API Manual of Petroleum Measurement Standards
Chapter 17

Marine Measurement
Section 14 - Measurement of Non-Liquid Bulk Cargoes by Draft Survey

PART 2 - BARGES

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Measurement of Bulk Cargoes by Draft Survey
1. Scope
   This document describes the procedure for determining the transferred quantity of non-liquid petroleum products loaded onto or discharged from inland barges by draft survey. This procedure is not an alternative where effective static or dynamic liquid measurement methods can be used.

2. Normative References
   The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

   API MPMS Chapter 11—Physical Properties Data, Section 5—Density/Weight/Volume Intraconversion.
   API MPMS Chapter 17—Marine Measurement, Section 4—Method for Quantification of Small Volumes on Marine Vessels (OBQ/ROB)

3. Terms and Definitions
   
   **Aft:** Towards the stern (rear)
   
   **Aft draft:** The distance from the bottom of the keel to the waterline on aft draft marks.
   
   **Aft Void:** A space in the aft end of a barge, separated from the cargo hold.
   
   **Apparent Density:** Density in air (11.5)
   
   **Arithmetic mean draft (AMD):** The arithmetic mean of the forward draft and the aft draft will equal the draft midships if there is no hog or sag.
   
   **Average Waterline Length (AWL):** The arithmetic mean of the port side waterline length and starboard side waterline length.
   
   **Barge depth:** The distance from the bottom of a barge to the surface of the deck.
   
   **Barge Displacement Tons:** The underwater volume multiplied by the apparent density of the harbor water.
   
   **Box Barge:** A barge that is shaped like a box and that does not have a rake bow. The height of a box barge is approximately uniform forward, aft and midships.
   
   **Coaming:** The portion of the hopper extending above the deck.
   
   **Corrected Mean Draft:** The final draft calculated using the Quarter Mean method.
**Cover:** The sections which cover the hopper: one of three distinct types: steel lift, fiberglass lift, and rolltops. Lift covers should be lifted on and off the barge; rolltops roll on rails mounted on the coaming cap.

**Deadweight:** A measure of how much weight a ship or barge is carrying or can safely carry. It is the sum of the weights of cargo, fuel, fresh water, ballast water, provisions, passengers, and crew. It does not include the weight of the ship or barge.

**Deck:** The walking surface around the perimeter of a vessel.

**Deck break:** The point at which the foredeck rises.

**Density in air:** Apparent weight of a substance occupying unit volume.

**Depth:** The vertical dimension measured from the bottom of the hull to the deck.

**Displacement:** The occupation by a submerged body or part of a body of a volume that would otherwise be occupied by a fluid.

**Draft:** The depth of a vessel below the water line measured from the surface of the water to the bottom of the vessel’s keel. (17.2)

**Draft Marks:** The vertical column of numbers on each side of the vessel at each end and amidships to indicate the distance from the lower edge of each number to the bottom of the keel.

**Extreme Breadth:** The maximum breadth of the hull measured to the outside surfaces of the side shell plating or to be the outside of the guards, if fitted. (2)

**Extreme Draft:** The depth of the vessel below the waterline measured vertically from the waterline to the lowested projected portion of the vessel. (2)

**Forward:** Toward the bow (front).

**Forward draft:** The distance from the bottom of the keel to the waterline on the forward draft marks.

**Freeboard:** The vertical distance measured from the deck to the waterline. Freeboard is equal to the depth of the hull minus draft.

**Gunwale:** The intersection of the deck plating with the side shell plating and may be a tee connection or radius connection.

**Headlog:** The structural member at the extreme end between the rake shell plating and the deck.
**Heavy Survey:** The draft survey performed with all cargo on board.

**Hog:** Is the distortion of a ship’s form due to stresses in which the bow and stern drop below their normal positions relative to the midship portion of the vessel. (2.8)

**Hopper:** The cargo compartment.

**Length overall:** The longitudinal dimension in a horizontal plane measured from the foremost point of the headlog (bow) to the aftermost point of the stern (transom); the extreme length of the barge.

**List:** The leaning or inclination of a vessel, expressed in degrees to port or starboard away from the vertical.

**Manhole:** Holes in the deck provided for access into the void compartments.

**Mean of Means:** The arithmetic average of the forward and aft mean drafts.

**Midships:** The longitudinal position on a barge that is midway between the fore and aft draft marks.

**Port Side:** The left side, facing forward.

**Quarter Mean Draft (QTR):** The draft of record, determined for both light and heavy drafts.

**Rake:** It is the end portion of the hull that rises from the bottom at an inclination from the vertical to meet the deck at the headlog.

