ECONOMIC COMMISSION FOR EUROPE

COMMITTEE ON ENERGY

WORKING PARTY ON COAL

CODE OF UNIFORM STANDARDS AND PROCEDURES FOR THE PERFORMANCE OF DRAUGHT SURVEYS OF COAL CARGOES

GE.92-30190/4244B
PREFACE

Under the auspices of the ECE Working Party on Coal, this Code of Uniform Standards and Procedures for the Performance of Draught Surveys of Coal Cargoes has been elaborated by experts from major coal exporting and importing countries and was completed in October 1991.

The Code was adopted by the ECE Working Party on Coal at its session in October 1991 (ENERGY/WP.1/2, para. 42) and endorsed by the ECE Committee on Energy at its session in November 1991 (ECE/ENERGY/18, para. 23 (e)). The maintenance and application of the Code will be monitored by the ECE Meeting of Experts on Coal Trade, Statistics and Transport, in cooperation with other interested international organizations.

NOTE: Mention of any names of commercial firms in this document is only for reference to a process and does not imply endorsement by the United Nations.
BACKGROUND

Draught survey is one of the most common methods in use worldwide for determining the weight of seaborne bulk cargoes of low unit value, and the most common method for bulk coal cargoes transported by sea. In 1990, bulk cargoes transported by sea amounted to almost 1 billion tonnes, of which one third was accounted for by coal.

The accuracy of draught surveys may vary for several reasons. Discrepancies in draught survey results between the points of loading and unloading may give rise to commercial disputes between the sellers, vessel operators, buyers and surveyors, over which weight to accept as the basis for payment of the cargo, freight, port fees and other charges. With the volume and value of future seaborne coal trade expected to increase, shippers and receivers have become more and more concerned about discrepancies in draught survey results and consequently the need for a remedy arose.

The Working Party on Coal, a subsidiary body of the United Nations Economic Commission for Europe, agreed in 1989 to make proposals for an improvement of the situation. The use throughout the world of uniform standards and procedures for the performance of draught surveys was suggested for enhancing their accuracy. The resulting Code of Uniform Standards and Procedures for the Performance of Draught Surveys of Coal Cargoes represents a set of recommendations which may be applied in full or in part by parties in international coal trade who see fit to do so. Wide application of the Code is expected to benefit all the parties involved and to contribute to an improvement of international coal trade practices.
INTRODUCTION

For over a century, draught surveys have been accepted as an accurate and convenient means of establishing the weight of bulk cargoes. They have been the basis for the preparation of bills of lading and assessing various charges and port fees. The basic principle upon which the draught survey methodology is based is over 2,200 years old tracing back to Archimedes' law of buoyancy. The application of this law of physics to ships was further refined by formulas developed by European naval architects in the nineteenth century. While this principle is the basis for the work of draught surveyors throughout the world, the procedures by which they are applied vary considerably from country to country and even from port to port.

The purpose of this Code is to make these procedures reasonably uniform. It is further designed to provide a professional standard for the work of the draught surveyor. As the Code is also intended for the benefit of persons who may not have seafaring experience, certain aspects are explained in greater detail than might be considered necessary by master mariners. A glossary of terms has been added under Part 5. Additionally, this Code is intended to provide a source of information and serve as a reference book for those who make use of draught survey reports or equivalent weight certificates in the routine accomplishment of their commercial pursuits. It should be emphasized that in draught surveying there is no substitute for experience and that accuracy often depends on careful attention to details and proper and diligent handling of unusual circumstances which may arise from time to time. It is hoped that neophyte and practising draught surveyors along with all other persons who are involved with the commerce of bulk cargoes, will find this document to be of value.

It is anticipated that in the years to come methods will be refined and new equipment will be developed which will improve the draught survey methodology. Therefore it is intended to revise the Code from time to time so as to keep abreast of such advances. Following this trend, there is further a need for:

- including in a vessel's design special features and apparatus intended to facilitate and refine draught readings and tank soundings;
- improving the accuracy and standardizing the content and format of the ship's technical data especially in the area of tank calibration;
- providing each vessel with a "Data Manual for Draught Surveys" which is certified by the vessel's home administration or its classification society;
- improving surveyors' equipment and devising new equipment taking advantage of advances in technology;
- where necessary, providing a means for continuing education to improve the skills of draught surveyors;

- studying the content of and means for developing an international database on draught surveys which could be used to establish norms and identify specific problems which need to be addressed;

- promoting an international forum for periodic dialogue between all parties who have an interest in draught surveys.

Maybe this Code and its widespread use will lead to international cooperative programmes for improvements also in these areas.
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PART 1.

DRAUGHT SURVEY PROCEDURES
UN/ECE CODE OF UNIFORM STANDARDS AND PROCEDURES FOR
THE PERFORMANCE OF DRAUGHT SURVEYS OF COAL CARGOES

PART 1 - DRAUGHT SURVEY PROCEDURES

The following Code of procedures is recommended for calculating the
weight of dry cargoes at both loading and discharge ports.

Provided that approved suitable vessel information is available, that is
the vessel's draught survey manual issued upon request of the shipowners by
the classification societies, and also provided that the work is conducted by
qualified and experienced surveyors, the adoption of this code will ensure
that cargo weights will be consistently determined within an accuracy of 0.5%,
which has been accepted by bulk trades throughout the world. In fact, checks
conducted in various parts of the world, where the same vessel has been
surveyed by independent operators, indicate that an order of accuracy to
within 0.1% can be obtained under proper and favourable conditions.

For each draught survey the Surveyor must provide his client with a
draught survey report which is equivalent to a weight certificate. This
document should indicate the way in which the survey was conducted, the
calculations which were performed, and any other information pertinent to the
survey, including problems which may have been encountered. The UN/ECE
constitute the formats for such a report.

These forms serve the purpose of:

- achieving uniformity in the format and content of draught survey
  reports;

- facilitating the auditing of the reports;

- accommodating the range of instruments used for the preparation of
  reports which varies from pencils to computers;

- furnishing complete data which may be utilized in data bases useful to
  commercial and professional interests.

Section A of Part 1 provides an introduction to the draught survey
including some general principles.

Section B contains a line by line description of the proper utilization
of the Forms.

Section C summarizes some of the factors which can affect draught surveys.

Section D gives advice on improving the accuracy.
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<th>002</th>
<th>003</th>
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<td>005</td>
<td>Corporate identification:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>006</td>
<td>Office of the surveyor at:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>007</td>
<td>Telephone no:</td>
<td>Fax no:</td>
<td>Telex no:</td>
</tr>
<tr>
<td>008</td>
<td>Vessel M/V</td>
<td>Call letters:</td>
<td>Survey no:</td>
</tr>
<tr>
<td>010</td>
<td>Vessel previous names:</td>
<td></td>
<td>Registy:</td>
</tr>
<tr>
<td>012</td>
<td>Built year:</td>
<td>By:</td>
<td>Flag:</td>
</tr>
<tr>
<td>014</td>
<td>Survey requested by:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>016</td>
<td>On the account of:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>018</td>
<td>Attended also by:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>020</td>
<td></td>
<td>as:</td>
<td>joint surveyor</td>
</tr>
<tr>
<td>022</td>
<td>This is to certify that the undersigned did, in Bona Fide, attend on board the subject vessel as she lay afloat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>024</td>
<td>at the port of:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>025</td>
<td>for the purpose of determining by draught computations the</td>
<td></td>
<td></td>
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<tr>
<td>026</td>
<td>amount of</td>
<td></td>
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<tr>
<td>027</td>
<td>loaded, unloadeed (holds no.</td>
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</tr>
<tr>
<td>028</td>
<td>) and having followed the rules as set by the</td>
<td></td>
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<tr>
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<td>U.N. / ECE Code of Uniform Standards and Procedures for the Performance of Draught Surveys have the</td>
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<td>030</td>
<td>following to report:</td>
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<td></td>
</tr>
<tr>
<td>032</td>
<td>date:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>033</td>
<td>Name of surveyors/s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>034</td>
<td>Master</td>
<td></td>
<td></td>
</tr>
<tr>
<td>035</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>036</td>
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<td></td>
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</tr>
<tr>
<td>037</td>
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<td>052</td>
<td>Cargo handling equipment T. brought on board:</td>
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Ed. October 15, 1991 - 1.8 - Microsoft Excel 2.2
### DRAUGHT SURVEY REPORT OF CARGO IN BULK

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<td>Vessel M/V:</td>
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#### 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:

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<th>Shipyard no.:</th>
<th>Hull no.:</th>
<th>Dated at:</th>
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#### Surveyor remarks on ship's documents:

#### Metric Tonnage:

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<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>
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<tr>
<td>[ ] meters</td>
<td>[ ] meters</td>
<td>[ ] meters</td>
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<th>Constant declared</th>
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<th>Light shipweight (plan)</th>
<th>Summer displacement</th>
<th>Summer deadweight</th>
<th>Net register tons</th>
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<tr>
<td>[ ] metric tonnes</td>
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#### Starting Survey

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<th>Tonnes per Centimetre Immersion</th>
<th>Longitudinal Centre of Flotation</th>
<th>Distance marks forward pp. (forward - aft+)</th>
<th>Distance marks after pp. (forward - aft+)</th>
<th>Distance marks midship pp. (forward - aft+)</th>
<th>Moment to Trim One Centimetre +50</th>
<th>Moment to Trim One Centimetre -50</th>
<th>Vessel list</th>
<th>Accessibility of sounding pipes</th>
<th>Working order of gauges</th>
<th>Legibility of draught marks</th>
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</table>

#### Finishing Survey

| [ ]                             | [ ]                              | [ ]                                        | [ ]                                        | [ ]                                      | [ ]                              | [ ]                        | [ ]            | [ ]                            | [ ]                     | [ ]                      |

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

**Form "C"**

<table>
<thead>
<tr>
<th>Corporate Identification:</th>
<th>LOADED</th>
<th>UNLOADED</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vessel M/V:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Survey No:</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### DRAUGHT STATEMENT

#### DRAUGHT READINGS HOURS:

<table>
<thead>
<tr>
<th>Starting Survey</th>
<th>Finishing Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>From:</strong></td>
<td><strong>To:</strong></td>
</tr>
<tr>
<td><strong>Draught forward port</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Draught forward starboard</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Draught forward mean</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Stem correction</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Draught forward (corrected to fore pp.)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Draught after port</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Draught after starboard</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Draught after mean</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Stem correction</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Draught after (corrected to after pp.)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Draught fore &amp; after mean</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Draught midship port</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Draught midship starboard</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Draught midship mean</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Midship correction</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Draught midship (corrected to midship pp.)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Sag (+) Hog (-)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Mean of means</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Correction (-) for keel thickness if applicable</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Draft moulded corrected for hog/sag</strong></td>
<td></td>
</tr>
<tr>
<td><strong>(Note: Utilize line 152 or line 154)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Trim:</strong></td>
<td><strong>fwd (-)</strong> <strong>aft (+)</strong></td>
</tr>
<tr>
<td><strong>Observed density</strong></td>
<td><strong>Kg/m3</strong></td>
</tr>
<tr>
<td><strong>(Ship's tables density Kg/m3) (Hydrometer no.)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Displacement (at Kg/m3 density)</strong></td>
<td><strong>Metric tonnes</strong></td>
</tr>
<tr>
<td><strong>First trim correction</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Second trim correction</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Total trim correction</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Displacement corrected for trim</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Correction for density average</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Displacement corrected for density</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Total deductibles</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Displacement corrected for deductibles</strong></td>
<td></td>
</tr>
</tbody>
</table>

---

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"
**DRAUGHT SURVEY REPORT OF CARGO IN BULK**

<table>
<thead>
<tr>
<th>Vessel M/V:</th>
<th>Survey no:</th>
</tr>
</thead>
</table>

### STARTING SOUNCING:

<table>
<thead>
<tr>
<th>From Hours</th>
<th>To Hours</th>
<th>Date</th>
<th>Trim</th>
</tr>
</thead>
</table>

### Compartment Title:

<table>
<thead>
<tr>
<th>Tank no.</th>
<th>Blgges</th>
<th>Duct keel</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Maximum height measured (*)</th>
<th>Sounding / ullage</th>
<th>Sounding / ullage corrected for trim / list</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>meters</td>
<td>meters</td>
<td>meters</td>
<td>m³</td>
<td>Kg/m³</td>
<td>tonnes</td>
</tr>
</tbody>
</table>

### A - BALLAST

### B - FRESH WATER

<table>
<thead>
<tr>
<th>Total A</th>
<th>Total B</th>
</tr>
</thead>
</table>

(*) Statement of obstructions in sounding tubes:
<table>
<thead>
<tr>
<th>Compartment Title</th>
<th>Maximum Height</th>
<th>Sounding / Ullage</th>
<th>Sounding Corrected for Trim / List</th>
<th>Volume Corrected for Trim / List</th>
<th>Density of Water in Air</th>
<th>Total Weight</th>
<th>Total Tonnage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tank no.</td>
<td>measured (*)</td>
<td>meters</td>
<td>meters</td>
<td>meters</td>
<td>meters</td>
<td>metric</td>
<td>metric</td>
</tr>
<tr>
<td>Bilges</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duct keel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### A - BALLAST

### B - FRESH WATER

Total A

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>Corporate identification:</th>
<th>LOADED</th>
<th>UNLOADED</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Vessel MV:</th>
<th>Survey no:</th>
</tr>
</thead>
</table>

#### SOUNDINGS

### STARTING SURVEY

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

#### COMPARTMENT C - FUEL OIL

#### COMPARTMENT D - DIESEL OIL

#### TOTAL C

#### TOTAL D

#### SUMMARY OF DEDUCTIBLES

<table>
<thead>
<tr>
<th>STARTING SURVEY</th>
<th>FINISHING SURVEY</th>
</tr>
</thead>
<tbody>
<tr>
<td>metric tonnes</td>
<td>metric tonnes</td>
</tr>
</tbody>
</table>

- Ballast water
- Fresh water
- Fuel oil
- Diesel oil
- Slops
- Lubricating oil
- Swimming pool water
- Anchor & Chain
- Others

<table>
<thead>
<tr>
<th>Total Deductibles</th>
<th>Total Deductibles</th>
</tr>
</thead>
</table>

---

Ed. October 15, 1991 - 1.8 - Microsoft Excel 2.2
**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;E&quot;</th>
</tr>
</thead>
</table>

**Corporate Identification:**

**Vessel M/V:**

**Survey no:**

### Cargo Statement

<table>
<thead>
<tr>
<th>Metric Tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

**Starting Displacement Corrected:**

**Finishing Displacement Corrected:**

**Difference in Displacement = TOTAL CARGO IN BULK IS:**

**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></td>
</tr>
</tbody>
</table>

**Corrected light displacement =**

<table>
<thead>
<tr>
<th>Deductables=</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

| Lightship= |
|           |

| Constant= |
|          |

| Mean of previous constants= |
|                            |

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 initialed 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: ____________________
PART 1
SECTION A
INTRODUCTION TO DRAUGHT SURVEY AND GENERAL PRINCIPLES

What is a draught survey?

A draught survey is a method of cargo weight determination by ship's displacement calculations, empty and loaded (or loaded and empty), taking into account any change in weight of the liquids on board. The accuracy of the draught survey will be dependent upon the experience and the care taken by the surveyor concerned, on the documentation of the vessel, on the spirit of co-operation of the vessel crews and of the shore terminal personnel and, last but not least, on the instruments used by the draught surveyor and the weather and sea conditions in the harbour.

In the following sections details will be given regarding the procedures to be followed for the draught survey but before going any further, it is necessary to explain the following basic principles:

1. The Principle of Archimedes

Referring to the "Principle of Archimedes", i.e. a vessel when freely floating in water, will displace a weight of water equal to its own weight, it is obvious that the weight of the displaced volume of water will not only be the weight of the cargo on board (loaded or unloaded). This weight will also include:

- the weight of the vessel in light condition, i.e. including all the equipment required for sailing; and the provisions;
- the residual weight (borne by trade patterns and changing from time to time);
- all deductible liquids on board;
- ballast: required for stability reasons;
- fresh water: drinking water and cooling water;
- bunkers: fuel, diesel and lubricating oil;
- constant: see definition in the glossary.

2. Variation of displacement of a loaded ship

It also follows from the "Principle of Archimedes" that:

(a) If a weight of cargo, say 80,000 tonnes, is loaded on (or unloaded from) a vessel floating freely in water of any measured density, then the vessel will sink (or float) into the water until the total weight of water
displaced is equal to the original weight of the vessel plus (or minus) the
80,000 tonnes of cargo which has been loaded (unloaded) and plus (or minus)
density variation of the water intervened between the starting survey (first
measurement) and the finishing survey (second measurement).

(b) If a vessel of fixed weight floating freely in water of low density,
for example dock water of apparent density 1,000, is moved into water of
higher density, for example sea water of apparent density 1,025, then the
vessel will rise slightly in the water because of the smaller volume needed
for the same weight of the water displaced.

3. "Empty" ships are actually partly loaded with ballast

In the draught survey daily practice one of the complicating elements is
due to the fact that "empty" ships (that is before loading or after unloading)
are in actuality always loaded with ballast water which makes the calculation
of the cargo loaded or unloaded more difficult. The ballast water, that is
pumped outboard during loading of cargo, and inboard during unloading,
moreover, tends to hide sediments that can be assumed or misidentified with
the cargo.

When sailing without cargo a vessel has to be ballasted to be at
sufficient draught for manoeuvrability and the submerging of its propeller.
After arrival at the loading berth, the starting survey is usually carried out
when the vessel is still ballasted. Consequently, in order to be able to
calculate "the light ship weight", it is most important to determine a
reliable ballast quantity. This quantity is, together with fresh water, fuel
oils, etc., deducted from the vessel's gross weight. After completion of
loading, again ballast tanks are sounded to determine possible residuals. It
is commonly accepted that ballast water has the greatest influence on the
final tolerance in the out-turn figure. Consequently it must be emphasized
that greatest care should be taken during all measurements and observations
regarding the ballast. It is not unlikely that in a near future "inbuilt new
instruments" of the ship will permit to measure with high accuracy the mass of
liquid present at any given time in each tank/compartment of the vessels.

4. Relevance of draught surveys

Throughout the world, millions of tonnes of raw and processed materials
are bought and sold every day. If any of those materials are carried by ship,
it is possible that the weight of the consignment will be measured by a
draught survey. This code of standards and procedures has been compiled as an
aid to the parties involved. Virtually all draught surveyors have a
qualification as Master or comparable professional skill. For other persons
who may use this code, definitions of technical expressions used are shown
in part 4.

