
<table>
<thead>
<tr>
<th>Compartment Title:</th>
<th>Maximum height measured (*)</th>
<th>Sounding / ullage metres</th>
<th>Sounding corrected for trim / list metres</th>
<th>Volume corrected for trim / list m³</th>
<th>Density of water in air Kg/m³</th>
<th>Total weight Metric tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A - BALLAST</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Total A</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>B - FRESH WATER</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Total B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(*) Statement of obstructions in sounding tube/s:
# DRAUGHT SURVEY REPORT OF CARGO IN BULK

<table>
<thead>
<tr>
<th>Corporate identification:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vessel M.V.:</td>
<td>Survey no:</td>
</tr>
<tr>
<td>FINISHING SOUNCING:</td>
<td>From Hours:</td>
</tr>
<tr>
<td></td>
<td>To Hours:</td>
</tr>
<tr>
<td></td>
<td>Date:</td>
</tr>
<tr>
<td></td>
<td>Trim:</td>
</tr>
<tr>
<td>Compartment Title:</td>
<td>Maximum height measured (*)</td>
</tr>
<tr>
<td></td>
<td>metres</td>
</tr>
<tr>
<td></td>
<td>Sounding / ullage</td>
</tr>
<tr>
<td></td>
<td>metres</td>
</tr>
<tr>
<td></td>
<td>Sounding / ullage corrected for trim / list</td>
</tr>
<tr>
<td></td>
<td>metres</td>
</tr>
<tr>
<td></td>
<td>Volume corrected for trim / list</td>
</tr>
<tr>
<td></td>
<td>m3</td>
</tr>
<tr>
<td></td>
<td>Density of water in air</td>
</tr>
<tr>
<td></td>
<td>Kg/m3</td>
</tr>
<tr>
<td></td>
<td>Total weight Metric tonnes</td>
</tr>
</tbody>
</table>

## A - BALLAST

| Total A |  |

## B - FRESH WATER

| Total B |  |

(*) Statement of obstructions in sounding tubes:
**U.N. • ECE • DRAUGHT SURVEY CODE**

**DRAUGHT SURVEY REPORT OF CARGO IN BULK**

<table>
<thead>
<tr>
<th>LOADED</th>
<th>UNLOADED</th>
<th>FORM &quot;D3&quot;</th>
</tr>
</thead>
</table>

**Corporate identification:**

**Vessel M/V:**

**Survey no:**

**SOUNDINGS**

<table>
<thead>
<tr>
<th>Compartment</th>
<th>Total sounded</th>
<th>Ullage metres</th>
<th>Actual Density Kg/m³</th>
<th>Actual Volume m³</th>
<th>Weight Metric Tonnes</th>
<th>Sounding metres</th>
<th>Actual Density Kg/m³</th>
<th>Actual Volume m³</th>
<th>Weight Metric Tonnes</th>
</tr>
</thead>
</table>

**STARTING SURVEY**

**FINISHING SURVEY**

**C - FUEL OIL**

**D - DIESEL OIL**

**Total C**

**Total D**

**SUMMARY OF DEDUCTIBLES**

<table>
<thead>
<tr>
<th>STARTING SURVEY metric tonnes</th>
<th>FINISHING SURVEY metric tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ballast water</td>
<td></td>
</tr>
<tr>
<td>Fresh water</td>
<td></td>
</tr>
<tr>
<td>Fuel oil</td>
<td></td>
</tr>
<tr>
<td>Diesel oil</td>
<td></td>
</tr>
<tr>
<td>Slops</td>
<td></td>
</tr>
<tr>
<td>Lubricating oil</td>
<td></td>
</tr>
<tr>
<td>Swimming pool water</td>
<td></td>
</tr>
<tr>
<td>Anchor &amp; Chain</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
</tr>
<tr>
<td>Total Deductibles</td>
<td></td>
</tr>
</tbody>
</table>
U.N. • ECE • DRAUGHT SURVEY CODE

DRAUGHT SURVEY REPORT OF CARGO IN BULK

<table>
<thead>
<tr>
<th>LOADED</th>
<th>UNLOADED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FORM "E"

Corporate identification:

Vessel M/V: 

Survey no: 

CARGO STATEMENT

<table>
<thead>
<tr>
<th>Metric Tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting Displacement Corrected</td>
</tr>
<tr>
<td>Finishing Displacement Corrected</td>
</tr>
<tr>
<td>Difference in Displacement = TOTAL CARGO IN BULK IS:</td>
</tr>
</tbody>
</table>

OBSERVATIONS: Shore scale quantity (if available) M.T.

Note on any unusual situation/s, exception/s from required Uniform Code standard, specific identification (source, drawing no., date, title, certifying authority) of each ship's document used in translating recorded measurements into weights and, when applicable, reasons for surveyor's refusal or impossibility to perform the survey:

<table>
<thead>
<tr>
<th>Metric Tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected light displacement =</td>
</tr>
<tr>
<td>Deductables=</td>
</tr>
<tr>
<td>Lightship=</td>
</tr>
<tr>
<td>Constant=</td>
</tr>
<tr>
<td>Mean of previous constants=</td>
</tr>
</tbody>
</table>

I certify that the constant calculated from this draught survey has been entered into the ship's "Constant Certificate".

In my judgement the weather conditions, the sea conditions, and the conditions of the ship at the times the draught surveys were conducted, were within acceptable limits and did not adversely affect the accuracy of this survey. This Bona Fide report consisting of _______ pages, including this page, all duly initialled or signed is issued without prejudice and is for the benefit of whom it may concern.

Name of surveying firm (corporate identification)

By: ____________________________

(Signature of Surveyor/s)

Name/s in print: ____________________________

I have participated in all stages of this draught survey, and agree with the results obtained. I acknowledge receipt of the ship's copy.

Signed: ____________________________

Rank: ____________________________

Name in print: ____________________________