**Rake Barge:** A barge that has a rake at the forward end.

**Rake Tank:** A void space in the rake end of a barge, separated from the cargo holds.

**Sag:** Is the distortion of a vessel’s form because of stresses in which the midship portion of the vessel drops below its normal position relative to the bow and stern.

**Starboard Side:** The right side, facing forward.

**Stern:** Aft most part of the barge.

**TPI:** Represents short tons per inch of immersion. It is the weight that should be loaded or discharged to change the barge’s mean draft 1 inch.

**Transom:** The vertical aft end of a barge.

**Trim:** Is the difference between the draft forward and the draft aft.
Void Compartments: The non-cargo spaces between the outer hull and the hopper.

Waterline/Water line: The length of the line created by the surface of the flotation water from the point where it contacts the bow to the point where it contacts the stern of the vessel.

4. Significance and Use (Purpose)

The purpose of this section of the standard is to provide uniform draft survey methods to determine the weight of non-liquid petroleum products transferred to or from inland barges. By following the methods described in this standard, results are expected to be more consistent and reproducible.

The standard will address detailed procedures for taking the necessary measurements in the field, performing calculations and reporting the results.

5. Health and Safety Precautions

Personnel involved with the measuring and sampling of petroleum and petroleum-related substances should be familiar with their physical and chemical characteristics, including potential for fire, explosion, and reactivity, and with the appropriate emergency procedures as well as potential toxicity and health hazards. Personnel should comply with the individual company safe operating practices

6. Theory of Draft Surveys

Draft surveying is a commercially acceptable form of weighing that is based on Archimedes Principle. Archimedes Principle is a law of physics stating that the apparent upward force, or buoyancy, of a body immersed in a fluid is equal to the weight of the displaced fluid.

The weight of the barge is determined both before and after loading and allowances made for the difference in water. The difference between these two weights is the weight of the cargo.

7. General overview of the procedure

The draft of the barge, light and loaded, is measured and calculated using a standard procedure. The rake length, rake manhole depth, headlog height and other features of the barge are measured. Voids are gauged for the presence of water before and after cargo transfer. Flotation water is sampled and the apparent density is measured.

Weather, floatation water condition, the presence of hatch covers and other important data are collected and reported. The waterline length of rake barges is determined by standard equations using certain measurements. A standard calculation is then applied to determine the cubic feet of water displaced by the cargo (and any non-cargo components) on board the barge. By applying the measured apparent density, the weight of a cubic foot of the flotation water is calculated. As commercial weights are typically reported ‘in air’ rather than ‘in vacuum’ it is important that the hydrometer used is calibrated to read
apparent density. One such hydrometer in common use is the “Zeal Draft Survey Hydrometer”.

The weight of the water displaced, minus any adjustments for any non-cargo components, is equal to the weight of the cargo. All measurements, data and calculation results are recorded and reported in a standardized format.

8. Conditions of the Barge Survey

8.1 Precision versus Accuracy

Precision is the degree of repeatability of a process or measurement. Accuracy is how close a calculation is to a known and true value. By implementing an industry wide standard set of procedures and calculations a more precise system of draft surveying barges may be achieved.

8.2 Barge Location

The surveyor should ensure that the barge is free floating to be accurately surveyed. Barges are frequently fleeted on river banks. Lines securing the barges to shore or other barges in fleet may be tight which can affect the flotation of the barge.

8.3 Barge Types

The type of barge, box or rake, will affect some procedures being followed by the surveyor. While many barges are standard sizes, dimensions should not be assumed. Actual measurements should always be made and recorded.

Damage to the barge such as dents in the hull and/or gunwale distortion may affect the measurements. They should be recorded as observations.

Water in the barge due to leaks or rainwater in the hopper is always a factor which should be evaluated as part of the survey. Water in the voids should also be measured.

Note: It is not common practice to use ballast water in empty barges operating in the inland waterways but the voids should be checked.

8.4 Survey Conditions

Environmental conditions at the time of survey may impact the precision and safe completion of the survey and should be carefully evaluated. Water and weather conditions, current, tide, swell, foaming, wind, driftwood can all contribute to measurement problems. Debris jammed between the barge and dock and/or other barges can cause draft reading errors.