The following procedures were compiled taking into account the existing
bibliography and references.
5. Loading of multiple cargoes

It is frequently the case that two or more separate cargo lots are loaded into a vessel, either during a more or less continuous operation at the same port, or sequentially at separate ports. The latter situation may arise due to draught restrictions at the first port, resulting in the need for the vessel to "top-up" at a second port or vice versa at the unloading port(s).

Where two or more cargoes can be loaded or unloaded separately and fully, it is preferable that an initial draught survey be conducted, followed by intermediate surveys to calculate the weight of the first and subsequent cargoes loaded or unloaded. On completion of loading or unloading, a final survey should be conducted to determine both the total weight and the weight of the final cargo.

In cases where loading or unloading is conducted sequentially at separate ports, it is recommended that both a starting and a finishing survey be conducted at each port. In this case, the starting survey should verify the weight already or still on board and should also recalculate the "constant" or undefined weight of the vessel.

In cases where multiple cargoes cannot be loaded or unloaded separately, or where several loading heads or unloading grabs are employed simultaneously, it is recommended that only the starting and finishing surveys be conducted. The apportionment of the weights of each of the cargoes should then be made by comparing surveyed weight with belt weightometer or shore weight to achieve a factor which is applied to each cargo, as follows:

Surveyed weight = factor (f)

Shore weight

Weight of Cargo A = shore weight x (f)
Weight of Cargo B = shore weight x (f)

It is considered that the adoption of this methodology for multiple cargoes will result in an order of accuracy within 0.5%, which is accepted for bulk cargoes throughout the world. However, where two or more loading heads or unloading grabs are employed simultaneously, it is important that the relative errors between individual belt weightometers be checked and recorded frequently. While absolute accuracy is not required, it is important that the weightometers be in harmony with one another, to avoid incorrect apportionment of cargo weights delivered by each loading head. Missing the shore reference the draught surveyor should assume written instructions on the criteria to be used (for instance stowage factor of goods, rail car, etc.).

6. Requirement for draught surveys during loading or unloading

It is recommended that draught surveys should always be conducted prior to and on completion of loading or unloading. Where loading or unloading takes place sequentially at several ports, the decision as to whether or not to conduct a pre-loading survey at the second or subsequent ports should be at the discretion of the shipper. In the majority of loading and unloading
ports, the final draught survey certificate forms the basis on which harbour rates, loading, stevedoring and other service charges are levied, as well as completion of the Bill of Lading for the vessel. It is therefore in the interests of both the Shipper or Receiver and the Vessel Agent to ensure that a satisfactory draught survey has been completed. Payment for draught surveys on loading normally is the responsibility of the shipper and on unloading of the receiver. In practice these charges are normally incorporated into the cargo superintending fees. In cases of dispute between the shipper and the ship's master over any draught survey, the master retains the right to arrange for a second, independent survey to be conducted but, in such cases, the cost of the second survey should be borne by the vessel operator.

7. Monitoring of discrepancies and trends

Particularly for comparison of load port and discharge port draught surveys it is essential to consider the eventual superficial moisture drainage occurred during the transit time.

As per world practice, moisture determination takes place on all minerals before loading and after unloading. the difference between the two figures can only be with a negative sign at disport. If and when data are otherwise, this vital element cannot be utilized and comparability becomes less reliable. When all factors and actors work properly this moisture difference should be equal to "bilge drainage" plus evaporation less sprinkled water on the load/unload belts for dust controlling apparatus.

It is strongly recommended that arrangements be made between shippers and consignees, whereby copies of Moisture Certificates and Draught Survey Certificates at the loading and out-turn ports are exchanged for each cargo. Where such arrangements have been entered into, the shipper should provide the consignee with the following information by telex, facsimile or other method which will ensure that the information is available prior to discharge:

- copy of Moisture Certificate(s) at loading port or ports;
- copies of Certificates of Draught Survey(s) conducted at the loading port or ports;
- notes provided by the surveyor in relation to sea and weather conditions at the time of loading, together with any comments on deficiencies found with the vessel or its equipment or difficulties encountered in the use of the ship's tables.

It is important that the consignee or surveyor at the disport also be provided with a record, certified by the master or a ship's officer of any tonnages pumped overboard from bilges during the voyage as a loss in cargo weight may occur through drainage and/or evaporation particularly on a long voyage involving significant climatic changes.
It can be pointed out that for instance most of the minerals and the coals shipped in bulk, drain moisture during the transit time and/or can be subject to be wetted by snow or rain or water (shore or vessel's dust control installation) or to evaporate during loading and unloading operations. Statistical data collected over decades show that depending upon the cargo size the quantities involved by the above phenomena can be significant. Water drainage tends to be directly proportional to the level of superficial moisture at the loading point and to the length of the trip. Data indicate that in case of high departure level of superficial moisture (like 10% or more) and long sailing distance (like 40 days or more), involving significant climatic changes during the voyage, the drainage can be in the order of 1% of the cargo weight measured on departure.

On lower superficial moisture level on departure (like 6% or 7%) and shorter sailing distance (like 15-20 days) with similar climatic conditions from loading to discharge the drainage of superficial moisture stays generally within 0.5% limit or less.

In relation to the out-turn survey, this information should also be provided by the consignee to the shipper, so that trends between loading and discharge ports can be monitored and statistical information collected in an organized fashion. The systematic exchange of surveys made in different parts of the world would be equally important. This would allow the dissemination of truly uniform practice, make possible the study of trends, and identify possible anomaly by a given vessel. Such professional tool could be served properly and profitably by a specialized trade publication and possibly be supported by an internationally accessible library where all surveyed vessel data could be classified.

8. Controls before draught survey starts and time allocation

The following operations should be routine for the performance of draught survey either at loading or unloading port(s); a check should be made of any equipment malfunctions, including blockages in sounding pipes, etc., which could affect the accuracy of the survey.

At most loading and discharge ports, there is pressure to commence operations as soon as possible after the vessel has berthed. Despite this pressure, sufficient time must be allowed for the surveyor to gain the necessary data before loading or unloading is commenced.
PART 1

SECTION B

UTILIZATION OF THE UN/ECE DRAUGHT SURVEY CODE

FORMS "A" THROUGH "E"

1. **Format and procedure**

   In order to establish a uniform procedure to be followed between loading and out-turn surveys, the coded format, together with the accompanying explanation given in this document, should be followed. It is understood that slight alterations or additions may be necessary to form "A" lines 001 to 010 due to specific requirements of the principals involved. It should be evident that if cargo is measured at both loading and discharging ports, it is of the utmost importance that the draught survey at each port should be carried out by uniform procedures utilizing the same report format. For multiport loading or discharge the performance of the draught survey by the same individuals will improve the reliability of the final certificates.

2. **Vessel acceptance**

   The vessel presented for survey should meet the following:

   1. Vessel should be in general good condition and fully afloat.

   2. Vessel should present to the surveyor documents as prescribed in the section on documents.

   3. The ship should have a zero list but, in any case, the list must not exceed 1/2 degree.

   4. The ship should have negligible trim but, in any case, the trim must not exceed the range of the trim corrections furnished with the ship's tank sounding tables.

   5. As many ballast tanks as possible should be either empty or pressed up. This is an ideal situation only when the vessel has a negligible trim, and a sufficiently tall tank sounding pipe such that when the tank is fully pressed up, a proper sounding can be taken to verify this "full" state. Whenever the vessel has a trim, or whenever "voids" of air are suspected to be present in a ballast tank, then the most accurate method of obtaining the true weight of the ballast water onboard is for the sounding caps to be left off all top-side (or under-deck) tanks. In this way an actual sounding can be obtained, and an accurate volume of ballast water obtained from the tank calibration tables. If the sounding caps were screwed tightly down, and the tanks pressed up by overflowing the ballast through the tank ventilators, the ship's staff may be sure the tank is full, but in the absence of a sounding they cannot prove it, and even so, voids of air may still be present.
6. Free ballast in cargo holds should not be present, however, the amount of such ballast must be precisely determined or eliminated before the survey can start.

7. All draught marks, deckline marks and Plimsoll marks should be permanently indicated by raised figures or figures outlined with a weld bead and shall be clearly legible. While the draught readings are being made, there should be no transfer of liquids or movement of heavy equipment which could alter the list or the trim.

8. It should be reported to the surveyor, and he should be alert for, any addition or removal of weight, other than the cargo, which occurs while the survey is in progress. Every effort should be made to delay the requirement for such weight changes until after the survey observations have been completed.

9. Further to item (8) above, it is imperative that no cargo shall be loaded or discharged before the surveyor has completed his initial observations, readings and measurements, and given his express consent for cargo operations to commence.

10. All sounding pipes must be accessible, unobstructed, and capable of serving their intended purpose. All gauges, furnished in lieu of sounding pipes, shall be in proper working order.

3. **Accuracy**

   For the purpose of uniformity, all draughts, soundings and other figures shown in the survey, shall be in the order of **two (2) decimals** as, considering all factors inherent in draught surveys, anything further is considered superfluous. For sea water density, **four (4) decimals** must be used.

4. **Instructions for completing forms "A" through "E" of the UN/ECE Draught Survey Code**

   The identification numbers stated in the following instructions refer to the Line Numbers on the left hand border of the sample Forms "A" through "E" of the UN/ECE Draught Survey Code, Edition October 1991 - 1.8, with cross-references to line numbers of other Forms.

   FORM "A" (Preface page)

   The information presented on this page is meant to encompass the general information pertinent to any cargo weight determination derived from draught survey. There may be additional data related to specific cases. These can be included as detailed in the commentary of each line:

   001 - Indicate if draught survey report refers to loaded or unloaded cargo. In case of need a rubber stamp can be added for such other qualifications of the report such as "Certificate of weight", etc.
In these two lines the identification of the corporation or the private professional need to be provided.

These two lines are filled with specific indications of branch and/or port offices for larger corporations.

In these two lines details of telephone no., fax no. and telex no. need to be provided.

These lines are provided for indicating in sequence the vessel's name (in case the vessel should change name while loading or unloading only the last name will be indicated); the call letters which are the letters used to communicate with the vessel; and the survey serial no.; the latter number needs to be the same as eventually listed in the surveyor's log book.

In sequence it is required to indicate in these lines possible previous names of the vessel and the actual classification registry, and registry number.

These lines are provided for identification of the year of construction of the ship, the shipyard (with hull no.), and the actual flag of the vessel.

In sequence these lines need to be filled with the identification of the corporation requesting the survey; the corporation on whose account the survey is being conducted and, if applicable, the identification of persons, other than the surveyor and of the ship crews, attending the survey. Such attendance of outside entities generally falls in three classes: as joint surveyors, as umpire or just to monitor (generally on behalf of either sellers or buyers).

The blank space needs to be filled with the indication of the port.

The blank space needs to be filled with the indication of the type of cargo being loaded or unloaded. It must be clarified that by including such an indication in the survey the surveyor does not undertake any liability on the type and/or quality of the cargo being loaded or unloaded.

In the blank space the surveyor should identify the hold's number in which cargo was loaded or unloaded. In case of holds loaded only in part such detail can be listed in the footnotes or in an annex of the survey report.

The first line will serve to indicate the date of the starting and the date of the finishing surveys. The second line will be used to indicate the number of hours used to make the surveys.
Identify the name (or the names) of the surveyors performing the starting and the finishing survey.

Identify the Master. It is not unusual that the Master of the finishing survey may be different than the Master of the starting survey.

These lines will serve to identify the Chief Officer and the Chief Engineer. Not infrequently the names will be different from starting to finishing survey.

In these four lines should be identified respectively the names and the ranks of the witness of the draught readings and of the tank soundings. Not infrequently the names in these lines will be the same as the Chief Officer (who generally assists in the draught readings) and of the Chief Engineer (who generally assists in the tank soundings).

In this line should be identified the terminal, pier, or berth where the vessel was located at the time of the starting and finishing surveys.

These lines are provided for recording the weather temperature in centigrade and the sea conditions.

Indicate the heading of the ship.

Indicate the direction of the wind.

Indicate the speed of the stream in Km/h only in ports where such element is of relevance.

Indicate status of the tide at the time when the starting and finishing surveys were conducted.

Indicate such information on ice only when applicable.

Cargo handling equipment brought temporarily on board should be described in these lines and tare weight of it properly identified.

Normally in these lines is identified the weight of the anchor and of the chain and/or other temporarily missing ship's equipment.

FORM "B"

Specify in the appropriate box if the survey relates to the cargo loaded or unloaded.

In these two lines the identification of the corporation or the private professional need to be provided.
Identify the vessel name and the serial number of the survey.

Tick the appropriate box to record the criteria for calculating the corrections.

Identify the ship's approved hydrostatic data. In this connection it needs to be stressed that the range of hydrostatic data shall be from light ship draught to the deepest draught permitted by the Load Line assignment.

Tick the appropriate box regarding the degree of tank calibration.

Enter the range of "tables for correcting tank calibrations for trim" available. In case trim should exceed the range of tables, the surveyor will stop his activity until such time when the ship will be trimmed again within the range of the approved tables.

Enter in sequence the shipyard no., the hull no. and the place and date of the document from which the information was obtained.

Any discrepancy which would be obvious to a qualified surveyor should be summarized in these two lines. In case space should not be sufficient, an extra page can be added to explain more in detail the problems faced.

Ship's particulars in these lines can be filled in by the Master in advance of survey start in order to reduce the time of the preliminary formalities. Naturally the surveyor can ask to verify the relevant figures from the original approved documents.

**Calculation of Constant**

At the termination of the survey which takes place when the cargo is not on board, i.e. either before it has been loaded or after it has been discharged, the following calculation shall be made for comparison with the previous history of the ship:

\[
\text{Constant} = \frac{\text{Corrected Displacement} \text{ (Unloaded)}}{\text{Light ship Weight listed in approved Trim & Stability Booklet}}
\]

(line 090) = (line 170) - (line 092)

This undefined weight should not be accepted as a "constant" for the vessel, but should be recalculated at each draught survey and should be recorded on a light ship correction certificate which should be maintained on board the ship, recording the following information:
"Constant" Certificate

<table>
<thead>
<tr>
<th>DATE</th>
<th>PLACE</th>
<th>CONSTANT OR CORRECTION TO LIGHT SHIP WEIGHT</th>
<th>SIGNATURES</th>
<th>CHIEF OFFICER</th>
<th>SURVEYOR IDENTIFICATION OR STAMP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

so that large discrepancies could be noted for future reference.

098 - The surveyor should enter this set of vessel particulars in connection with starting and finishing survey.

106 - Depending upon the conditions found, enter on each of these lines the term "Satisfactory" or "See Form E". When the latter designation is used, the discrepancy in the referenced item should be briefly described in the blank space on Form E or on additional, attached sheets.

110 - Space available to list additional pertinent details and/or short remarks on previous lines.

FORM "C"

117 - Specify in the appropriate box if the survey relates to the cargo loaded or unloaded.

120 - In these two lines the identification of the corporation or the private professional need to be provided.

122 - Identify the vessel name and the serial no. of the survey.

126 - Enter starting and finishing hour of draught reading operations for starting survey and for finishing survey. Indicate hours from 00 to 24 and minutes from 00 to 60.
Reading the draughts

129 - The draughts shall be read at the forward and after marks and at midships, port and starboard, and recorded immediately before cargo loading/discharging operations commence and, again, immediately after cargo loading/discharging operations are completed.

145 All draught readings shall be witnessed and agreed to by a licensed deck officer (complete line 39 on Form "A"). If the readings cannot be properly observed from the pier or from a ladder over the side, the readings over the side shall be made from a small boat manoeuvred to the proximity of the marks. If turbulent conditions of the water surface prevent accurate readings and when local conditions will allow, a draft reading tube which dampens out the surface oscillations shall be employed. At exposed ports, the use of a boat may be impractical or even dangerous. In such situations a suitable alternative is to read the nearside draught marks and to employ a manometer to determine the offside draughts, by calculating proportionally the effect of vessel heel. The use of a manometer can also enable calculations of heel when the vessel is subject to rolling as a result of sea conditions.

Irrespective of the availability of the midship draught marks, the midship draughts, port and starboard, should be determined by measuring the freeboards from the deck line to the waterline.

To obtain an accurate depth of the ship, add the Summer freeboard, listed on the ship's Load Line Certificate, to the Summer Draught. It needs to be noted that the Load Line Certificate should always be sighted as this is the legal source for this information (not the Plimsoll mark on the side of the vessel). From this depth, subtract the port and starboard freeboards, thus obtaining midship draughts.

131 - The mean draught at the mark is the numerical average of the readings observed on the port and starboard sides.

Correction of Draughts from Marks to Perpendiculars

133 - The draught readings at the marks must be corrected to the equivalent readings which would obtain at the Forward and After Perpendiculars as specified by the following formula:

\[ \text{Draught at Perpendicular} = \text{Draught at Mark} + \text{Corr.} \]

\[ \text{Corr.} = \pm \left( \frac{T}{D_1} \times D_2 \right) \]

where: \(T\) = Trim between draught marks

\(D_1\) = Distance between draught marks

\(D_2\) = Distance from draught mark to perpendicular
The sign of the Corr. to PP depends on the observation of the slope of the waterplane between the location of the mark with respect to the location of the perpendicular.

143 - The Draught forward and after mean is the numerical average of the draughts at the Forward Perpendicular (line 134) and at the After Perpendicular (line 141).

147 - The Draught midship mean is the numerical average of the draughts read port and starboard at midships (lines 145 and 146).

148 - If the midships marks are not located at a position half way between the Forward and After Perpendiculars, the mean reading at the marks (line 147) must be corrected to this midpoint location by the following formula:

\[
\text{Draught at Midships} = \text{Draught at Midship Mark to Midships} + \text{Corr.}
\]

\[
\text{Corr. to Midships} = \pm \frac{T}{D_1} \times ML
\]

Where:  
\( T \) = Trim between draught marks 
\( D_1 \) = Distance between draught marks 
\( ML \) = Distance from midship draught mark to the vertical at the half-length between the forward and after perpendiculars

The sign of the Corr. to Midship depends on the observation of the slope of the waterplane between the location of the mark with respect to the location of the midships.

**Calculation of Hog or Sag**

150 - Deflection of the hull, i.e. deformation of the bottom of the ship from a straight line to a curved line either concave (SAG) or convex (HOG) is determined from the following formula:

\[
\text{(line 150)} = \text{(line 149)} - \text{(line 143)}
\]

If resulting sign is + the ship has SAG 
If resulting sign is - the ship has HOG

**Calculation of M/M/M Draught**

151 - The Mean of the Means of the Mean draught is an approximate method of correcting the calculated displacement for the effect of hull deflection. This method, which is described in paragraph (a), shall be used except in the special situations defined in paragraphs (b), (c), or (d).
(a) If hog or sag exists, the draught applied in the displacement calculations shall be adjusted in accordance with the following formulas:

\[ M = \frac{Dfp + Dap}{2} \]  
(line 143)

\[ \frac{M}{M} = \frac{M + MS}{2} \]  
(line 151)

\[ \frac{M}{M} + MS = \frac{M}{M} \]  
(line 152)

where:

- \( Dfp \) = draught at For'd Perp. (line 134)
- \( Dap \) = draught at After Perp. (line 141)
- \( MS \) = draught at Amidships (line 149)
- \( M/M \) = draught applied in the displacement calculations (line 152)

(b) If the ship is provided with an approved table which furnishes a correction for hull deflection, then this correction shall be used in lieu of the correction prescribed by paragraph (a). A statement of such usage shall be clearly documented on Form "E", so that the same methodology will be applied in any other draught surveys conducted on the same voyage.

(c) If it is agreed before the voyage commences, that the displacement will be calculated by integration of the transverse section areas representing the immersed portion of the hull as actually trimmed and deflected, with appropriate correction for the weight of the shell plating and the appendages, then this method shall be used in lieu of the correction prescribed by paragraph (a). The total hull deflection measured amidships shall be apportioned at each station between the Forward and After Perpendiculars by the parabolic coefficient set forth in Table I. A statement of such usage shall be clearly documented on Form "E" so that the same methodology will be applied in subsequent surveys as agreed.
### Table I

<table>
<thead>
<tr>
<th>Hog - Sag Correction to be applied to station draughts when hydrostatic properties are calculated for actual trimmed water line</th>
<th>Station</th>
<th>Proportion of hog or sag</th>
</tr>
</thead>
<tbody>
<tr>
<td>F.P.</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>1/2</td>
<td>.81</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>.64</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>.36</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>.16</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>.04</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>.04</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>.16</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>.36</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>.64</td>
<td></td>
</tr>
<tr>
<td>9-1/2</td>
<td>.81</td>
<td></td>
</tr>
<tr>
<td>A.P.</td>
<td>1.00</td>
<td></td>
</tr>
</tbody>
</table>

Apply proportional correction to the draught taken from a trimmed straight line through amidship.

Correction (+) for hog and (-) for sag

(d) If it is agreed before the voyage commences that the correction for hull deflection be related to the waterplane area, then the method described below shall be used in lieu of the correction described in paragraph (a).

Such usage shall be clearly stated (Form "E") so that the same methodology will be applied in subsequent surveys as agreed.

When the ship is hogged:

\[ D = M - f \times (M - MS) \]

When the ship is sagged:

\[ D = M + f \times (MS - M) \]

where:
- \( D \) = Draught applied in displacement calculation (line 154)
- \( M \) = Mean of draughts at Forward and After Perpendiculars (line 143)
- \( MS \) = Mean of draughts measured at Amidships (line 149)
- \( f \) = Coefficient from Table II
(a) In the relatively unusual case where the hydrostatic data is referred to the moulded base line, the thickness of keel plate (line 153) must be deducted from the M/M/M draught before entering the hydrostatic tables.

(b) In the event that the ship has hydrostatic curves instead of tables, displacement (1), i.e. line 161, shall be obtained by reading a displacement, from the curves at the closest delineated calibration, and applying a correction for the actual M/M/M draught as follows:

\[ D(1) = DC + TPC \times (\text{difference between CD and M/M/M}) \]

where:
- \( D(1) \) = Displacement (1) (line 161)
- \( DC \) = Displacement read at calibration
- \( CD \) = Calibration draught utilized
- \( TPC \) = Tonnes per centimetre

The sign is applied according to whether the M/M/M is above or below the calibrated draught which was utilized in the calculation.

**Calculation of displacement (2)**

\[ \text{Displacement (2)} = \text{Displacement (1)} + \text{Trim Corr.} \]

(line 166) \hspace{1cm} (line 161) \hspace{1cm} (line 164)

This calculation is not necessary if the displacement is calculated directly by the method set forth in paragraph (c) of the section on calculation of M/M/M draught, which includes the effects of both trim and hull deflection, i.e. the value obtained by such method is Displacement (2).

**Calculation of trim correction**

162 - (a) Except when the displacement is corrected for trim by the method described in paragraph (c) of the section on the calculation of M/M/M draught or except when trim correction tables are available, the correction for trim shall be calculated by means of the following formula:

\[ \text{LCF Corr.} = \frac{TPC \times LCF \times T \times 100}{LBP} \]

(line 162)

The sign of the correction shall be in accordance with the following table:

<table>
<thead>
<tr>
<th>TRIM</th>
<th>LCF Fwd</th>
<th>LCF Aft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aft</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Fwd</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

**Nemoto Corr.**

\[ 50 \times (\frac{dM}{dz}) \times T^2 \]

(line 163) LBP
Calculation of trim

155 - The forward and after trim of the ship shall be calculated from the draughts at the perpendiculars (lines 134 and 141), using the following formula:

\[ \text{Trim} = \text{Dap} - \text{Dfp} \]

where:  
- \( \text{Dap} \) = draught at After Perp. (line 141)  
- \( \text{Dfp} \) = draught at Forward Perp. (line 134)  
+ shall be indicated as Trim Aft  
- shall be indicated as Trim Forward

Determination of Displacement (1)

153 - Except as noted in paragraphs (a) and (b), displacement (1) is to be extracted from the ship’s approved hydrostatic tables for the \( M/M/M \) draught by means of linear interpolation.
The Nemoto Correction is always +

where:  
TPC = Tonnnes per centimetre immersion (line 099)  
LCF = Longitudinal centre of flotation (line 100) (metres)  
T = Trim between Perp. (metres) (line 155)  
LBP = Length between Perpendiculars (metres)  
(line 090)  
\( \frac{dM}{dz} \) = Difference in moment to change trim one centimetre for two draughts, one 50 cm higher than the mean observed draught and another 50 cm lower than the mean observed draught (metre-tonnes)

Then

(line 164)

164 - (b) If the ship has approved tables which provide a correction to the displacement for the effect of trim, then this correction shall be utilized in lieu of the calculation described in paragraph (a).

Calculation of density correction

157 - Samples are to be taken with a "tumble-fill" or equivalent type of salinometer pot.
158 The results of all tests should be averaged and should be compared with other recent tests at the port or berth. If unexpected variations occur, the samples should be retaken and tested again, if necessary at one-metre intervals on both port and starboard sides of the vessel. In many ports the density of dock water changes with depth and tide. Consequently a number of samples should be taken at various levels and locations to obtain a reliable mean density. Tidal variations can also affect density.
The density meter should be kept clean, otherwise it is liable to show unacceptable deviation from actual density.

(a) The density of the water in which the ship is immersed shall be measured either immediately before or immediately after the draughts are read. The measurements shall be made with a glass hydrometer, certified by the manufacturer to be accurate, and calibrated to read weight per unit volume in air. Serial number and identification of the instrument shall be entered on line 159.

The density shall, initially, be measured amidship, near the water surface and, again, near the bottom of the keel. If the readings are identical single additional readings shall be made at the bow and the stern. If the readings are not identical to the previous readings then readings at two levels shall be made at the bow and the stern. The density (line 157) shall be the average of all readings taken.
(b) The weight of the ship and all that is in her must be adjusted for the difference in the actual weight, in air, of the water displaced by the ship and the assumed weight used by the naval architect in computing the draught versus displacement table. This correction is made in accordance with the following formula:

\[
\text{Density Corr.} = \frac{\text{RD} - \text{MD}}{\text{RD}} \times \text{Displacement (2)}
\]

(line 167) = (line 161)

where: \( \text{RD} = \text{Density of water specified in the ship's hydrostatic data (line 158)} \)
\( \text{MD} = \text{Average density of water as measured in accordance with paragraph (a) (line 157)} \)

Disregard the resulting algebraic sign because the correction will be applied in accordance with the rule set forth in the next paragraph.

**Calculation of Displacement (3)**


(line 168) = (line 166) ± (line 167)

The sign of the Density Correction is dependent on the relationship between the measured density and the reference density used in the hydrostatic data. Thus, if the measured density is less than the reference density, the density correction is minus and vice versa.

**Calculation of total deductibles**

169 - In the draught survey calculations there must be a means for discriminating between the weight attributable to the cargo and the weight attributable to other burdens within the ship. The means for this is provided by identifying and summing all non-cargo weights as measured and calculated on Forms "D/1", "D/2", and "D/3". The following special instructions apply:

(a) In the starting survey, all the deductible weights, which are on board at the time of the survey, must be identified and the weight attributable to each must be stated in the draught survey report. Summation of these items furnishes the Total Deductible Weight.

(b) Unless important alterations occurred from starting to finishing survey such as discharge of fresh water near completion to accommodate cargo; in the finishing survey, the procedure required by paragraph (a), need not be repeated. Instead, only the ballast tanks, on Form "D/2", must be measured and calculated a second time. The weight, at the time of the finishing survey, of the fuel, fresh water, and other consumable liquids shall be determined by deducting the "in port" consumption from the weight reported at the starting survey.
(c) If fuel, fresh water, or other consumables are taken on board between the start and finish surveys, the increase in weight indicated by the delivery invoices, shall be calculated into the change in weight due to "in port" consumption, provided such indicated weights appear "reasonable". Otherwise, the actual weights of fuel and water should be determined at the initial and final draught survey.

(d) In the situation where the vessel is in port for a protracted period between the starting survey and the finishing survey, the measurement and calculation of the deductible weights on Forms "D/1", "D/2", and "D/3" shall be conducted at both the starting and the finishing surveys. 

(e) In the unusual case where the condition of the ship, at the time of the starting survey, is not conducive to the accurate determination of the tankage, the measurements and calculations listed on Forms "D/1", "D/2", and "D/3", with the exception of the Ballast Tanks, may be deferred until the finishing survey. The weight attributable to the "in port" consumption shall be added to the weight reported at the finishing survey. This situation should be noted in the footnotes.

(f) In some exceptional cases there is a non-cargo weight adjustment which must be dealt with differently than provided for on Form "D/3", lines 357-359. This occurs when a significant weight, which is part of the ship's structure or basic equipment (i.e. is included in the approved light ship weight), is not on board at the time of the survey. If the deficiency exists at the time of both the starting and the finishing survey, it has no effect on the cargo weight but it will increase the constant as shown on Form "B", line 090. If the deficiency exists at the time of one of the surveys but not the other, it will affect the cargo weight also. Therefore, the deficiency must be corrected in the final cargo weight as shown on Form "E", lines 376-380. The details of such correction shall be included on Form "E".

**Calculation of Final Corrected Displacement**

\[
\begin{align*}
170 & \quad \text{Corrected Displacement} = \text{Displacement (3)} - \text{Deductible Weight} \\
& \quad \text{(line 170)} \quad \quad \text{(line 168)} \quad \quad \text{(line 169)} \\
\end{align*}
\]

**FORM "D/1"**

This form needs to be filled during the starting survey.

178 - Indicate in the appropriate box if the survey relates to the cargo loaded or unloaded.

181 - In these two lines the identification of the corporation or the private professional need to be provided.

183 - Identify the vessel name and the serial no. of the survey.

184
Enter with the starting and the finishing hour of ballast and fresh water soundings; indicate hours from 00 to 24 and minutes from 00 to 60. Enter subsequently with date or dates and specify trim of the vessel while the soundings for ballast and fresh water took place.

Ballast tanks

Enumerate in sequence each compartment containing ballast water (one for each line from forward to after). All ballast tanks must be sounded with a calibrated steel sounding tape and water finding paste. At exposed berths, where vessel movement could cause errors in tank soundings, the soundings should be made at least three times with a steel tape and paste, or alternatively with a float, and the average taken of the readings.

Water in ballast tanks must be measured by sampling via the sounding pipes with appropriate equipment (such as a small pump and plastic tubing) and the density calculated, using equipment and procedures as set out in lines 157 to 167. Corrections for heel and trim must be applied to soundings, including allowances for unpumpable volumes in "dry" tanks. Any inadequacy of tank tables in regard to capacities or corrections for trim, should be noted on the surveyor's report. The heading of all columns of this form is self explanatory except that a few comments are in order:

(a) Every tank should be sounded scrupulously. Expressions such as "full" or "empty" with the corresponding, appropriate figure against it shall not be used.

(b) The trim of the vessel must not be ignored. "Pocketing" often leaves voids in supposedly "full" tanks. Small quantities coupled with large trims can render primitively shaped volumes, the size of which must be arrived at by solid geometric mensuration, should sufficiently arranged tables not be available.

(c) Special attention should be given to the density of the liquid in the tank in order to arrive at an accurate weight. This is especially important in ascertaining weights in ballast tank since, for obvious reasons, the specific gravity may vary from less than 1 through 1.025. To assume the latter (or the first) when, in fact, the actual figure is somewhere in between can lead to large errors in the bigger vessels.

Bilges: all bilges are to be sounded or confirmed dry by visual inspection.

Bilges pumping certificates should be placed on board and the master should be requested to keep an accurate record of any bilges pumped overboard during the voyage. This record should be handed to the consignee's surveyor at the discharge port and a copy retained on board. To secure reliability of the data the bilge water should be first pumped in a calibrated compartment and from there overboard each time that such compartment is full. This is a very critical point, failing which, reconciliation of loading and discharging port results can become difficult, as explained in previous paragraph.
Duct keels and swimming pools: care must be taken to include soundings of special spaces such as duct keels, or inspection of the swimming pools, etc., in the starting and finishing conditions. Water in the swimming pools shall be listed separately, from ballast of all other compartments, and entered in line 357 of Form "D/3".

Total weight in metric tonnes of ballast water listed in previous lines should be entered on the right hand side and also on line 351.

Fresh water: the quantity of fresh water listing each tank is to be established by sounding or by gauge if fitted, and corrections made when applicable for heel and trim. The total is to be entered on line 352 of Form "D/3".

Enter in this space an indication of possible obstructions in sounding tube or tubes and identify each problem encountered. In case of need add an extra page to illustrate in detail the problem and how it was faced in the situation.

FORM "D/2"

This form needs to be filled during the finishing survey.

Indicate in the appropriate box if survey relates to cargo loaded or unloaded.

In these two lines the identification of the corporation or the private professional need to be provided.

Identify the vessel name and the serial no. of the survey.

Enter with the starting and the finishing hour of ballast (and possibly fresh water) soundings: indicate hours from 00 to 24 and minutes from 00 to 60. Enter subsequently with date or dates and specify trim of the vessel while the soundings for ballast and possibly fresh water took place.

All ballast tanks need to be listed in the same order as in form "D/1" and the value sounded for each tank entered in the appropriate columns with necessary corrections.

All bilges checked and listed as in form "D/1" with pertinent data if necessary.

Duct keel and any other compartment listed in form "D/1" needs to be listed also in this form and applicable values entered in the appropriate column. Surveyors are warned that the erroneous assumption possibly made on "empty" or "full" duct keel, eventually due to the difficulty of sounding may lead to surprising discrepancies.
As explained in previous section, fresh water generally does not need to be sounded again if it was sounded for the starting survey unless for some special situations like for instance when at last moment ballast water is pumped out of board to load more cargo. Under such circumstances it is necessary to repeat the fresh water soundings.

Enter in this space an indication of possible obstructions in sounding tube or tubes and identify each problem encountered. In case of need add an extra page to illustrate in detail the problem and how it was faced in the situation.

FORM "D/3"

Indicate in the appropriate box if survey relates to cargo loaded or unloaded.

In these two lines the identification of the corporation or the private professional need to be provided

Identify the vessel name and the serial no. of the survey.

The headings of the columns are self explanatory.

Similarly to soundings made for ballast and water determinations, under section C (lines 319 to 334) the figures for fuel oil on board shall be measured and entered with the identification of each tank in the sequence order from forward to after, unless for special circumstances it is sufficient to measure fuel oil only for the starting survey.

For fuel consumption during loading or unloading the Chief Engineer's data (provided reasonable figures are offered to the Surveyor) are an acceptable method of calculating final fuel weight for finishing survey. Naturally in this case only the last column (weight metric tonnes), under finishing survey will be entered with the appropriate calculated numbers.

In case of any slop tank also the content of such compartment needs to be sounded and pertinent data entered with specific identification of each tank after the data of fuel oil. Total C for fuel oil will be entered on line 353, as appropriate under starting and finishing survey.

The summation of slops will be entered in line 355 under starting and finishing survey.

Similarly for diesel oil, the same operations listed above for fuel oil, need to be done with the same criteria.

In this case, also, any large difference in figures between the initial and the final survey needs to be investigated and, if necessary, all tanks sounded again and weight determined using the appropriate specific gravity for the fuel.
Summary of deductibles

346 - All figures of these lines have to be entered accurately, filling in the starting survey and the finishing survey data as follows:

351 - In the starting survey table needs to be entered the summation of line 219. In the finishing survey tables the summation of line 276.

352 - In the starting survey the summation of line 232 and in the finishing survey the summation of line 290.

353 - Summations of line 333 need to be entered under the respective starting and finishing table.

354 - Summations of line 343 respectively under starting and finishing.

355 - Subtotals possibly entered in section of fuel oil need to be entered in this line respectively under starting and finishing survey as appropriate.

356 - The totals of lube oil shall be generated in the total quantity directly from ship's documents and entered under starting and finishing survey.

357 - The water contained in the swimming pool must be entered as appropriate under starting and finishing survey.

358 - Enter the weight of the anchor(s) and chains, under starting and finishing.

359 - Enter in this line every other weight other than cargo identified in the starting and finishing survey.

361 - Summation of all above listed items represents the total weight of the deductibles to be entered in line 169 and to be deducted from the starting and the finishing displacement of line 168 to obtain the displacement corrected for deductible of line 170.

FORM "E"

This is the concluding part of the draught survey.

364 - Indicate in the appropriate box if survey relates to cargo loaded or unloaded.

367 - In these two lines the identification of the corporation or the private professional need to be provided.

369 - Identify the vessel name and the serial no. of the survey.
376 - Enter the corrected displacement of the starting survey, as per line 170.

378 - Enter the corrected displacement of the finishing survey as per line 170.

Calculation of cargo weight

380 - When both the starting and finishing surveys have been completed:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(line 380)</td>
<td>Loaded</td>
<td>Unloaded</td>
</tr>
<tr>
<td></td>
<td>(line 170)</td>
<td>(line 170)</td>
</tr>
</tbody>
</table>

383 - When such data is available and for statistical purposes only, enter in the provided space the shore scale quantity converted in metric tonnes. The scale weight should in no way whatsoever influence the cargo weight as measured by the surveyor. He is obliged to report his result honestly and strictly on the basis of the measurements and calculations he has made.