All conditions that affect the survey should be noted and recorded.

8.5 Unusual Conditions or Circumstances
Every survey is different and may present some unusual conditions or circumstances. The surveyor should keep detailed records and report any observations that could affect the precision of the survey results.

9. Procedure

9.1. The draft of the barge, light and loaded, is measured and calculated using a standard procedure and formula.

9.2. Rake length, rake manhole depth, headlog height and other features of the barge are measured.

9.3. Voids are gauged for the presence of water before and after cargo transfer.

9.4. Harbor water is sampled and the apparent density is measured.

9.5. Weather, harbor water condition, the presence of hatch covers and other important data are collected and reported.

9.6. Waterline length of rake barges is determined by standard equations using certain measurements outlined in this manual.

9.7. A standard calculation is applied to determine the cubic feet of water displaced by the cargo (and any non-cargo components) on board the barge.

9.8. By applying the measured apparent density, the weight of a cubic foot of the harbor water is calculated.

9.9. The weight of the water displaced, minus any adjustments for any non-cargo components, is equal to the weight of the cargo.

9.10. All measurements, data and calculation results are recorded and reported in a standardized format.

9.11. The standard provides a standard report format which should be used by the surveyor for reporting the measurements and calculations obtained as well as conditions present when the survey was performed. This allows all parties, initial, interim and receiving, to have the same and more complete data concerning weight determinations of the cargo. The standard reports should also be included or referenced in all subsequent communications relating to the survey.

9.12. The standard briefly outlines the issue of general conditions of the barge survey. The surveyor should consider and evaluate many conditions which will potentially impact his efforts to produce a more accurate survey.

10. Field Measurement Procedure

A rake barge is equipped with a defined bow and a box barge is shaped like a rectangular box with square vertical ends forward and aft.
As with all draft surveys the purpose is to calculate the quantity of water displaced by the barge. The difference between the before and after displacement quantity is equal to the cargo loaded or discharged. Displacement is volume of water displaced by the barge multiplied by the apparent density of the flotation water.

As in all displacement methods to determine the weight of cargo on board a barge, the surveyor will take observations and measurements in order to determine the draft and waterline length of the barge. A rake barge differs from a box barge in that it is equipped with a rake at the forward end. The rake causes the waterline length to vary depending on the draft of the barge. So in addition to recording the drafts the surveyor will need to make physical measurements of the rake.

10.1. Tools

10.1.2. Calibrated Marine (draft survey) hydrometer and cylinder/beaker.
10.1.3. Thermometer or portable electronic thermometer.
10.1.4. Paint or other waterproof marker to mark the deck.
10.1.5. Water sampler and rope.
10.1.6. Water finding paste.
10.1.7. Field notebook/tally book for recording measurements and observations.
10.1.8. Intrinsically safe Flashlight.
10.1.9. Rain gauge measuring in fractions of an inch.
10.1.10. Personal protective equipment.

10.2. Steps to a Rake Barge Draft Survey.

10.2.1. Opening Survey

10.2.1.1. Reading the drafts or freeboards
10.2.1.2. Obtaining the apparent density of the harbor water
10.2.1.3. Measuring the waterline length
10.2.1.4. Survey of void tanks
10.2.1.5. Calculations

10.2.2. Closing Survey

10.2.2.1. Reading the drafts or freeboards
10.2.2.2. Obtaining the apparent density of the harbor water
10.2.2.3. Measuring the waterline length
10.2.2.4. Survey of void tanks
10.2.2.5. Calculations
10.2.3. Reporting

10.3. Reading the Drafts

10.3.1. Read the drafts indicated by the permanent markings on the port and starboard sides of the barge, fore and aft, for the purpose of determining whether or not the barge is free floating. When draft readings indicate that one corner or one side of the barge is significantly higher, further checks should be made to ensure that the barge is not grounded. Grounded barges should be moved to a location where they float freely before continuing with the draft survey.

10.3.2. Drafts are indicated by the position of the waterline at the draft numbers or marks. Draft numbers are 6 inches in height and spaced 6 inches apart so a one foot increment is indicated when water is just touching the bottom edge of a number.

9 __ _6"……………………….9'00"
9 __ _6"……………………….9'00"
8 __ _6"……………………….8'00"
8 __ _6"……………………….8'00"
7 __ _6"……………………….7'00"
7 __ _6"……………………….7'00"

10.3.3. While reading permanent draft markings, the surveyor should visually check the barge exterior for signs of damage or distortion and findings should be recorded.

10.4. Draft Determination

10.4.1. For calculation purposes it is common practice to use the freeboard measurement instead of the draft reading.

10.4.2. Ensure the barge is floating. Freeboard readings should be taken from the deck fore and aft, port and starboard, and midships port and starboard. (6 freeboard readings are recorded). Freeboard measurements are subsequently converted to drafts.

10.4.3. To obtain the freeboards the surveyor should position himself on the deck in line with the draft markings on the hull. Make a waterproof mark at the upper strake and measure the freeboard by lowering the gauge tape with ‘T’ bar attached to the water line.

A calibrated T bar.
10.4.4. The measurement is to be made from the intersection of the two lines and should be marked with an arrow to show which side of the perpendicular line to measure from. The width of the lines will be controlled by making all measurements from the outboard edge of the waterproof (reference) line.

10.4.5. By marking the point where the freeboard was recorded ensures consistency so that succeeding freeboard can be taken from the exact same point.

10.4.6. Freeboards should be recorded:

<table>
<thead>
<tr>
<th></th>
<th>Port</th>
<th>Starboard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fwd (FP)</td>
<td>x’ xx”</td>
<td>Fwd (FS)</td>
</tr>
<tr>
<td>Mid (MP)</td>
<td>x’ xx”</td>
<td>Mid (MS)</td>
</tr>
<tr>
<td>Aft (AP)</td>
<td>x’ xx”</td>
<td>Aft (AS)</td>
</tr>
</tbody>
</table>

10.5. Harbor water density

10.5.1. The apparent density of the water in which a barge is afloat will change with both temperature and composition. The draft of a barge will change accordingly with changes in apparent density. The calibrated marine hydrometer measures the ‘density in air’.

10.5.2. From a position on the offshore side of the barge the surveyor should draw a sample of the harbor water

*Note:* For procedure in hydrometer utilization please refer to Annex C.
10.5.3. Read the apparent density of the water at the meniscus on the hydrometer stem.
10.5.4. Record the apparent density to 4 decimal places.

10.6. Measuring the Waterline Length

10.6.1. This varies on rake barges between light and heavy condition because of the incline of the rake. A series of measurements of the rake are taken to determine the waterline length by calculation.

10.6.2. The following measurements are required.
* Hull length
* Hull width
* Hull depth
** Head Log Height
** Head Log to End of Rake Shear
** Head Log to Aft Edge of Manhole
** Deck to Rake Bottom
** Distance aft marks to stern
** Distance from end deck shear to forward draft marks

* Usually provided by the barge company on their website.
** Physical measurement necessary

10.7. Measuring Cargo Hopper Coaming Opening

10.7.1. Measure width of forward and aft coamings and record in feet.
10.7.2. Measure length of side coaming and record in feet.

10.8. Survey of Void Tanks
10.8.1. The surveyor should open all void tanks. If water is sighted, a measurement should be taken using the gauge tape and water finding paste.

11. Calculations

11.1. Calculation in 3 steps:


11.1.2. Waterline length – equals the average waterline length (AWL) of the light and heavy surveys.

\[ AWL = \frac{(AWLL + AWLH)}{2} \]

Where AWLL = \((\text{Port waterline length light} + \text{Starboard waterline length light})/2\)

Where AWLH = \((\text{Port waterline length heavy} + \text{Starboard waterline length heavy})/2\)

11.1.3. Displacement – the displacement is equal to the volume of water multiplied by the apparent density of the harbor water which is equal to the weight of cargo loaded or discharged.

\[
\text{Water volume displaced by the cargo} = \text{mean waterline length} \times \text{barge beam} \times \text{change in draft}
\]

\[
\text{Change in draft} = \text{heavy corrected mean draft} - \text{light corrected mean draft}
\]

11.2. Weight Adjustments

11.2.1. Calculations of the weight of the cargo will be affected by changes in void tank water volume or presence of hatch covers. Hatch covers, on or off, need to be in the same condition for both initial and final surveys to avoid need for weight adjustment.

11.2.2. Every attempt should be made by the surveyor to correct any condition that will lead to the need for an adjustment to the calculated weight of the cargoes.