389 - These lines should be filled with illustration of unusual situations (extra pages can be added if needed); with specific identification of vessel's documents used; and, in case of need, with the identifications of the reasons for surveyor's refusal or impossibility to perform the survey. In such instances, provided facts are objectively listed, the surveyor shall be entitled to the agreed fee like if the survey had been made.

401 - Enter calculation of the constant.

408 - In the situation described in the previous sentence these four lines need to be reworded (i.e. "where not within" - in lieu of "where within" and "did adversely affect" instead of "did not adversely affect") or voided completely.

412 - Enter total number of pages including pages possibly added to the seven pages of the UN/ECE Draught Survey Code Forms (Ed. October 1991-1.8).

416 - In these two lines the identification of the corporation or the private professional need to be provided.

418 - Signature of the surveyor or surveyors and indication underneath of the full names in print and title(s). Surveyors are warned that each page of the survey needs to be signed or initialled by the surveyor(s). Moreover it is good practice by the surveyor to tender the manuscript of the document for the signature of the Master (or alternatively of the Chief Officer and the Chief Engineer) only as witness and for endorsement of the vessel's data by themselves released to the surveyor.
PART 1
SECTION C
FACTORS AFFECTING DRAUGHT SURVEYS

Quite apart from the points made in other parts or sections of this code certain inherent limits of approximation remain in this technology like in any other weighing process meant to measure quickly and inexpensively large masses of materials.

1. Incorrect hydrostatic information or draught marks

Investigations carried out in specially performed draught surveys have indicated that there can be significant errors in the determination of displacement due to typographical errors or arithmetical errors in the ship's hydrostatic tables. This could be improved if the tables furnished to the surveyor bore an approval stamp by the flag government or the classification society.

After a number of years careless re-painting of draught marks, especially if they have not been permanently marked on the hull, can cause erroneous readings. If there is any doubt, the draught marks should be re-sited at the next dry docking.

2. Incorrect tank calibrations

This is normally ascertained after a number of draught surveys when a constant error may appear. It may be verified by a careful draught survey when just the tank/tanks in question are filled or emptied with no other weight changes. Classification societies, upon request of the shipowners, may however issue the special calibration certificates for each tank or compartment of the vessel.

3. Mud and/or scale in ballast tanks

The quantity of mud and/or scale will increase over a period of years, depending on the sediment in any ballast taken, on the extent of scale formation and on the cleaning which is carried out. It is difficult to quantify. The effect on ballast calculations can be minimized unless there are reasons to the contrary by leaving a measurable quantity of water in the ballast tank instead of pumping it dry. The calculation would then use a difference in known water quantities rather than assume that a tank is completely empty: in this way the error would be confined within the density differential of the mud and the ballast water.

Regularly, large bulk carriers arrive at unloading ports with a slight trim by the head as a result of burning fuel from the aft located fuel tanks during long sea passages. Since generally the sounding pipes are located aft only, dry soundings of ballast tanks do then not necessarily mean that no water is present, since any water will accumulate in the fore end. When the ballast tables are subsequently entered with zero sounding and the head trim,
considerable quantities of residual ballast water are found. Again, this water does not actually have to be present. Consequently, when one assumes empty or tabulated quantities, both may be wrong.

4. **Bottom shell growth**

Marine growth on the bottom of the ship, especially if dry docking is delayed or there is a failure in the antifouling paint, adds weight to the ship. But, because this weight does not change between the start and finish surveys, it has no effect on the calculation of the cargo weight, unless the vessel is docked for a long period or the antifouling paint deteriorates.

5. **Water disturbance**

Normally due to wind, swell, or passing traffic. Accurate reading of the draught requires the use of a draught reading tube such as one of those described in Section 1 of Part 2 "Draught Survey Instruments".

6. **Variations in sea-water density**

If a loaded vessel has a small underkeel clearance, the sea-water may hold mud/sediment in suspension, or its density could be affected by chemicals in solution. This may be apparent from the bottom layer sample. If it is suspected, a sea-water sample should be taken at the maximum draught as a check. In river ports or in proximity of river mouths or of industrial plants there may be numerous layers of water with differing densities, which may substantially affect the accuracy of the water sample unless properly detected.

7. **Vessel squat**

When a vessel is moored in a tidal stream or a fast flowing current, in shallow water, it will squat in the water, i.e. its draught will increase. This is due to a fall in the pressure of the water between the bottom of the hull and the sea-bed. The sinkage is due to a number of complex factors due to the hydrodynamic properties of the hull, especially where underkeel clearance is small and which cannot be accurately determined by theoretical calculations. There appears to be no effect at current speeds below 2.5 knots. If conditions are conducive to squat the surveyor and the master should monitor carefully that the vessel is fully afloat and not touching the bottom, and for best accuracy, consider waiting for slack water, or shifting the vessel to another berth where the effects of squat are known to be less.

8. **Asymmetrical hull deflections**

If the mean draught midships differs from the mean of the forward and after draughts it is assumed that the deflection of the hull shape takes the form of a parabolic curve. This assumption is inherent in the two-thirds and quarter-mean methods of correcting for hull deflection. If there is no difference between the mean draught midships and the mean of the forward and after draughts it is assumed that the hull shape has not been deflected. Both
assumptions may be incorrect. In practice, the hull deflection may not be a parabolic curve or there may be deflections between the ends of the vessel and the midships points (i.e. as a modified sine curve).

If the draught is not read at all six draught marks, the hull may be twisted without the fact being known.

9. Solar bending

Vessels of approximately 50,000 tonnes deadweight and upwards may be subject to hull deflections caused by solar bending of the deck and structure above the waterline. The effect would normally be a hogging which can be appreciable. Some readings taken on a 74,000 tonnes dwt bulk carrier and reported in "Seaways" (March 1987) showed that the fully loaded vessel was sagged 5cms at 0700 and hogged 27.5cms at 1700 on the same day with no movement of weight within the vessel (apart from normal oil/water consumption for an anchored vessel).

10. Use of approximate methods for corrections

The mathematical methods used to correct for trim and/or hull deflection (hog or sag) if these conditions exist, are approximations because of limitations of time, expense and the work site. However, if the same methods are correctly and uniformly employed in all surveys, the resultant error in the exact cargo weight will be minimal. However, if in better equipped ships, correction tables for trim and/or hull deflection are available, then such tables should be used instead of the approximate methods.
PART 1

SECTION D

IMPROVING ACCURACY

In a draught survey operation several parties are involved and it is to the advantage of each party to join the efforts to increase the accuracy. The parties involved are:

A. The buyers, the sellers, the charterers, the terminals and the vessel's staff

Assuming that buyers, sellers and charterers are equally concerned about the correct weight of the cargo, also for the master (respectively chief officer to whom the responsibility of the cargo weight is delegated) shortages and discrepancies may be a problem.

In order to avoid this, it is strongly recommended that, once a vessel is nominated, a telex be sent to the master informing that the bill of lading weight will be established by draught survey. This, in order to indicate that his vessel is to meet certain requirements at time of arrival at load/disport. If not, the vessel may be placed in off-hire and the master/owner be held responsible for all related costs.

B. Telex format to advise master of draught survey

A suggested format for such a telex is quoted below:

Suggested telex format

To the Master, M.V. ____________________________
Copy to performing surveyor ___________________
From ____________________________ (the charterer's agent)

Subject: Presentation of vessel on arrival in full readiness for draught survey to be conducted in accordance with the UN/ECE Draught Survey Code 1991.

Sir,

Please be advised that, under the terms and conditions of your charter party, you must present your vessel in full readiness for an independent marine surveyor, acting on our behalf, to conduct a draught survey to establish bill of lading quantity. The draught surveyor will board your vessel upon arrival at the cargo handling berth.

1. Vessel shall arrive at the loading (or unloading) port with a trim not exceeding her ballast tank trim correction tables and without list (in any case the list must not exceed 1/2 degrees).
Clause in the charter party (Copy to be sent to master and to charterer's agent at loading and unloading ports).

The weight of the cargo will be determined by draught survey, consequently:

1. Vessel shall arrive at the loading (or unloading) port with a trim not exceeding her ballast tank trim correction tables and without list (in any case the list must not exceed 1/2 degrees).

2. Vessel shall furnish the following documents which are approved or otherwise suitably verified as being applicable to the ship:
   
   (a) Hydrostatic tables (or curves)
   
   (b) Trim and stability booklet
   
   (c) Calibration, tables for all tanks - ballast, bunkers, freshwater, slops, etc., with corrections for trim
   
   (d) General arrangement plan
   
   (e) Load line certificate
   
   (f) Record of the ship's constant

3. The draught marks, forward, afloat, and amidships, the deck line, and the plimsoll marks, all port and starboard shall be clearly legible and cut in, raised, or marked with a weld bead on the shell plating.

4. Vessel shall not take, pump out or switch from one tank to another, ballast freshwater or bunkers while draught survey is carried out.

5. It should be avoided having ballast in one of the holds. Otherwise loading operations not to be started before hold is pumped out completely.

6. Unless properly calibrated, the ballast tanks should, or be made empty, before survey starts. (This individually per tank). Sounding pipes must be intact, free of blockage and readily accessible.

7. Loading/unloading operations should not start until the draught readings and the density readings have been completed. Tank soundings shall be made immediately thereafter. The condition of the ship or the availability of ship's personnel should not interfere with or delay the timely completion of this operation.

8. Notice of readiness will be accepted only when the vessel is ready for a draught survey and complies with the above mentioned points and no other condition may exist on board which will interfere with a timely and accurate draught survey.

9. Officers and crew are requested to offer the surveyor their fullest cooperation in the performance of his duties.
2. Vessel shall furnish following documents which are approved or otherwise suitably verified as being applicable to the ship:

   (a) Hydrostatic tables (or curves)

   (b) Trim and stability booklet

   (c) Calibration tables for all tanks - ballast, bunkers, freshwater, slops, etc., with corrections for trim

   (d) General arrangement plan

   (e) Load line certificate

   (f) Record of the ship's constant

3. The draught marks, forward, aft, and amidships, the deck line, and the plimsoll marks, all port and starboard shall be clearly legible and cut in, raised, or marked with a weld bead on the shell plating.

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8. Notice of readiness will be accepted only when the vessel is ready for a draught survey and complies with the above points and no other conditions may exist on board which will interfere with a timely and accurate draught survey.

9. Officers and crew are requested to offer the surveyor their fullest co-operation in the performance of his duties.

10. Failure to present the vessel in compliance with the required conditions may result in the vessel being placed off-hire and/or being held liable for consequential costs by charterers upon documentary certification of facts and events by an independent marine surveyor.

C. Clause in charter party on draught survey

   Of course, it is advisable to include the basic requirements the vessel has to meet in case of weight determined by draught survey also in charter parties and sales contracts (ships having unsuitable documents may be rejected by charterers). A proposed language of these requirements follows here below:
10. Failure to present the vessel in compliance with the required conditions may result in the vessel being placed off-hire and/or be held liable for consequential costs by charterers upon documentary certification of facts and events by an independent marine surveyor.

D. The stevedores and the terminals

Stevedores and terminals also have a great interest to know the correct weight of the cargo taken into warehouses and reloaded afterwards.

1. The loaded weight: to be sure no tonnages are loaded in excess.

2. The discharged weight: to be certain that the quantity received as per B/L weight is correct so that they can be sure they will be in a position to redeliver the intaken weight afterwards. That is why it is of prime importance that the stevedores and the terminals allow enough time to the surveyors to properly perform the draught survey, before starting the loading/discharging operations.

E. The insurance companies

Since many cargoes are insured against weight losses, insurers are of course concerned about shortages being kept to a minimum.

F. The administrations

In most parts of the world different types of tax, duties, fees and ad valorem dues are assessed on quantities loaded or unloaded. Consequently also Governments and other entities of the administrations have good cause for a correct determination of loaded or unloaded quantities.

G. The constant

Apart from the above, immediate help to the surveyor, in checking the accuracy of his calculations, can be derived from the constant (see definition in the glossary).

When a builder delivers a new ship he must make an accurate assessment of its lightship (i.e. empty) weight. This value is approved by the ship’s administration after confirmation by an inclining test. And, since it is important to all future voyage stability calculations, it is listed in the ship’s trim and stability booklet, a document which is required for all ships by international law. However, after the ship goes into commercial services and the years of operation accrue, the weight which is correctly attributed to "lightship weight" is found to be greater than the lightship weight listed in the trim and stability booklet. This difference is attributable to the following items which fluctuate or are, generally, not amenable to precise measurement:
- Commissary stores and crew's personal baggage and stores

- Thermodynamic deformation (relevant on large hulls)

- Accumulation of additional equipment, supplies, replaced spare parts which are retained, extra wire rope, cordage, etc.

- Build-up layers of paint and marine growth on exterior hull

- Residues of ballast water on boundaries of tanks

- Mud or scale in ballast tanks

The constant has no effect on the accuracy of the weight of the cargo as determined by the draught survey for any single cargo, if it does not change between the start and the finish of surveys. If a good record of the actual constant is maintained over the life of the ship (see page 32) it is very useful in cross-checking the accuracy of the survey. The following check calculation should always be made at the end of the start or the finish survey, whichever is the condition, i.e. before the cargo is loaded or after it has been discharged:

\[
\begin{align*}
\text{Corrected displacement} & \quad - \text{Non-cargo weights (tankage, ballast, etc.)} \\
\text{Lightship weight (in T & S booklet)} & \quad \times \text{Constant}
\end{align*}
\]

If the constant indicated by this check varies by more than plus or minus 10 per cent from the prior history of the constant, it indicates that there may be an error which necessitates that all the readings and calculations should be carefully rechecked.
PART 2.

DRAUGHT SURVEY INSTRUMENTS
Surely this is an area in which there is a large scope for wiping out obsolete practices, borne throughout decades of individual uncoordinated judgement and adaptation.

Each draught surveyor and each corporation specialized in draught survey claims to possess the best design of instruments to cope with the requirements of the job. This is true to some extent but only in the sense that each one of such individuals, one way or another, is carrying out draught surveys having, however, no mirror in which to compare its set of instruments.

Time is right for a major reconsideration of all this area and hopefully for the penetration of the modern measurement technology and computerization.

Scope exists for introducing new instruments able to perform exactly the following basic functions as listed here below with the goal of gaining speed and attaining a higher level of reliability:

(a) An instrument to measure exactly distance, inclinations, and depth.

(b) An instrument able to scan exactly the differences of density in a stratification of water from the surface level to the underkeel of the ship depth.

(c) An instrument able to measure exactly the volume and the density of liquids contained into a given compartment.

(d) An instrument able to measure exactly the volume, net of possible residuals, of a given compartment.

(e) An instrument able to measure exactly the volume occupied by the "ship hull" in the water and hopefully also the depth of the immersion of the peripheral line of such mass from the underkeel level.

(f) A portable computer easy to utilize and with software specifically created for draught survey. Such an instrument per se would quickly standardize draught survey practices throughout the world. At present mostly the Pacific and Oceanic areas seem to be moving toward this new frontier. Annex A to this book offers an automatic calculation programme connected with the draught survey.

However, until such time when the above-described improvement in quality will be accomplished the following equipment can be considered to be necessary for the conduct of draught surveys.

EQUIPMENT FOR THE CONDUCT OF DRAUGHT SURVEYS

In order to perform accurate draught surveys the surveyor must equip himself with standard items such as a steel sounding tape, water finding paste or chalk, a powerful flash light, binoculars, calculator, water sampling containers, etc. Some of the typical characteristics of some such instruments are illustrated in the following paragraphs.
To maintain accuracy in less than ideal conditions the surveyor should further equip himself with specialized items. Conditions that demand extra care and specialized equipment include:

- Rough seas at the time of reading the draughts
- Varying densities at different depths and locations of the water in which the vessel floats
- Different densities in the many ballast tanks due to the vessel ballasting in different geographical locations
- Tanks, especially full top side tanks, that have sounding pipes flush with the deck.

Each of these conditions can hamper the draught surveyor if he does not have equipment that can achieve accurate determination.

I. Reading freeboards/draughts - rough seas

It is not unusual to find one or two foot seas running along side the vessel being surveyed. Most surveyors have adopted some measuring device that calms the water during measuring. One method that is used with excellent results is a clear, flexible plastic tube of about 6 metres in length with an additional clear rigid plastic tube of about 1 metre and of the same diameter (2 cm) glued to it. Attached to the lower end of the flexible tube there will be a narrow weight (1 kg). The upper end of tube (the rigid part) will be attached to a rope, the tube is submerged in the sea directly in front of the draught marks with approximately 1 meter exposed above water (Fig. 1).

The water level within the tube may be seen to rise and fall very slightly, however, with the tube adjacent to draught marks the mean water level can easily be read (this is obviously more practical at the midships mark than at the bow or stern). The water level visible in the tube is unaffected by wave motions and so gives a good reading.

- Figure 1
DRAUGHT INDICATOR PATTERN

developed and patented by:

NIPPON KAIJI KENTEI KYOKAI

(Japan Marine Surveyors and Sworn Measurers' Association)

The draught indicator is constructed with the following parts:

1. Water-guiding rubber hose
2. Sinker for water-guiding rubber hose
3. Draft indicator inner tube
4. Draft indicator protector
5. Protector cap
6. Water level indicator
7. Measuring line fixing metal
8. Lead weight fixing ring
9. Alighting recognizing rod fixing metal

Draft Indicator Pattern
Description of the parts of the draught indicator:

1. Water-guiding rubber hose

   Rubber hose: Outer diameter 10 mm (inner diameter about 5 mm) of about 20 feet long will be required. In the port where oil is afloat, rubber is often damaged. Therefore, use vinyl pipe of the same diameter, but in winter time vinyl, is not suitable for use, on account of many cracks due to hardness which may prevent the true indication of water level. Synthetic rubber hose is preferable.

2. Sinker for water-guiding rubber hose

   In order to sink the rubber hose to the bottom, use the sinker of some steel pipe of sufficient thickness fixed to the lower part of rubber hose.

3. Draft indicator inner tube

   Outer diameter about 22 mm length about 480 mm transparent vinyl pipe. The lower end connects to water-guiding rubber hose. The water will come into this pipe which is open at the top so as to release the air in the tube.

4. Draft indicator protector

   Overall length about 550 mm. Main tube made of brass, length about 500 mm, inner diameter 22 mm, having 15 mm wide and about 450 mm long window. Water-guiding rubber hose with sinker and draft indicator inner tube are attached to this protector.

5. Protector cap

   A device to prevent the entry of water from top of the indicator inner tube and to prevent the separation of each part, and to connect measuring line and water level indicator.

6. Water level indicator

   Length 470 mm. Width 15 mm and thickness 3 mm made of plastics. In order to indicate the water level, glossy surface was made dull with sand paper. It is inserted in the inner tube and fixed with lower part of the protector cap.

7. Measuring line fixing metal

   Fixed at the upper part of the cap by means of a screw clamp and connected to end ring of the measuring line. The top of this metal indicates 0 inch, in other words, graduation of measuring line starts there.

8. Lead weight fixing ring

   Use vinyl insulated telegraphic wire of 3 mm diameter, in order to hang the lead weight to keep the protector upright.
9. Alighting recognizing rod fixing metal

When lowering the instrument in the water and looking down from right above, some horizontal mark is required, for which this metal is to be used.

For use of the instrument, see the following example

Example:

From the spot marked with 8 m draught lower the draft indicator with tape line of the length of 1.20 m and suppose that the lower part of the protector has reached the water level.

Pick up the draft indicator and look at the water level indicator discoloration and suppose it indicates 17 cm.

8.00 m - (1.20 + 0.17) = 6.63 m ........ is the reading of draught.

Caution for use

1. Keep the stoppers of the cap tight.

2. Once the protector alights on water, you must not raise the measure tape to bring it in line with the datum point on ship's side. You are only allowed to lower it.

3. After taking measurement, you can lower the measuring tape 3 or 4 inches successively, and you can make consecutive measuring three or four times.

4. When the indicator gets wet all over the surface, take it out and wipe down and expose to the wind. Soon the indicator will dry up and can be used for the next service. At night time when you are unable to observe wet part, you may use chalk coating on the surface of indicator plate.

5. After the lower part of the draft indicator alighting on the water, it will take 10 seconds until the water comes inside the inner pipe and comes to standstill. You should allow in any case 15 seconds for water-level settlement.

6. When the water-guiding tube is bent or has a knot, there would be some inconvenience for the rising of water. Therefore, it is important to ascertain the tubes are all cleared up just before lowering water-guiding tube into water.

7. When the tape-line is driven out or curved on windy days and no accuracy is expected, use 3 mm electric cord measure-line instead of the tape-line.

If one side of the mid-ship draught mark can be read easily and accurately because it is on the lee side, in certain ports, but only in those ports where temperature remains constantly above freezing, the weather side can be determined by rigging a clear plastic tube filled with water on the
main deck, forming a "U" shape. Running vertically down the inside of the port bulwark horizontally across the deck and vertically up the starboard bulwark. The amount of water in the tube is adjusted so that the head of water in the vertical sections (at the bulwarks) can be measured from a fixed point (usually the deck surface) and the difference in height of the water levels is equal to the list. If the tube does not stretch completely from side to side then the horizontal length of the tube actually used can be proportioned to the vessel's beam and the list calculated by "similar triangle" calculation, bearing in mind reference points for measuring the head of water in the vertical sectors of the tube should be at equal height above the keel.

There will be times when the offshore seas are so rough that reading the offshore draught through a plastic tube is impossible. Presuming that a good (lee) inshore draught is read, an acceptable correction can be made by using a small clear flexible plastic tube approximate length 50 m and diameter 1 cm. The tube is filled with water, all bubbles removed and stretched athwartship, from top of port rail to starboard rail at approximately midship area. The height of the water level in the tube is measured from the deck, port and starboard at the exact same location. The difference in the water level readings will be the amount of list, 1/2 of this must be added or deducted according to the list, to or from the draught read, and this will be the midship mean draught.

**Figure 2**

![Diagram](image)

**Notes:**

1. Water level at scales must be higher than the deck at the centreline.
2. All air must be excluded from the tube.
3. Zero of both scales must be the same height above the deck line.

In cold climatic conditions, however, the instrument (Fig. 2) is difficult to operate and can be replaced by manometers or by instruments like the one patented in Poland and illustrated on later pages.
DEVICE FOR SHIP'S "FREE-BOARD" MEASUREMENTS

Introduction

This instrument has been made through modification of the first one, patented in 1972. All defects were eliminated and there has been made a new apparatus operating regardless of conditions. It had been checked in its final version from 1984 till 1988 making several hundred measurements. Inspections on ships proved that this type of construction had not been found in other harbours.

Device features

- measure "free board" exact to ± 2 mm.
- measurement is unfailing in each type of waving, unless the ship falls to swell (when swelling, induce regular interval of sound audibility and its fading). An accuracy of ± 5 mm can be achieved in swell conditions.
- it eliminates need of overside rope ladder climbing (especially dangerous in winter time). Using this instrument measurements are carried out from the deck (safely and cheap).
- when ship berthing, 3 cm wide slit is enough for making the measurement.
- using of graduated cable instead of measuring tape enables to make measurements in wind conditions and ensures long service life of device.
- in ice conditions, the device lead weight can punch a hole and receive signals from the surface of the water.
- prompt measurement enables to check ship draught during the end phase of loading and to stop it in due time.
- when measuring on vessels with rounded sheer strake, an arbitrary mark has not to be on deck line but, e.g., on rail. Similar marks may be graduated on ait and fore body to enable accurate reading of vessel draught in each weather and situation conditions (e.g. roadstead).
- reel and short sounder make the device easy to be carried in handbag.
Structure and operation

Measuring device consists of: pipe sounder (1) with 5 meters long rubber hose (2) and sinker (3), deaerating rubber hose (4) (30-40 cm long, placed on the upper part of the sounder). There is an electrode connected by means of measuring cable (5) to electronic system and loudspeaker, graduated cable at 5 cm intervals is spooled on the reel (7).

When waving use the rubber hose (2) while measurements. In coastal and harbour conditions at 5 meters depth there is constant pressure and thus constant, independent of waving, level of water in the sounder. Either when slight waving or in the ice condition, a sharpened pipe (6) with water inlets is screwed in to enable punching a hole in ice and make a reading of water level.

Instruction for use

Measurement is made by lowering the apparatus with rubber hose into the water. When receiving the signal, apparatus should be slowly lifted until the signal fades, then make a reading. Sufficient accuracy of measurements is 2-3 mm.
1. pipe sounder
2. rubber hose
3. sinker
4. deaerating rubber hose
5. measuring cable
6. sharpened pipe
7. the reel
8. baffle plate
9. electrode system

DRAUGHT SURVEY APPARATUS
In case of out of control signal interfering with the measurements, inside of device ought to be flushed with fresh water and dried up. Sounder is ready for measuring when supply switch on and the short-circuiting switch pressed.

In fact there is no need to take care of the apparatus except when the batteries are dead and should be replaced.

II. Water sampling devices: there are devices on the market for sampling liquids at different depths - they are effective. The following sketches suggest alternative sample devices that have been found useful.

**Figure 3:** is a 4 cm pipe with threaded pipe caps on both ends. Holes are drilled in the top cap, of sufficient size and number, to accommodate a timed descent in the water.

Example: If it takes 10 seconds to fill the tube, then the surveyor will time his lowering to the wanted depth to 10 seconds. (This method will give a good mean density from surface to bottom).

![Cap with holes](image)

**Figure 4:** This water sampler can be made of 5 cm clear plastic tubing, with a clapper valve epoxy glued to the bottom, a 1/2 kg, weight is also attached to the bottom of the tube. Attached to the top of tube a loose thin plastic covering in such a way as to permit water to pass out through the top but to restrict water from entering when being pulled up. To recover a water sample, the tube is lowered to a desired depth. Raised and lowered a few times, about one meter at a given depth, to be sure that a good sample has entered the tube. This sample will produce a density only at the level to which it was lowered.

![Valve](image)

**Figure 5:** when taking samples of ballast water through a sounding tube, this version of the sampler in figure 5 is used. The material should be copper tubing of about 40 cm in length and 2 cm diameter. A valve's device should be fixed in the lower part in a way that when the tubing touches the bottom, the valve opens and water fills in. This sampler is lowered to the bottom of the tank to find the actual density of the water. It is important that the sample be taken inside the tank and not in the higher (upper) part of the sounding tube in correspondence of the hold, this because the density may very likely vary due to difference in temperatures.
Figure 6: Another equipment used to perform a draught survey is the tumble-fill salinometer pot for collection of water samples.

Aim: To glean samples of dockwater/seawater at various specific depths.

Descriptions: Can with cork which can be removed at desired depth by jerking a cord.

Specification: The instruments must be able to obtain a sample at various depths; material: stainless steel; capacity: 1,000 ml; min. height: 400 mm.

As alternative to the above, surveyors also use the "zone samplers". In these cans the water continues to flow as long as they are in downward motion and then close when stopped at a given depth.

III. Proving side tanks are full: Top side tanks frequently appear to be full, but due to vessels trim and deck camber the forward end of the tanks will frequently have large voids. To prove these tanks are near 100% full, the tanks may be pressed up and forward vents overflowed. If this condition is not observed, it is possible to observe the level of the water in the tank with the use of a 3 cm clear plastic tube approximately 1.5 m in length. One end of the tube will have a glued foam rubber tapered grommet (see Fig. 7). At the instant of removing the sounding cap, the grommeted end of the plastic tube is inserted into the sounding pipe. The ballast might be seen to overflow the top of tube, then drop well down, and in a few seconds stabilise at a steady level. The correct level of the tank is the lowest level reached.

Figure 7: Example

Determine height of water in tube or height of water above deck plate required to prove tank is full.

\[
L \times T = H
\]

\[
LBP
\]

L = Length of tank
T = Trim of vessel (actual trim measured at perpendiculars)
LBP = Length between perpendiculars
H = Height of water to prove that the tanks are full.
IV. **Linear distance measuring devices**: serve to measure free board of the vessel at the quayside, for ballast soundings etc.

**Typical winding-case**

**Figure 8**: Steel tape measure: surveyors in many parts of the world use steel tapes with a T bar or other similar arrangements, at the starting ends, for measuring freeboards. This system has been considered good enough by Board of Trade and Port Authorities. Naturally only professional products should be used, being the liability of the manufacturer to secure calibration of the tape. Each instrument should be accompanied by a calibration certificate issued by an official standards institution.

**Figure 9**: Tank sounding tape: stainless steel tape for ballast soundings, equipped with a bob-weight of a size which will clear the internal diameter of sounding pipes; Aim: to determine fluid height in the ship's tanks.

**Description**: the sounding tape consists of: brass or anodized metal frame with handle; measuring tape fitted with swivel hook or end fittings for dip weight.

**Specifications**: Frame: different types available; can be left at the users' discretion. Tape: minimum length: 25 mm; material: stainless steel; graduated: 1 mm; numerated: 10 mm. Dipweight: material: brass; weight: 400 gr; height: 100 mm; graduated: 1 mm; numerated: 10 mm.

**Certification**: each instrument should be accompanied by a calibration certificate issued by an official standards institution.

**Typical winding-frame**
V. **Figure 10: Density measuring device:** to measure density of water and ballast:

**Hydrometer:** reputable glass draught survey hydrometer, measuring density in air in kilograms per litre and certified by an appropriate registered testing laboratory, or which is regularly checked against a certified hydrometer.

**Aim:** to determine the density of sea/brackish/fresh water.

**Spec:** Zeal draught survey hydrometer or equivalent.

- **materials:** suitable transparent glass.
- **dimensions:** overall length: 335 mm app.; diameter 27 mm app.
- **scale:** the white paper scale is graduated in density kg/l in air (density in air is sometimes termed apparent density). This permits the weight to be obtained by multiplying the scale reading by the volume in m³ of water displaced.
- **reference temperature:** 15°C.
- **poising:** shot and black wax.
- **range:** 0.990 to 1.040 kg/l (in air).
- **graduated:** 0.0005 (0.010 graduations in red).
- **figured:** 0.005.
- **surface tension:** medium (to be marked on the instrument).
- **marks:** manufacturer's name or easily identifiable mark.
- **identification number.**

**Certification:** each instrument should be accompanied by either a manufacturer's certificate of conformity or a correction certificate issued by an Official Standards Institution. At least two instruments with official correction certificates should be available for reference purposes.
INSTRUCTION LEAFLET FOR DRAUGHT SURVEY HYDROMETER

for determining the density of sea/fresh water

When carrying out a Draught Survey on bulk carrying cargo vessels, it is important that the weight to volume relationship of the supporting water is clearly understood and accurately reported.

Most hydrometers at present in use for Draught Surveys are not really suitable for the purpose but ZEAL have designed, in conjunction with S.G.S. Van Bree N.V., Antwerp, Member of the Société Générale de Surveillance S.A., Geneva, this special Draught Survey Hydrometer of the required accuracy, incorporating the following features:

- A range of 0.990 to 1.040 kg/l suitable for use in sea and fresh water and thus covering the range of densities normally required for Draught Surveys;

- A scale graduated in density kg/l in air (density in air is sometimes termed apparent density). This permits the weight to be obtained by multiplying the scale reading by the volume in m$^3$ of water displaced;

- Calibration of the hydrometer for use in sea water, a liquid of medium surface tension;

- Manufactured from glass, thus permitting certification by the British Standards Institution if required;

- Alternatively, a ZEAL Certificate of Conformity of test for accuracy against a B.S.I. certified Standard hydrometer can be supplied.

INSTRUCTIONS FOR USE

1. A clean, representative sample of the supporting water should be obtained by means of a sampling can or other suitably designed sampling apparatus. (A sample of at least one litre will help to ensure that the temperature and density do not change unduly between collection of sample and taking of readings.) The depth of water in the container must be sufficient to allow at least 25 mm clearance between the bottom of the hydrometer and the bottom of the container. The internal diameter of the container or jar should be at least 50 mm.

2. The number of samples to be taken, also at which depths and at which positions outside the vessel they should be taken, may be important according to the circumstances.

3. Readings may be taken by lowering the hydrometer into a suitably shaped sampling apparatus or by transferring the water to a suitable glass test jar. If a metal or other non-transparent container is used for taking readings ensure that it is full to the brim. If a glass test jar is used, it should preferably be rinsed first with part of the sample so as to avoid undue temperature changes. The container or test jar should be shielded from draughts, which might affect the readings.
4. The reading must be taken in the sampling apparatus or glass test jar as rapidly as possible. Undue delay in taking the reading could result in temperature changes leading to inaccurate results. In case of doubt, a repeat sample should be taken in order to verify the first observation.

5. Ensure that the stem of the hydrometer and the surface of the water sample are free from grease and oil since otherwise the accuracy of the readings could be adversely affected.

6. Hold the hydrometer vertically by the top of the stem and gently lower it into the water sample until it floats freely.

7. Take the hydrometer reading where the level liquid surface meets the graduated scale (see illustration overleaf).

CORRECTIONS TO HYDROMETER READING

1. If the instrument is supplied with a B.S.I. Certificate, the appropriate correction should be applied.

2. For most Draught Survey purposes, no further corrections to the readings are needed.

Note

A reading is most correct when the glass hydrometer is used at a temperature of 15° C. If immersed in water at temperatures higher or lower than 15° C, the instrument will expand or contract so that, for precise laboratory work, a small correction would be applicable.

However, for Draught Survey work, it should be noted that the ship itself will normally expand or contract according to the temperature of the water in which it is floating. The corrections required to compensate for these changes in volume are of opposite sign and tend to compensate for each other.

As it is not practicable to calculate any temperature corrections for the ship, for most Draught Survey purposes no correction should be applied for the expansion or contraction of the hydrometer glass.

IMPORTANT

It is most important to note that the density required for Draught Survey purposes is the average density (in air) of the water in which the ship is floating. Any attempt to correct this water density to density at 15° C, 60° F or some other standard temperature can lead to very serious errors in the weight calculation.
TAKING A READING

The line A ------- A indicates the correct reading position at eye level e.g. 1.0285 kg/litre in air.

APPENDIX

When necessary, a ZEAL Draught Survey hydrometer with a B.S.I. Correction Certificate may be used to verify the accuracy of a brass Loadline hydrometer graduated in Sp.Gr.60° F/60° F in vacuo. If the two instruments are compared in fresh water at a temperature of 15° C or 60° F the following equation applies:

(1) Correct reading on glass hydrometer -0.0020 =
correct reading on brass Loadline hydrometer.

If the comparison has to be made in water at some temperature substantially higher or lower than 15° C, the following corrections should be applied to the readings of the glass and brass instruments before using the equation (1).

<table>
<thead>
<tr>
<th>Water temperature °C</th>
<th>Glass Hydrometer</th>
<th>Brass Hydrometer</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>-0.0003</td>
<td>-0.0006</td>
</tr>
<tr>
<td>10</td>
<td>-0.0001</td>
<td>-0.0003</td>
</tr>
<tr>
<td>15</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>20</td>
<td>-0.0001</td>
<td>-0.0002</td>
</tr>
<tr>
<td>25</td>
<td>-0.0003</td>
<td>-0.0005</td>
</tr>
<tr>
<td>30</td>
<td>-0.0004</td>
<td>-0.0008</td>
</tr>
</tbody>
</table>
VI. **Figure 11:** Glass/plexiglass tube: graduated plastic or glass measuring cylinder, of a minimum of 5 cms internal diameter and of sufficient height to contain the hydrometer and allow a clearance between the bottom and the hydrometer of at least 2.5 cms. It must be possible to read the bottom of the water meniscus at eye level. Density measurements must be taken with the cylinder on a level, stable surface and protected from wind. **Aim:** for easy and exact reading of the density value. **Material:** glass or plexiglass. **Specifications:** diameter: about 50 mm; length: 400 mm.

VII. **Density samples pump:** a small pump and plastic tubing or bailing equipment for obtaining the density samples of the ballast tanks via the sounding pipes.

VIII. **Water sensitive paste:** water finding paste for ballast soundings. **Aim:** to obtain a more accurate reading of the liquid weight. **Description:** water sensitive or water finding paste is a product which will change colour to f.i. red on contact with water. Consequently when applied on the sounding tape it will allow more accurate reading.

IX. **Engineers scale:** engineers scale for lifting dimensions from vessel's drawings or hydrostatic curves.

X. **Calculator:** with software adequate for collecting primary data and for printing agreed format of survey.

XI. **Powerful torch:** for night hours or dark compartment controls.

XII. **Binoculars:** for reading draught marks.

XIII. **Conversion factors:** for conversion factors, only the appropriate factor listed by the United Nations publication on weights and measures shall be used.
PART 3.