11.2.3. The weight of any cargo on board a barge before loading or after discharge will be reflected in the survey. However, the surveyor should report his estimate of the weight of any cargo left on board a barge after discharge, or found on board prior to loading, if having this remaining cargo aboard is an acceptable condition to the contracting parties. (A barge should always be cleaned prior to loading).

11.2.4. The surveyor shall attempt to estimate the weight of any uncorrected condition. The surveyor’s report shall specifically indicate the weight resulting from the condition and the basis for the estimation.

11.2.5. Rain during the loading of an open hopper barge, measure the rain fall from the rain gauge set prior to opening survey. Rainfall deduction to final cargo equals recorded rain fall \(\times\) hopper coaming width \(\times\) hopper coaming length \(\times\) 62.43 lbs./cu.ft.
12. Calculation Procedures

12.1. The Average Draft of a Barge by the Quarter Mean Method

12.1.1. The sum of the 2 forward drafts and the 2 aft drafts shall be divided by 4 to obtain the forward/aft mean draft (FAM)

\[(FP + FS + AP + AS) / 4 = FAM \] (mean of forward and aft drafts)

12.1.2. The sum of the 2 midships drafts shall be divided by 2 to obtain the midships mean draft (MSM)

\[(MP + MS) / 2 = MSM \] (mean of midships drafts)

12.1.3. The sum of the forward/aft mean draft and the midships mean draft shall be divided by 2 to obtain the mean of means draft (MOM)

\[(FAM + MSM) / 2 = MOM \] (mean of FAM & MSM)

12.1.4. The sum of the mean of means draft and the mean midships draft shall be divided by 2 to obtain the quarter means draft (QTR)

\[(MOM + MSM) / 2 = QTR \] (Quarter mean draft)

12.1.5. The quarter mean draft (QTR) is the draft of record and should be determined for both light and heavy drafts.

12.2. Mean Waterline Length

12.2.1. The calculation of displacement volume requires determination of the mean waterline length of the barge. Determination of the waterline length is described in section 10.6.

12.2.2. The sum of the port waterline length and the starboard waterline length is divided by 2 to obtain an average waterline length for the opening (light) survey. Average waterline length for the closing (heavy) survey is determined in the same manner. The sum of the two waterline lengths is divided by 2 to obtain the mean waterline length.

12.2.3. Calculation of the Mean Waterline Length (these measurements should be recorded in feet to 3 decimal places):
AWLL + AWLH/2 = MWL

Where:  AWLL average waterline length light = (port waterline length light + starboard waterline length light) /2

Where:  AWLH average waterline length heavy = (port waterline length heavy + starboard waterline length heavy) /2

12.3. Cubic Feet of Water Displaced by the Barge

12.3.1. The width of the barge (beam) multiplied by the mean waterline length multiplied by the change in quarter mean draft equals the number of cubic feet (volume) of water displaced by the cargo placed on or taken off the barge.

Calculation of Cubic Feet of Water Displaced

\[ W \times MWL \times \text{Change in draft} = \text{Ft}^3 \text{ of water displaced by cargo} \]

Where:  \( W = \) barge width (beam) (from owner's records or actual measurement)
Where:  \( MWL = \) mean waterline length
Where:  \( \text{Change in draft} = \) Heavy QTR – Light QTR (recorded in feet to 3 decimals)

The cubic feet (cf) of water displaced is then converted to actual weight in pounds based on measured apparent density of harbor water to determine the weights of the cargo.

12.4. Weight of the Cargo Transferred

12.4.1. Calculate the pounds-per cubic-foot of the water in which the barge is floating. The following values are assumed for the purposes of this calculation. Using a Density-in-Air Marine (draft survey) Hydrometer:

The weight of 1 cubic foot of pure water with an apparent density of 1.0000 = 62.43 pounds.

\[ 62.43 \times \text{measured apparent density} = \text{pounds/cubic foot of harbor water} \]

Example:

Measured apparent density from the hydrometer = 0.9988

\[ \text{Lb/Ft}^3 \text{ Pure water at 1.0000} = 62.43 \]
62.43 \times 0.9988 = 62.355 \text{ Lb/Ft}^3

**Using a Spec:**

62.30 \times 0.9988 = 62.225 \text{ Lb/Ft}^3

Multiply the calculated weight per cubic foot of harbor water by the cubic feet of water displaced by the cargo to obtain the weight of the cargo in pounds.