VESSEL DOCUMENTS
UN/ECE CODE OF UNIFORM STANDARDS AND PROCEDURES FOR THE
PERFORMANCE OF DRAUGHT SURVEYS OF COAL CARGOES

PART 3 - VESSEL DOCUMENTS

GENERAL PRINCIPLES

Notwithstanding the personal accuracy of any surveyor the result of a
draught survey in the first place depends on the condition of the vessel with
regard to her draught marks and possibilities of tank: ballast hold
soundings, further on the availability of approved data to derive the
corresponding displacement, and last but not least on the quality of the tank
soundings and the accuracy of the calibration tables.

Based on the above items and in consideration of the fact that a draught
survey is usually carried out at both ends of a voyage leg (but seldom by one
and the same surveyor), the necessity is quite obvious that both surveyors
should perform their survey with the same procedure, using the same weight and
measurement units, finding uniform standards of data compilation and
documentation on board.

1. Unification of the List of Documents: every bulk carrier has a Trim and
Stability booklet, a Load Line document, hydrostatic tables or curves,
capacity plan, and tank sounding tables etc. The most recent bulkers also
have a computerized program meant primarily to facilitate vessel's master
stability calculations and not necessarily useful for draught survey
calculations. It is hoped that within a reasonable future shipbuilders will
provide new constructions and reclassified vessels with uniform tables, using
the metric system as illustrated by the following sections. Such tables
should be provided always either in English language only or in
multi-languages, one of which shall be English, to facilitate worldwide
understanding, readability and also usage by computer programs.

Furthermore every ship should be furnished by building yards with
computerized calculations tools provided the inputs of such programs are
approved and certified by the building shipyard and by the Classification
Registry of the ship.

Pending such improvement of the vessel documents the reference documents
usable in a draught survey are made up of a wide variance of format,
precision, and useability of the items. Language other than English also
represents a barrier some time and leads to possible mistakes.

There is a possibility for a big improvement of the content and the
quality of vessel's documents and for prescribing standardized formats
requiring Governmental Certification of content so as to insure accuracy and
consistency.

Each vessel needs to be provided with a "Data Manual for Draught Surveys"
which is certified by the vessel's home Administration or its classification
society.
2. **Vessel information:** it is the responsibility of the vessel's master to provide the surveyor with accurate and up-to-date hydrostatic information and tank calibration tables for the vessel, which have been certified by the appropriate Government Agency in the country of vessel construction and/or registration. This data in summary should include:

- The accurate lightship weight of the vessel, including any modifications which have been made.

- Draught - displacement tables for the vessel; in case of very large or very old vessels one way of upgrading the results should be to use the bonjean data if they are available.

- Volume and calibration tables for all ballast, fuel tanks and any other compartment, including correction factors for heel and trim.

- Unpumpable volumes for all ballast and fuel tanks.

In addition it is the master's responsibility to ensure that draught marks are clearly visible at a minimum of six points on the hull, i.e. at the forward, midships and aft positions on the port and starboard sides.

Vessel's master should also share with surveyors copy of previous draught surveys from which a diligent surveyor could get quick indications on possible anomalies surfaced also in other ports. The benefit of such cooperation between ship and surveyor would save time, money and unnecessary frictions for all interested parties.

It is well known that many old ships do not have the documentation for the draught survey in order. It is suggested that a certain time should be given to the Owners, say one year, to produce the documentation as requested by the final form of draught survey techniques and equipment specifications indicated below.

If charterers would include such a prescription in charter parties in their own interest, the issue would find a quick and general answer.

3. **The basic document for the performance of draught survey:** is the "Data Manual for Draught Surveys" which is certified by the vessel's home Administration or its classification society.

The use of the term "approved" documents in the following sections shall be taken to mean that the reference data has been checked by the Administration, a recognized Classification Society, or by the Shipbuilder and that the document available on board has a unique drawing number for identification purposes and; also, bears a stamp or similar endorsement attesting to such verification.

The language of the approved documentation shall be in English or, alternatively, all identifications, labels, etc., facilitating the use of the technical data shall have subtitles in English.
The weight and measurement units unless there is prior agreement to use different units, shall be in the metric system. The displacement is to be indicated in tonnes equivalent to 1 cubic metre of water at 4°C where the density and the specific gravity is 1.000.

As for the sign convention all moments shall be measured from midships. Forward shall be designated (-) and aft shall be designated (+).

The thickness of keel plate shall be always included. The bottom of the keel shall be the zero vertical reference on all tables of hydrostatic data.

All draught marks must be displayed in centimetres or decimetres at both sides of the vessel, forward, aft and midships. The marks shall consist of numbers 10 cm high with the bottom of the number positioned so as to be the reference mark for the indicated number. The marks shall be placed at every second decimetre and be outlined with a beading of welding or similar, permanent, raised presentation. The range of the marks shall encompass draughts from lightship to the deepest draught permitted by the Load Line assignment with such additional marks, forward and aft, as will encompass the anticipated operational range of trim of the vessel. The approved documentation of the vessel shall include a diagram or a table which furnishes the length between the draught marks and the distances between the draught marks and the adjacent perpendiculars.

Forward and aft the draught marks must allow draught readings even if the vessel is extremely trimmed by head or stern. They should be displayed beginning at a draught of 20 cm forward and - depending on LPP - at a reasonable draught aft, and going up to a height of summer draught + LPP/100 forward and + LPP/20 aft.

Even smaller vessels should have midship draught marks. Vessels in excess of 200 metres L.O.A. should have marks provided at five points (forward, end of mid-quarters, midship and aft) on each side, to allow more accurate calculations of hogging or sagging.

4. **Provisions for Sounding Tanks**: all tanks for ballast or consumable liquids also on "small" coastal vessels shall have sounding pipes located at the forward and after ends of the tanks. Ballast water tanks in the double bottoms shall have sounding tubes at the forward and after ends of the tanks to permit soundings when pocketing occurs due to trim in either direction.

In addition tank sounding and calibration tables should be made in tabular presentation for soundings taken forward and aft, with corrected volumes for each decimetre of sounding and each metre of trim. Linear corrections to soundings should not be presented as they may lead to negative sounding results and do not take "wedge" volumes (dead remains) into consideration. The approved documentation of the vessel shall include a drawing(s), plan and elevation, drawn to a scale appropriate to the length of the vessel but not smaller than 1:200, which locates and identifies every cargo space, tank, cofferdam and void space. The location and length of each sounding pipe shall be shown on this drawing or on a supplementary document. Ballast hold calibration tables should be compiled for soundings and ullages.
Specific notes should be made of the exact location of the reference height of the sounding pipe from where ullages are taken (deck plate or top of sounding pipe).

If soundings are taken, likewise specific note should be made whether soundings are taken to top of DB tanktop or to bottom of bilge: if the latter is the case, additionally height and volume of bilge are to be noted.

The range of the trim calibration values for all tanks and ballast holds should be in accordance with the length of the vessel for a trim equivalent to LPP/100 for forward and LPP/20 for aft.

The approved documentation of the vessel shall include tank capacity tables for all ballast and consumable liquid tanks. The tables shall indicate volume in cubic metres versus the sounding or ullage in increments of 10 cm. The tables shall be calibrated for zero trim. Additional tables of volumes or tables of corrections to zero trim volumes shall be provided for such other trims, in increments of 1.0 m, forward and aft, to encompass the vessel's intended operational range of trims. It is to be noted that if the trim exceeds this range and the absence of data will prevent accurate calculation, the draught survey cannot be conducted.

If the vessel has a duct keel, large bore ballast pipes, or similar appurtenances which, in normal operations may or may not be flooded, information on the volumes of these spaces shall be included in the approved documentation of the vessel. Surveyors are warned to pay special attention when entering the correction tables particularly in respect of the scale of increments.

5. **Verification of Ballast Tank Condition:** remaining mud in ballast tanks can lead to considerable inaccuracy in the determination of the ballast weight.

There is almost no possibility for the draught surveyor to ascertain the mud in the tanks, either because the tanks are full or the manhole covers are overstowed by cargo.

Periodical surveys regarding the condition of ballast tanks are part of the class renewal survey anyway. It would be for the class surveyor to extend his inspection in order to verify mud and sand in ballast tanks as well. The surveyor should be instructed and compensated adequately for this troublesome work.

6. **Light Ship Weight:** there are different methods in use to determine the light ship weight of a vessel. It is seldom the case that the calculated light ship corresponds to the actual light weight, but such difference forms part of the ship's constant.

The "as built" shape normally varies from the design shape and consequently the volume of the underwater body as calculated is only an approximation.
This fact does not lead to any discrepancies between weight loaded and weight discharged as long as this weight is determined at both ends by means of draught surveys. But the weight is wrong by the error of "as built" and it also explains some times the discrepancies between a weight measured by belt weighing and weight determined by a draught survey.

There are methods and techniques available today to measure this discrepancy, and such measurements should become compulsory for ships serving in the bulk trade.

Furthermore the light ship weight should be approved and verified by the Classification Society and re-approved after the vessel has been in service for 10 years, thereafter every five years, and of course after each modification of the vessel, such as reinforcement of deck stringers, removal or addition of cargo gear etc.

Record of ship's constant: the constant is defined as the difference between the lightship weight in the ship's approved Trim and Stability Booklet and the lightship as calculated in a completed draught survey. The vessel is required to keep a "constant" certificate which shows the date, the constant obtained, and the signatures of the chief officer and the surveyor. It shall be the responsibility of the Chief Officer to maintain this record (see remarks on line 090 of Form "B").

7. Particulars of Vessel: the vessel's approved documentation shall include the following information:

- length overall
- length between perpendiculare
- extreme breadth
- moulded breadth
- depth overall (including keel plate)
- moulded depth
- summer draught
- summer freeboard
- summer displacement
- summer deadweight
- light ship weight.

8. The Required Hydrostatic data: the vessel's approved documentation shall include the following hydrostatic data in tabular form and with the zero reference taken at the bottom of the keel plate:

- displacement
- tons per centimetre immersion
- longitudinal Centre of Flotation
- moment to trim one centimetre.

The range of the hydrostatic data shall be from the light ship draught to the deepest draught permitted by the Load Line assignment.
9. **Displacement**: the approved documentation of the vessel shall include tables furnishing displacements in metric tons of fresh water for every 20 mm from the light weight draught to the deepest draught permitted by the Load Line assignment. These tables shall provide data for zero trim and for such other trims, in increments of 0.5 m, or less, forward and aft, as will encompass the intended operational range of trims. It is to be noted that draught surveys cannot be conducted when the trim exceeds this range.

The displacement data shall be generated by integration of the Lines drawing at the various trims tabulated and shall include the shell plating and the appendages. The displacement at trims other than zero may be calculated by formula but this shall include both the LCF and the Nemoto corrections.

10. **Summary of the required documents**: for an accurate draught survey it can be considered that the following items are mandatory requirements:

- sign convention;
- draught readings from below keel;
- raised draught marks up to LPP/100 fwd, LPP/20 aft;
- proper tank sounding conditions;
- verification of light weight;
- particulars of vessel as previously listed;
- distance between draught marks and perpendiculars;
- length between draught marks fore and aft;
- displacement tables corrected for trim in FW;
- tanks sounding tables in tabular presentation of volumes;
- trim correction tables with corrected values for each decimetre of sounding and each 0.5 m of trim;
- range of calibration tables for a trim of forward LPP/100 aft, LPP/20;
- identification plan for:
  - each tank and ballast hold;
  - each cofferdam and void space;
- with capacity tables for:
  - each ballast tunnel/duck keel and;
  - large bore ballast pipes.

11. **Final observations**: as long as no respected international standards are applicable, Yards and Owners will continue to supply just the minimum of information on the vessel, using their own standard and opinion about measurements units, signs, volume moulded or on shell sides, arrangement of sounding pipes etc. Since the inaccuracy of documents (like for instance approximate tank calibration) could affect also the seaworthiness of the ships, I.M.O. and Classification Registry should revise their rules in this matter and proceed in turn to the verification of the existing vessels when they will be due for Class Survey. The Solas convention should help indirectly the situation within 1993.

Especially light ship weight is a figure in regard to which Yard and Owners tend to have different views although they aim for the same target: to achieve the maximum dead weight capacity at a minimum of expense. In the market, this can become a question of compatibility and competition and exceptions are made if standards are not mandatory.
PART 4.

SURVEYORS' QUALIFICATIONS
UN/ECE CODE OF UNIFORM STANDARDS AND PROCEDURES FOR THE
PERFORMANCE OF DRAUGHT SURVEYS OF COAL CARGOES

PART 4 - SURVEYORS' QUALIFICATIONS

GENERAL PROBLEMS

There is no standard for draught survey execution contrary, for instance, to the drawing up of the ship's data (draughtsmanship, diagrams etc.). Also a reference can be made to the IMO Conventions on Load Lines (1966). When calculating the vessel's displacement (e.g. at the inclining test) Classification Societies and Shipping Inspectorates stick to this Convention. For draught survey instead the surveyors are actually at total liberty to set their own standards.

Every Sworn Surveyor in the countries where certification exists has to make a pledge to carry out his duties "to his best skill and knowledge like a good and true draught surveyor".

Unfortunately standards or agreements on draught survey methods that may be referred to are still lacking, rendering trading partners strongly dependent on the integrity and skill of the surveyor. The world over there is excessive diversity in the way draught surveys are carried out leading to a great deal of uncertainty for buyers, sellers and carriers of cargo.

Obviously each surveyor regards himself as an expert in his field employing standards of his own (individual subjective interpretation) which may deviate from the standards used by his colleague at the other side. If the trading partners are lucky, surveyors at either side agree upon a certain working code in order to reduce discrepancies caused by the different methods used (collective subjective interpretation).

The lack of draught survey uniformity tends to generate numerous complaints by Principals, the weak legal evidence of the draught survey report and the lack of an authorized training or certification scheme are other deficiencies.

The qualifications and experience of the draught surveyor is considered to be of paramount importance. Frequently, surveys must be conducted under time constraints or adverse conditions of sea and/or weather. Also, the format and content of the ship's technical data varies widely and special expertise is needed to use this information correctly. It is believed that quite often cases of dispute over cargo weights can be attributed to a lack of experience on the part of the draught surveyor. In other cases, the difficulty may be caused by deficiencies in the ship's data. The expertise of the draught surveyor will depend upon his training, professional development and subsequent experience. While a background as a deck officer on a merchant ship has been, and will probably continue to be, the principal prerequisite for the draught survey profession, non-seafaring persons can function satisfactorily in this profession provided they obtain sufficient instruction. This Code will meet a need by supplying a text book which, augmented by on-the-job training, could constitute such instruction.
SPECIFIC CONSIDERATIONS AND LIMITATIONS

At present, in most countries, there is no governmental certification of draught surveyors. So the choice of the surveyor by the client must be on the basis of his reputation. Most of the major organizations specialized in the draught survey activity recognize the importance of maintaining their reputation and, therefore, demand the highest standard of character and integrity in selecting their employees. Eventually, there should be an International Scheme for Licensing the Surveyors set for instance by the ILO.

Only requiring a certificate from a school would probably not address the problem. Surveyors should be taken from the rank of experienced seamen possibly holding licences no less than first mate certificate and subsequently be trained on the job.

As for the importance of nautical-related activities, there is a difference between nautical and engineering disciplines. In the former case the deck officer is concerned with operating the ship at sea and in port. Engineers and naval architects operate in a world of structures and materials which can be measured and costed. They are practising established disciplines linked particularly, as far as ships are concerned, to standards created by Governments and Classification Societies that define strength, durability, maritime fitness, etc.

Nautical-related activities instead, are more sporadic and create less predictable demands which are, by their nature, challenging. They do, however, require experience for their solution. As opposed to engineer surveyors, who are devoting their talents and skills to what is basically another diversification of their primary career, the draught surveyor is in essence starting a second career and coming from a shipboard environment, may find it somewhat difficult to find his way around shore-based institutions and practices. This is why proper training is a must.

Draught surveys will involve the surveyor in the measurement of a wide variety of different types of vessels and of different nationalities each with its own characteristics. Furthermore, measurements may sometimes have to be made in difficult circumstances so that no draught survey manual could endeavour to cover all possibilities.

Because of the above peculiarities all draught surveys should be conducted by an accredited and experienced marine surveyor as experience in this area will assist in alerting him to any deficiencies in vessel equipment or hydrostatic data and to the effect of any modification to the vessel which may influence the accuracy of the survey. It may appear that the draught survey accuracy entirely depends upon the skill and the integrity of the surveyor/expert. Yet, however skilled the surveyor may be, without the required data and the cooperation of the partners concerned, he will not be able to effectively prevent weight disputes, nor will he be able to effectively resolve such disputes as may arise.
Skilled or not, figures will always be arrived at in one way or another, but whether or not this represents the correct weight will remain an open point of dispute so long as those directly involved (the buyer, the seller, the carrier and the cargo or transport underwriter) remain devoid of the understanding of how their cargo values are ascertained. Only they, and they alone, are capable of enhancing the reliability of the draught survey by exerting their influence when concluding their agreements of sale, charter and selection of draught surveyors. It goes without saying that unscrupulous and/or unqualified individuals in this discipline, like in other fields of activity, can be hired for very low fees and cause large economic damages. This is why it is advisable to reward adequately the surveyors.

In terms of high level education the surveyor should have satisfactorily completed two years of College or University or demonstrated an equivalent level of education as evidenced by possessing not less than a first mate (chief officer) licence in the merchant marine or equivalent. This qualification is intended primarily to establish that the person has the mental capability to satisfactorily carry out the tasks required by a draught surveyor.

In terms of training prior to commencing work as a surveyor, the person should have a minimum of five years' experience in work on board ship either in seagoing operations or port cargo operations. This experience is intended to ensure that the person has a good knowledge of the layout of a ship, especially its cargo holds and tanks, the general working of a ship, and the hierarchy of the personnel involved in the operation of a ship.

Many surveyors have a nautical background during which they have been sufficiently trained in practice. Another way to acquire the necessary training is to join one of the special training courses, such as given by international corporations specialized in draught survey. Prior to commencing work as a fully qualified draught surveyor, any person, including licensed merchant marine officers and persons with extensive maritime experience, shall undergo at least three months on-the-job training by accompanying a fully qualified surveyor engaged in the performance of draught surveys. This training shall include participation in not less than 50 complete draught surveys. The training shall cover, in detail, the subjects of acquisition of pertinent ship and cargo information, recording of draughts, determination of water density, sounding of tanks, calculations, and preparation of reports.

In terms of temperament, in so far as it can be evaluated, the surveyor should have the ability to work under pressure because ship operations or cargo operations often must await the completion of his tasks. Also, he should be tactful and able to work well with people because the expeditious completion of his task often depends upon the cooperation of personnel who are not within his charge.