Examples using the illustration above:

62.355 \times \text{ cubic feet of water displaced } = \text{ pounds of cargo}

Make any necessary adjustments to the calculated weight by adding or subtracting the weight adjustments described in section 11.2. The result is the net weight of cargo transferred.

Divide the net weight of the cargo in pounds by 2,000 to obtain the net weight in short tons.

Report to 3 decimal places.

### 13.0 Barge Deadweight Table Procedure (alternative method)

As with all draft surveys, the purpose of the Barge Deadweight Table Method is to calculate the quantity of cargo loaded on or discharged from a barge. The difference between the initial and final deadweight quantity is equal to the cargo loaded or discharged. Deadweight is the cargo capacity of a vessel. This alternative method is for application when loading or discharging inland bulk barges with deadweight tables provided by the barge owners or operators.

Typical inland barge deadweight table tonnages are reported in Short Tons (ST) of 2,000 lbs. with an assumed harbor water density of 1.000.

### 13.1 Procedure

The draft of the barge, light and loaded, is measured and calculated using the standard procedure and formula as in

Harbor water is sampled and the apparent density is measured. 6.5.8

Voids (wing and rake tanks) are gauged for the presence of water before and after cargo transfer. 6.5.11

Weather, harbor water condition, the presence of hatch covers, and other important data are collected and reported.
The final deadweight less initial deadweight, minus any adjustments for any non-cargo components, is equal to the weight of the cargo.

All measurements, data and calculation results are recorded and reported in a standardized format.

The method provides a standard report format which should be used by the surveyor for reporting the measurements and calculations obtained as well as conditions present when the survey was performed. This allows all parties, initial, interim, and receiving, to have the same and more complete data concerning weight determinations of the cargo. The standard reports should also be included or referenced in all subsequent communications relating to the survey.

13.2 Calculating the Weight of the Cargo Transferred by Deadweight Table Method

The initial quarter mean draft (QTR) is multiplied by the observed harbor water density to obtain the apparent density corrected mean draft (CQTR).

The initial deadweight is calculated by interpolating the deadweight table tonnage between the drafts immediately above and below the CQTR.

The final deadweight is calculated utilizing the same method as listed above for the initial deadweight.

Tonnage loaded equals final deadweight minus initial deadweight.
Tonnage discharged equals initial deadweight minus final deadweight.

Cargo tonnage corrections are deducted from the final cargo tonnage.

14. Report Formats

The barge draft survey report should be completed as accurately and completely as possible. The complete report includes 2 pages. The following instructions are for specific elements on the report. These elements include general information, measurements, observations and calculations.

1. Company/person requesting survey, if different from ‘client’ above.
2. Account to be charged, if different from ‘client’ above
3. Date of the initial survey
4. Date of the final survey
5. Location of the barge, initial survey
6. Type: Box or Rake
7. Cargo: Customer’s description
8. Covers: Describe type
9. Depth of the barge in feet
10. Length of the barge in feet
11. Width of the barge in feet
12-13.  Forward, port, initial and final measurements of freeboards in inches and eighths
14-15.  Midships, port initial and final measurements of freeboards in inches and eighths
15-17.  Aft, port Initial and final measurements of freeboards in inches and eighths
18-19.  Forward starboard, initial and final measurements of freeboards in inches and eighths
20-2.1 Midships, starboard initial and final measurements in inches and eighths
22-23.  Aft, starboard initial and final measurements in inches and eighths
24-25.  Port waterline length in feet to 3 decimals *(not for Deadweight Table method)*
26-27.  Starboard waterline length in feet to 3 decimals *(not for Deadweight Table method)*
28.  Mean waterline length in feet to 3 decimals *(not for Deadweight Table method)*
29-30.  Water apparent density to 4 decimals
31.  Fore/aft mean draft light
32.  Midships mean draft light
33.  Mean of means draft light
34.  Fore/aft mean draft heavy
35.  Midships mean draft heavy
36.  Mean of means draft heavy
37.  Quarter mean draft light
38.  Quarter mean draft heavy
39.  Change in quarter mean draft
40.  Total cargo in short tons
41.  Total cargo in metric tons
42-53.  Initial ballast tank readings
54-65.  Final ballast tank readings
66-67.  Surveyors name or initials
68-69.  Location of the barge, final survey
70-71.  Is the barge in fleet or at dock?
72-73.  Does the barge appear to be free floating? (yes/no)
74-75.  Enter date and time of survey
76-77.  Any extreme river conditions at time of survey?
78-82.  Rake profile information
83-84.  Draft mark measurements
85.  Harbor Water Density Correction factor
86.  TPI value
87.  Light TPI
88.  Heavy TPI
89.  Average TPI
90.  Weight adjustments
91.  Weight adjustment calculations