During the daily draught survey work a good deal of climbing of ladders and walking is involved. Consequently the need of good physical health is self-evident.
Last, but not least, in terms of character, because most of the component tasks which constitute a draught survey cannot be directly supervised and, because the draught surveyor must prepare his report on the basis of fact and without prejudice or favour to his client, or to any other party, it is of fundamental importance that the surveyor must not have a criminal record or any other blemish of his personal reputation which may indicate that he does not possess the highest standard of character and integrity.

In view of the complexities listed in the previous paragraphs and the necessary accuracy for the proper performance of a draught survey, it is axiomatic that the persons so engaged be of "proven ability" by which is meant in summary:

(a) An unblemished reputation attesting to his honesty and integrity.

(b) Total cognizance of shipboard terminology as it pertains to draught surveying practice.

(c) Knowledge of the principles of hydrophysics combined with sufficient familiarity with basic naval architecture to describe the basis for each of the steps necessary to accurately ascertain by draught survey procedure the amount of cargo loaded or discharged.

(d) Sufficient experience on board vessels of differing propulsion system and varying tankage arrangements to ensure that the survey includes all data necessary to a complete calculation. This shall include, necessarily, the ability to accurately interpret a vessel's plans and documents though they may be completed in a language alien to the draught surveyor.

(e) An understanding of mathematics sufficient to the performance of the calculations.

(f) A facility with items (b)-(e) above, taken in combination, sufficient to obtain such further information pertinent to the vessel, from the deck or engine personnel, as is necessary to the proper completion of the survey, should the need arise.

(g) Good command of the English language, and the ability to use modern computers and electronic instrumentation.
PART 5.

GLOSSARY
OF TERMS
AND DEFINITIONS
UN/EC Code of Uniform Standards and Procedures for the Performance of Draught Surveys of Coal Cargoes

PART 5 - GLOSSARY OF TERMS AND DEFINITIONS

Terms used in this document in connection with draught survey terminology and also terms typical of shipping, chartering and trading glossary are defined here for the benefit of the reader and user.

Administration
Means the Governments of the State whose flag the ship is flying.

Adopted
The action of IMO or ILO or other international organization in approving any set of rules to be submitted to governments for possible ratification.

Aft
At or towards the rear part of the vessel.

Aft draught (AD)
Draught, measured at the aft part of the vessel.

Aft perpendicular (AP)
See perpendiculars

Aft peak tank
A compartment situated at the extreme rear of the vessel often used to contain fresh water or ballast water.

Age of a ship
Means the elapsed period of time determined from the year of build as indicated on the ship's registry papers.

Air draught
A vessel's air draught is the height of the uppermost part of the ship (top of mast) above the waterline. Usually given to ascertain the ship's clearance under bridges or loading/discharge machinery.

All ships
Both "new" and "existing" ships.

Amidships (midships)
Amidships is to be taken as the middle of the Rule length, L, measuring from the forward side of the stem. (See also rule length and midships).

Angle of repose
The maximum slope angle of non-cohesive (i.e. free-flowing) granular material. It is the angle between a horizontal plane and the cone slope of such material.
A low angle of repose characterizes a bulk cargo which is particularly liable to dry surface movement aboard ship. (See also cargoes which may liquefy and flow state).

Aft perpendicular.

The following corrections must be made:
1. Perpendicular corrections to draught readings.
2. Nos. 1 and 2 trim corrections.
3. Hydrometer stem correction (if given).
5. Water tank trim and list corrections.
6. Ballast water density correction.
7. Fuel tank temperature corrections if temperature changes are large.
8. Alterations in bunker, lubricating oil and stores.

If any corrections cannot be applied, this fact should be noted in the report.

Nautical surveyors of whatever discipline are constantly required to find the area, the moment of area and the second moment of area of figures bounded by straight lines and curves. In the case of ships, the curves will generally be fair and smooth. If the ordinates defining a particular curve represent areas, then the area under the curve will be a volume and if required the centre of gravity of the volume can readily be found.

Cargo loaded on what would have otherwise been a return ballast leg is known as back cargo. The term usually applies to the cargo carried back to
the vicinity of the loading port of the principal (outward) cargo. Partial back cargoes are also common.

Back haul
The return voyage with or without back cargo.

Back-to-back Charter
A charter arrangement with a shipowner that guarantees cargo for a given period against a shipbuilding contract.

Ballast
Water, river water or sea water, pumped into the appropriate tanks or out of the vessel in order to adjust the trim or draught of the ship. To provide stability and propeller immersion.

Ballast tanks
Tanks specially designed aboard the ship to receive water ballast or, in the case of tank vessels, cargo tanks used to contain ballast.

Bareboat Charter
An agreement whereby the charterer assumes responsibility for virtually the complete management of the vessel and for all related expenses including the hiring of crew, maintenance and repairs.

Beam (breadth)
Breadth of the ship is the extreme width from outside of frame to outside of frame at or below the deepest subdivision load line.

Bilges
Spaces at the bottom of the engine room or pump rooms where water is allowed to accumulate. As the bilges usually also contain waste oil, they may not be discharged within port limits. For draught survey purposes the quantity of liquid in the bilges should be controlled before and after loading or discharge, so that any change in quantity can be detected.

Block coefficient (Cb)
The block coefficient, \( C_b \), is the moulded block coefficient at draught \( T \) corresponding to summer load waterline, based on Rule length \( L \) and moulded breadth \( B \), as follows:

\[
Cb = \frac{\text{moulded displ. (m}^3\text{) at draught } T}{LBT}
\]
Blocked sounding pipes

If a sounding tape cannot reach the bottom of the pipe, any reading will be in error. The maximum possible soundings, as shown in the tank calibration tables should be checked at intervals by the ship's personnel and checks should be made at a draught survey.

Boiler feedwater tanks

Tanks provided aboard the vessel to contain water used for the production of steam.

Bonjean curves

The area of a transverse section of a ship to successive waterlines may be calculated and plotted in the form of a fair curve known as a Bonjean curve (named after the Frenchman who first used them). The curves are often plotted on a profile of the ship as shown, and this enables the volume of displacement and centre of buoyancy to be calculated to any waterline, trimmed or even keel. The curves are particularly useful for stability, strength, capacity and launching calculations.

The curves may also be plotted using a vertical line as a common base. This has advantage that larger scales may be used for the areas of the sections, but if the ship is trimmed it is necessary to obtain the draught at each of the displacement stations before being able to read off the values of the areas.

Boundary curve and parabolic curve

If the equation of the boundary curve were known then the area under the curve could be found quickly and accurately using the appropriate mathematical formula for integration. In the majority of cases, however, the equations are not known and it is generally assumed that the curved boundaries consist of a series of parabolic curves. This enables approximate arithmetical, rather than mathematical, rules to be applied to calculate the areas and moments of areas about a particular axis. The values so obtained are normally sufficiently accurate for the great
majority of practical purposes. Any errors which may remain after taking appropriate steps are of the order of less than 1/4 per cent of the area which would be obtained using mathematical processes if this were possible.

Breadth (beam)

Breadth of the ship is the extreme width from outside of frame to outside of frame at or below the deepest subdivision load line.

Bulk carrier

A vessel designed for the carriage of bulk cargoes in dry form.

Bulkhead deck

Bulkhead deck is the uppermost deck up to which the transverse watertight bulkheads are carried.

Bunkers

The fuel used by a vessel. (See also fuel oil and oil fuel).

Bunker surveys

Any survey to establish the quantity, and in some instances the quality, of the oil, fuel and fresh water remaining on board a vessel.

Bunker tanks

Tanks intended to contain fuel oil either for steam raising purposes or for the provision of power to the main engines and auxiliaries.

Calibration tables

See tank sounding tables.

Cape Size

A class of vessel which, for the purposes of this Code, is taken to be in the range of 80,000-160,000 dwt in size. The term describes a vessel size that is too large for the Panama Canal and must navigate the Cape of Good Hope.

Captive fleet

A group of vessels owned and/or operated under the direct control of either a raw material seller or buyer.

Cargo guarantee

The guarantee given to a shipowner by a raw material buyer or seller that he will provide cargo for a certain period of time.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cargoes which may liquefy</td>
<td>Materials which are subject to moisture migration and subsequent liquefaction if shipped with a moisture content in excess of the transportable moisture limit. (See also Angle of repose and flow state)</td>
</tr>
<tr>
<td>Cargo space</td>
<td>Any space in the ship appropriated for the carriage of cargo.</td>
</tr>
<tr>
<td>C &amp; F</td>
<td>Cost and Freight. The seller must pay the costs and freight necessary to bring the goods to the named destination but the risk of loss or damage to the goods, as well as any cost increases, is transferred from the seller to the buyer when the goods pass the ship's rail in the port of shipment.</td>
</tr>
<tr>
<td>Centre of buoyancy (B)</td>
<td>The centre of gravity (B) of the volume formerly occupied by the fluid displaced by a floating body. Centre of displacement.</td>
</tr>
<tr>
<td>Centre of flotation (F)</td>
<td>The point around which a ship tips often called the &quot;tipping centre&quot; (F). This is the centre of gravity of the area, or centroid, of the waterplane of a ship. For small angles of trim consecutive water-lines pass through F.</td>
</tr>
<tr>
<td>Centre of gravity (G)</td>
<td>This is the point through which the total weight of the ship may be assumed to act. It is also defined by: (a) KG the vertical distance above the base. (b) FG the longitudinal distance from the forward perpendicular. (c) LCG the longitudinal distance from amidships.</td>
</tr>
<tr>
<td>Centre tank</td>
<td>Means any tank inboard of a longitudinal bulkhead.</td>
</tr>
<tr>
<td>Check of void spaces</td>
<td>Check soundings should be made of all void tanks/spaces, i.e. duct keel, chain locker, hold bilges, engine room bilge, cofferdams, saddle tanks, etc.</td>
</tr>
</tbody>
</table>
CIF

Cost, Insurance and Freight. This refers to the cost of a commodity, its insurance and cost of transporting by sea to a specified port, all borne by the seller. It should be noted that the seller is only required to cover insurance on certain minimum conditions.

Clean Ballast

Clean ballast means the ballast in a tank which since oil was last carried therein, has been so cleaned that effluent therefrom if it were discharged from a ship which is stationary into clean calm water on a clear day would not produce visible traces of oil on the surface of the water or on adjoining shorelines.

C.O.A.

Contract of Affreightment. This is a transportation contract between a charterer and a shipowner which is fixed on the basis of cargo quantity or consecutive voyages, and usually covers a long term period. A specific vessel may or may not be nominated to perform the task.

Coefficients of form

Form is used as a general term to describe the shape of a ship's hull as defined by the lines plan. To compare one ship with another a number of coefficients are used. These may be obtained by calculation and are of value when making power, stability, strength, tonnage and other design calculations.

Cofferdams fwd and aft

These terms apply more particularly to ocean tankers, coastal tankers and tank barges. They are empty spaces provided in order to separate the cargo tanks from the machinery space afloat and from the forward peak and other forward parts of the ship. Cofferdams are also on O.B.O. between each hold. Cofferdams frequently contain water, intentionally or accidentally, and should therefore always be sounded both before and after cargo is being measured by draught survey.
Combination carrier means a ship designed to carry either oil or solid cargoes in bulk.

Modern draught surveyors now can make extensive use of computers, which because of their high-speed number-handling capabilities take much of the tedium out of the basic calculations.

The software programs use simple and multiple arithmetical calculations and are based on the principles outlined in previous sections. For a ship the input data are generally the offsets of the ship as measured from the waterlines or body plan. Separate programs are available from many commercial sources and can be used on small or large computers.

Materials obtained from a natural ore by a process of purification by physical or chemical separation and removal of unwanted constituents.

A survey of a vessel and of the equipment on board to establish the condition and perhaps fitness to trade of the vessel and to draught survey control. To be required by charterers prior to a vessel being chartered or at regular intervals. Charterers intending to use a ship also for cargo weights determination should require also the survey of the vessel's documents including data specifically needed and issued for draught survey and calibration manual to be issued upon request by classification registry.

The difference between the light ship weight according to ship's documents and the net empty survey displacement after deducting all measurable weights. The weight of a completely empty ship (light weight) is known from the builders data, as used for the inclining experiment. The variable weights, i.e. fuel, ballast water,
fresh water, lubricating oil stores, etc. can be calculated by measuring those items. This is particularly true of liquids, providing the relevant tank has been calibrated. The total of the above known weights is normally less than the weight given by the displacement calculation for the particular draught. The difference is termed the constant for the vessel at that time. The constant will vary, depending on which items in a particular draught survey are considered to be fixed. It will include cooling water in the engine systems, lubricating oil in engine sumps, etc. but it may also include all lubricating oil and/or permanently filled water tanks. The constant should vary over consecutive surveys only by approximately plus or minus 10 per cent. Variations greater than this should be identifiable by differences in the items used to obtain the deductions mentioned in the first paragraph above. The more items which have their weights calculated in a particular survey, the smaller and more accurate the constant will be. The total of all known weights, plus the constant, is subtracted from the loaded displacement to obtain the weight of cargo on board.

Dead freight

Damages payable to the shipowners as a result of loading a vessel to less than the agreed limits.

Dead Remains in Tanks

Another source of error is the fact that it is almost impossible to empty each tank completely. Although this is unimportant for fuel oil tanks - the remaining fuel in the tanks will be included in the constant - it may cause important errors in the determination of the ballast figure. It is very difficult to trace and include in the dead weight calculation remaining "wedges" in ballast tanks, if the vessel's trim is contrary to the position of the sounding pipes, unless there are sounding pipes at both ends of the tank.
In addition the calibration tables have to be made in computed values for various trim conditions. Linear corrections may lead to negative soundings results and should not be accepted.

Deadweight (DW)

Means the difference in metric tons between the displacement of a ship in water of a specific gravity of 1.025 at the load waterline corresponding to the assigned summer freeboard and the lightweight of the ship.

Deckline

A line clearly marked on the Port and Starboard sides of the vessel, amidships as required by International Loadline Regulations.

Deepest subdivision load line

The waterline which corresponds to the greatest draught permitted by the subdivision requirements which are applicable, or by Load Line Convention requirements.

Deeptanks

Portions of a vessel's hold partitioned off and specially constructed to carry water ballast and also arranged to carry dry or liquid cargo alternatively. The usual plan is to have deep tanks at either or both ends of the engine and boiler space, extending from side to side of the vessel, but they are occasionally fitted in the wings only. The purpose of deep tanks is to provide additional ballast without unduly lowering the centre of gravity in large modern cargo vessels of bluff form, where double bottoms do not afford the necessary amount of ballast. They are bounded at each end by reinforced watertight bulkheads, and at the top by a watertight steel deck or flat. They usually run from the tank top up to or above the lower deck.

Density (apparent)

The apparent density of sea water, fresh water, ballast water, etc. is measured by the Draft Survey Hydrometer and gives weights comparable to those which would be obtained by weighing a
Density (true)  

The mass per unit volume of a substance.

Density of ballast water  
The density of the ballast should be measured in as many tanks as necessary in order to obtain a true figure. It may be that different tanks will have different densities, if ballast has been loaded at different places. Differences may also occur if the ballast was taken in a river port, with tidal changes.

Depth (D)  
Depth, (D), is measured, in metres, at the middle of the length, L, from top of keel to top of the deck beam at side on the uppermost continuous deck. When a rounded gunwale is arranged, the depth (D) is to be measured to the continuation of the moulded deck line.

Diesel oil  
Fuel oil used to feed diesel engines. There are various grades of diesel oil including light diesel oil for auxiliary engines and heavier diesel oil for main engines.

Displacement as a volume  
This is the volume of the depression in the water occupied by the ship, measured in cubic metres.

Displacement as a mass  
This equals the quantity of water displaced and as the kilogram is the unit of mass and 1,000 kg = 1 tonne, the unit which is used when referring to the size of a ship is the tonne.

Displacement as a weight  
This is the weight of water displaced by the ship and equals the volume displaced multiplied by a constant representing the density of water i.e.,

- In fresh water 1,000 kg/m³
- In sea water 1,025 kg/m³

The displacement weight of a ship can vary according to circumstances and position in the world, although displacement weight and ship weight are equal when the ship is at rest in equilibrium in still water.

carefully calibrated container on an accurate weighbridge, so as to obtain commercial weights. (See also specific gravity).
<table>
<thead>
<tr>
<th>Topic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacement and hydrostatic information</td>
<td>If the displacement for mean draught is given in cubic metres, this figure should always be used in conjunction with the observed apparent seawater density to obtain the weight of the ship at a given moment. This will be a weight in air. If the displacement is given in tons or tonnes the conversion factor applied to the volume should be obtained from the hydrostatic information. If it states that an &quot;S.G&quot; or &quot;density&quot; of 1.025 has been used then the given displacement should be converted back to cubic metres for multiplication by the apparent seawater density. This will ensure that all weights are weights in air not weights in vacuo.</td>
</tr>
<tr>
<td>Displacement and tonnage</td>
<td>Are among the terms most widely used when considering ships and shipping and although there are different types of displacements and tonnages they are all related basically to the total volume or partial volume of the ship.</td>
</tr>
<tr>
<td>Displacement extreme</td>
<td>This equals the moulded displacement, plus the displacement of the shell plating, bossings, cruiser stern and all other appendages.</td>
</tr>
<tr>
<td>Displacement moulded</td>
<td>This is the mass of water which would be displaced by the moulded lines of the ship when floating at the designed load water-line.</td>
</tr>
<tr>
<td>Displacement table</td>
<td>A table, specially prepared by the building shipyard for each vessel, giving the displacement corresponding to various draughts. The half-breadths of the moulded waterplanes are measured from the body plan and put into table. The displacement is found by summing the areas in two directions - i.e. vertically and horizontally - and of course the two answers must agree.</td>
</tr>
<tr>
<td>Double bottom tanks</td>
<td>Tanks situated in the vessel's double bottom and used either for bunkers or ballast water.</td>
</tr>
</tbody>
</table>
Draught (draft)

Draught is the vertical distance from the moulded base line amidships to the subdivision load line in question.

Draught marks

A series of figures painted or welded on the vessel's hull, usually forward, midships and aft, on both Port and Starboard sides and indicating the draught of the vessel at the points where the draught marks are situated.

Draught survey

A system of measurement of cargo weight based on measuring the draught of the vessel before and after loading or discharge, taking into account any changes in weight other than cargo, which may have taken place during the cargo handling operation, i.e. changes in the weight of water ballast, bunkers, stores, etc.