15. Computer Calculation s
   a. Data Entry
   b. See attached spreadsheets in Annex B
Annex A

HULL LENGTH - Obtained from barge chart, can also be measured

HULL WIDTH - Obtained from barge chart, can also be measured

HULL DEPTH - Obtained from barge chart, also 1' more than highest draft mark

Dist. from aft readings to stern - (A)
(A) - Measure from center of aft draft mark to end of stern.

Dist. from end of deck shear to find mark - (B)
(B) - Measure from center of find draft mark to weld (Rise) of the rake.

Rake Headlog Height - (C)
(C) - Measure from forward point of barge down until curve of rake.

Distance from Headlog to end of rake shear - (D)
(D) - Measure from forward point of barge to weld (Rise) of the rake.

Distance from Headlog to aft edge of manhole - (E)
(E) - Measure from forward point of barge to the aft side of barge manway hatch.

Light measured freeboard at headlog - (F)
(F) - Measure from forward point of barge (top of head log) to water. (Before & After)

Deck to rake bottom at Aft Edge of manhole - (G)
(G) - Measure from the deck at the aft side of barge manway hatch to bottom of rake.

***Note*** on (G) The depth of rake is from the bottom of rake to the deck NOT the top of the manway hatch. (If raised above the deck)

*** Always round these measurements to a whole inch ***
Annex B (Informative) – Survey Templates

Barge Reports (Excel Spreadsheets)

- Insert *Barge Draft Survey Box Template.xls*
- Insert *Barge Draft Survey RakeTemplate.xls*
- Insert *Deadweight Table Template.xls*
Annex C (Informative) – Draft Survey Hydrometers

Draft survey hydrometers

These instruments are designed to measure the ‘apparent density of water’. For purposes of draft surveys:

Apparent density (weight in air per unit volume) (t/m³) x Volume (m³) = Weight (t).

Modern hydrometers of glass manufacture are calibrated at standard temperature, 15°C or 60°F, and measure the apparent density of the water sample in kilograms per liter in air. They are usually marked ‘for draft survey’ and ‘medium ST’ (medium surface tension) and graduated in the range 0.990 / 1.040 kg/l.

These instruments are used to determine the weight in air (apparent weight) of a vessel, from which the weight of the cargo on board may be calculated. When manufactured of glass and calibrated at standard temperature, a small error results if the hydrometer is not being used at the designed standard temperature. However, it is accepted that no temperature correction is necessary, as it is compensated at survey by the change in volume of the steel vessel itself. The corrections due to the ‘coefficients of cubical expansion’ of glass and steel are very approximately the same, thus they cancel out. Older types of hydrometer used for draft surveys and manufactured from brass, or some other metal, can still be found on some vessels. These instruments should be accompanied with a table of corrections and the relevant temperature correction should always be applied. It is recommended that the use of a glass hydrometer is always preferable. The fragile glass hydrometer should be kept clean and protected. Draft survey hydrometers should not be used for load line survey purposes.

The displacement and apparent weight of a vessel have a relationship, as do the relative and apparent densities of the water in which the vessel is floating. The difference between the relative density (specific gravity) as determined by the relative density hydrometer and apparent density as determined from a draft survey hydrometer, is known as the ‘air buoyancy correction’, and can be accepted, at standard temperatures 15°C/15°C or 60°F/60°F, as 0.002 for marine surveys.
All hydrometers should be calibrated regularly; typically every six to twelve months depending upon how often the hydrometer is in service.

Surveyors should only use a hydrometer manufactured for the relevant type of survey being undertaken.

**Bibliography**

- The Fertilizer Institute’s Inland Barge Survey Procedures Manual, Version 1.0, Fall 1997
- Draught Surveys A Guide to Good Practice, NEP&I, 1994
- Measurement of Bulk Cargoes, UK P&I Club, May 2008