Drinkable water

Fresh water for human consumption. Potable water.

DWT

See deadweight

ECE

Economic Commission for Europe of the United Nations

Engine water

Water used for the cooling system of diesel engines.

ECOSOC

Economic and Social Council of the United Nations.

Even keel

When the forward and aft draughts of a vessel are identical, the ship is said to be on an "even keel".

Expert

A person with special skills, technical knowledge or professional qualifications whose opinion on any matter within his cognizance is accepted as evidence. The decision as to the qualification of a witness to give evidence as an expert is made by the judge or arbitrators.

Filled compartment

The term "filled compartment" refers to any compartment in which after loading and trimming as required the ballast water or cargo in bulk are at their highest possible level.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flag of registry</td>
<td>The country in which a vessel is registered.</td>
</tr>
<tr>
<td>Flag state</td>
<td>The country of the flag the ship is entitled to fly. The State having jurisdiction over that ship.</td>
</tr>
<tr>
<td>Flow moisture point</td>
<td>The percentage moisture content (wet mass basis) at which a flow state develops under the prescribed method of test in a representative sample of the material. (See also Flow state).</td>
</tr>
<tr>
<td>Flow state</td>
<td>A state that occurs when a mass of granular material is saturated with liquid to an extent that under the influence of prevailing external forces such as vibration, impact or ship's motion, it loses its internal shear strength and behaves as a liquid. (See also Angle of repose, Cargoes which may liquefy and Moisture migration).</td>
</tr>
<tr>
<td>F.I.O.</td>
<td>Free In, Out and Stowed. Loading, stowing and discharge which is free to the shipowner.</td>
</tr>
<tr>
<td>F.O.B.</td>
<td>Free on Board. Buyer of cargo arranges the shipping and pays for insurance and freight over and above price of the commodity.</td>
</tr>
<tr>
<td>F.O.C.</td>
<td>Flag of Convenience. Used to denote the registration of a vessel in a country that does not require its nationals to be necessarily involved in the ownership or operation of a vessel.</td>
</tr>
<tr>
<td>Fore (forward)</td>
<td>At or towards the front part of the vessel.</td>
</tr>
<tr>
<td>Forepeak tank</td>
<td>A compartment situated at the extreme forward part of the vessel often used to contain fresh water or ballast water.</td>
</tr>
<tr>
<td>Forward draught (FD)</td>
<td>Draught, measured at the forward part of the vessel.</td>
</tr>
<tr>
<td>Forward perpendicular</td>
<td>See perpendiculars.</td>
</tr>
<tr>
<td>FP</td>
<td>Forward perpendicular.</td>
</tr>
</tbody>
</table>
Freeboard Deck
The freeboard deck is normally the uppermost complete deck exposed to weather and sea, which has permanent means of closing all openings in the weather part thereof, and below which all openings in the sides of the ship are fitted with permanent means of watertight closing.

Freeboard (assigned or statutory)
The freeboard assigned is the distance measured vertically downwards amidships from the upper edge of the deck line to the upper edge of the related load line.

Fresh water
For the purpose of draught survey measurement of "deductible liquids", fresh water may be defined as the total of the drinkable water and washing water aboard the vessel.

Fuel oil (heavy)
High density fuel oil used either as boiler fuel or as fuel for main diesel engines suitably adapted for the purpose. (See also Bunkers and Oil fuel).

General cargo vessel
A vessel of the single deck type, or a vessel having one or more "tween decks" whose holds run without interruption from shell plating to shell plating or a vessel whose hold subdivision by longitudinal bulkheads is insufficient to effectively restrain the bulk cargo from shifts capable of imperilling stability and without special strengthening for heavy cargo.

Handy size
A class of vessels which, for the purposes of this Code, is taken to be under 50,000 dwt in size.

Hogging
The deflection of a vessel loaded in such manner that the draught amidships is less than the mean of the forward and aft draughts.

Hydrostatic curves
A document specially prepared for each vessel indicating, among other things, the centre of flotation or "tipping centre" at various draughts. Sometimes referred to as "curves of form".
Hull reference

For hull reference purposes, the ship is divided into 21 equally spaced stations where Station 0 is the after perpendicular, Station 20 is the forward perpendicular, and Station 10 is mid-Lpp.

I.F.O.

Intermediate Fuel Oil. The grade of fuel in general use.

I.L.O.


I.M.O.


Inclining experiment (KG)

The process of heeling a ship by moving known weights at measured distance in order to calculate the basic vessel lightweight information i.e. (KG).

Inmarsat

The International Maritime Satellite Organization, based in London. Deals with all matters related to satellite communications.

Interpretations

Agreement reached within IMO as to how the requirements of a particular convention might be applied in practice to achieve uniformity and simplicity.

I.T.F.

International Transport Federation.

Keel

The part of a ship extending along the bottom from stem to stern.

Knot

The unit of measure of ship's speed. One knot is a speed of one nautical mile or 1,852 m per hour. (See also nautical mile).

Lay-up

The mooring of a vessel for a substantial period of time usually without crew.

LCF

Length between centre of flotation and amidships. (See also Longitudinal Centre of Flotation).
**Length Between Perpendicular (LBP)**
(or baseline)
The distance, in metres, on the summer load waterline from the fore side of the stem to the after side of the rudder post, or to the centre of the rudder stock if there is no rudder post. The forward perpendicular, F.P., is the perpendicular at the intersection of the summer load waterline with the fore side of the stem.

**Length of the ship (L)**
Length of the ship (L) is the length measured between the perpendiculars taken at the extremities of the deepest subdivision load line.

**Light loading**
The loading of a vessel to less than its maximum permissible draught.

**Lightship**
A ship in the lightship conditions (Condition 0) is a ship complete in all respects, but without consumables, stores, crew and effects, and without any liquids on board except that machinery fluids, such as lubricants and hydraulics, are at operating levels.

**Lightweight**
Lightweight means the displacement of a ship in metric tons without cargo, oil fuel, lubricating oil, ballast water, fresh water and feed-water in tanks, consumable stores, passengers and their effects.

**Liner vessel**
A vessel which maintains a service between one and the same ports at fixed intervals in accordance with a schedule.

**List**
Inclination of the vessel from the vertical position measured at the longitudinal midships axis. It is usually measured by means of an inclinometer giving results in degrees of angle. List can also be calculated, if necessary, from the difference between the Port and Starboard midships draughts or freeboards.

**Litre**
One cubic decimetre.

**L.O.A.**
Length Over All. The total length of a vessel.
<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load line length (L1)</td>
<td>Load line length, L1, is to be taken as 96% of the total length on a waterline at 85% of the least moulded depth measured from the top of the keel, or as the length from the fore side of the stem to the axis of the rudder stock on the waterline, if that is greater. In ships designed with a rake of keel, the waterline on which this length is measured is to be parallel to the designed waterline. The length L1 is to be measured in metres.</td>
</tr>
<tr>
<td>Longitudinal Centre of Flotation (LCF)</td>
<td>The point in the waterplane area, at a given draught, around which a vessel will trim. If the LCF is forward of the midlength between perpendiculars it is given a negative sign, if it is aft the sign is positive.</td>
</tr>
<tr>
<td>Lubricants</td>
<td>Oils for lubricating the main engine, auxiliary engines and other moving equipment aboard the vessel.</td>
</tr>
<tr>
<td>Margin line</td>
<td>Margin line is a line drawn at least 76 mm below the upper surface of the bulkhead deck at side.</td>
</tr>
<tr>
<td>MARPOL</td>
<td>The International Maritime Organization's regulations on Marine Pollution.</td>
</tr>
<tr>
<td>M.D.O.</td>
<td>Marine Diesel Oil.</td>
</tr>
<tr>
<td>Mean aft draught</td>
<td>Average of the draughts measured at the Port and Starboard aft sides of the vessel.</td>
</tr>
<tr>
<td>Mean forward draught</td>
<td>Average of the draughts measured at the Port and Starboard forward sides of the vessel.</td>
</tr>
<tr>
<td>Mean midships draught</td>
<td>Average of the draughts measured at the Port and Starboard midships sides of the vessel.</td>
</tr>
<tr>
<td>Measurement of Bunker Quantities</td>
<td>In the initial draught survey all fuel, diesel and large lubricating oil tanks should be measured and the weights of the contents calculated. It is generally sufficient then to allow a daily consumption figure, to calculate the difference between the initial and final survey figures.</td>
</tr>
</tbody>
</table>
Measurement of Water Tanks

The volume of water in all ballast, fresh water and cooling water tanks should be measured by soundings or
ellages, using a steel tape or a brass rod. It is inaccurate to use a piece of rope or cord, which can stretch or
rink. It is inaccurate to overflow a tank and assume that it is full because there is no way of knowing if there are
void spaces between beams, stiffeners, brackets, etc. This is particularly true of long wing ballast tanks with a
dek camber. It is impossible to accurately calculate the volume of a tank which is overflowing at the
ounding pipe. If a tank has a
ounding which is in excess of the
aximum shown in the sounding tables
hen the water level should be dropped
ack to one which shows in the tables.
possible, the ship’s officers should
be advised of this last requirement
fore the draught survey is due to
art. Water tanks should be measured
at the initial and final surveys.

Midships (amidships)

Amidships is to be taken as the middle
of the Rule length, L, measuring from
the forward side of the stem. (See
also Amidships and Rule length.)

Midship section area coefficient (Cm)

This is the ratio of the immersed area
of the midship section (Am) to the area
of the circumscribing rectangle having
a breadth equal to the breadth of the
ship and a depth equal to the draught.

\[ C_m = \frac{A_m}{B \times T} \]

Cm values range from about 0.85 for
fast ships to 0.99 for slow ships.

Moisture content

That portion of a representative sample consisting of water, ice or other
liquid expressed as a percentage of the
total wet mass of that sample.
Procedures given in this Code apply
only to the usual cases wherein the
moisture consists almost entirely of
water or ice.
Moisture migration

The movement of moisture contained in materials by settling and consolidation of the material due to vibration and ship's motion. Water is progressively displaced which may result in some portions or all of the materials developing a flow state. (See also Angle of Repose, Cargoes which may liquefy and Flow state.)

Moment

The moment of a force is a measure of the rotating effect of the force about a given point. The rotating effect will depend upon the magnitude of the force and the length of the lever upon which the force acts, i.e. the perpendicular distance between the line of action of the force and the point around which the moment is being exerted.

Moment to change trim 1 cm (MIC)

The force in metric tons multiplied by the distance in metres required to change the trim of the vessel by 1 cm.

Moulded Depth

The moulded depth is the vertical distance measured from the top of the keel to the top of the freeboard deck beam at side.

Mud in Ballast Tanks

Remaining mud in ballast water tanks is one source of error. The only possibility to determine the weight of this mud would be to carry out a light ship draught survey without ballast water in the tanks. But how? It can only be done when the vessel is out of service at the repair yard or alongside a lay-by berth. As long as the vessel is in service - and this is normally the case - the surveyor will carry out the light ship survey with the vessel in ballast condition. Consequently the mud will "disappear" in the ballast figure and will later be included in the figure for total weights discharged upon laden ship survey. This will result in adulterated cargo weight. As the mud is still on board, and since it is in most cases impossible for the surveyor to ascertain it, the weight of the mud is included in the cargo weight and the surveyor will certify more
weight loaded/discharged than actually on board. The actual cargo weight is to be diminished by the amount of mud remaining on board. This error is completely concealed and can be assumed—depending on the age and size of the vessel—between zero and 5% of the ballast volume. The only possible precaution is to have all ballast water tanks inspected and verified in periodical sequences. Even if the weight of the mud is known, there still remains a source of error in it. This error is due to the fact that the mud has another specific gravity than the ballast water.

**National flag**

Denotes registry of a vessel in a country that exercises at least some degree of control over the manning of vessels, management, and operation of the vessel by nationals.

**Nautical mile**

A nautical mile is 1,852 metres. The standard unit of measure for marine navigation and for work with the Mercator chart. The nautical mile is for practical purposes the length of one minute of arc of a meridian or of the equator. Also called Admiralty mile. (See also Knot.)

**New ship**

Any ship whose keel is laid or construction commenced on or after the date upon which a convention or agreement has entered into force.

**O.B.O.**

A vessel designed for the carriage of oil, dry bulk or iron ore cargoes.

**Oil**

Oil means petroleum in any form including crude oil, fuel oil, sludge, oil refuse and refined products (other than petrochemicals).

**Oily mixture**

Oily mixture means a mixture with any oil content.

**Oil fuel**

Oil fuel means any oil used as fuel in connection with the propulsion and auxiliary machinery of the ship in which such oil is carried. (See also Bunkers and Fuel oil.)
Oil tanker means a ship constructed or adapted primarily to carry oil in bulk in its cargo spaces and includes combination carriers and any "chemical tanker" when it is carrying a cargo or part of a cargo of oil in bulk.

Open registry flag Denotes registry of a vessel in a country that does not require nationals to be involved in the ownership or operation of a vessel.

Panamax size A class of vessels which, for the purposes of this Code, is taken to be in the range of 50,000-80,000 dwt in size and is capable of negotiating the Panama canal maximum beam of 32.1 metres.

Parcel size The quantity of cargo carried by a certain vessel on a particular voyage.

Partly filled compartment The term "partly filled compartment" refers to any compartment wherein ballast water or cargo in bulk are not loaded to their highest possible level.

Perpendiculars (Forward and Aft) The vertical lines at the intersection of the summer load waterline with the fore side of the stem and with the after side of the rudder post, or with the centerline of the rudderstock if there is no rudder post.

Perpendicular corrections Corrections which have to be applied to draught mark readings when the draught marks are not coincidental with the perpendiculars or the midlength between perpendiculars.

Plimsoll line Another name for summer load mark.

Port side The left-hand side of the vessel as seen by an observer facing forward.

Potable water See drinkable water.

Ratification The action of a sovereign country in formally accepting a convention or other international instruments or set of rules.
Reading of draught marks

This is almost always carried out visually. Draught marks are shown in metres/decimetres or in feet. The reading should be made as close to the waterline as possible. In good conditions it is possible to read the draught to the nearest 1 centimetre or 1/2 inch, i.e. the true draught may be 0.5 cm or 1/2 inch above or below the recorded draught. Good conditions mean adequate lighting, minimal water movement, clearly painted draught marks and a clear sighting of the draught marks. Probability theory shows that with the above reading accuracy, over 95% of the results will have an error which is less than the tonnes per centimètre or half of the tonnes per inch immersion figures - TPC/TPI.

Representative test sample

Is a sample of sufficient quantity for the purpose of testing physical and chemical properties of the consignment to meet specified requirements. It should be collected by means of an appropriate systematic sampling procedure.

Resolutions

Rules created by IMO which represent the member countries' guidance or advice concerning the improvement of safety at sea or prevention of pollution. They are not binding upon Governments unless formally adopted.

Rudder post

An additional sternpost, in single-screw vessels, to which the rudder is attached.

Rule length (L)

Rule length (L) is the distance, in metres, on the summer load waterline from the forward side of the stem to the after side of the rudder post, or to the centre of the rudder stock if there is no rudder post. (L) is to be not less than 96%, and need not be greater than 97%, of the extreme length on the summer load waterline.

Sagging

The deflection of a vessel loaded in such manner that the draught amidships is greater than the mean of the forward and aft draughts.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample contamination</td>
<td>The sample bucket should be washed out prior to use. Even if it is reserved for seawater samples only, residues of salt may have remained in the bucket as it dried possibly affecting the next reading.</td>
</tr>
<tr>
<td>Saturated</td>
<td>A sample of bulk cargo is saturated when all the voids between the grains are filled with liquid when the sample is at rest.</td>
</tr>
<tr>
<td>Scale drawings</td>
<td>Ship's plans prepared so that each centimetre of distance on the scale corresponds to a known distance on the vessel. For example a scale marked 1/100 means that 1 cm on the drawing corresponds to 1 m on the ship itself.</td>
</tr>
<tr>
<td>Seawater density correction</td>
<td>The difference between the observed density of the water in which the vessel is floating and the density of seawater.</td>
</tr>
<tr>
<td>Ship/hull surveys</td>
<td>Any survey of the hull, structures, fittings, compartment layouts, weather decks of a vessel or other marine structure.</td>
</tr>
<tr>
<td>Shipper</td>
<td>For the purposes of this Code the term shipper means any person by whom or in whose name or on whose behalf a contract of carriage of goods by sea has been concluded with a carrier, or any person by whom or in whose name or on whose behalf the goods are actually delivered to the carrier in relation to the contract of carriage by sea.</td>
</tr>
<tr>
<td>Short loading</td>
<td>The loading of a vessel to less than its rated capacity.</td>
</tr>
<tr>
<td>Shut-out cargo</td>
<td>Cargo that should have been loaded but cannot because of bad stowage, or because the cargo is of an unacceptable quality, or the unscheduled departure of the vessel.</td>
</tr>
<tr>
<td>Shuttle voyage</td>
<td>A voyage conducted by a vessel between two ports on a regular basis.</td>
</tr>
<tr>
<td>Slow steaming</td>
<td>The operation of a vessel at less than its designed speed.</td>
</tr>
</tbody>
</table>
Slop tank
A tank specifically designated for the collection of tank drainings, tank washings and other oily mixtures.

Solid bulk cargo
Is any material, other than liquid or gas, consisting of a combination of particles, granules or any larger pieces of material, generally uniform in composition, which is loaded directly into the cargo spaces of a ship without any intermediate form of containment.

Sounding
Distance between the bottom of a tank striker plate and the surface of the liquid which the tank contains.

Sounding pipe
A fixed pipe through which soundings are taken.

Sounding tables
Calibration tables giving volumes or weights corresponding to liquid heights.

Specific gravity
Ratio between the mass or weight in air of a given volume of a substance and the mass or weight in air of the same volume of distilled water. Both the temperature of the substance and the temperature of the water must be defined. There are thus various forms of specific gravity which can lead to considerable confusion. It is for this reason that the term apparent density is preferred for draught survey, as this corresponds to weights obtained by weighing on a weighbridge. (See also Density and Use of correct hydrometer.)

Spot market
The market that is characterized by the transportation contracts that normally cover a single voyage only.

Starboard side
The right-hand side of the vessel as seen by an observer facing forward.

Stem correction
Correction applied to the mean forward draught when the port and starboard forward draught scales are not situated at the forward perpendicular.
Stern correction
Correction applied to the mean aft draught when the port and starboard aft draught scales are not situated at the aft perpendicular.

Stowage factor
The stowage factor of bulk cargo is the figure which expresses the number of cubic metres which one tonne of material will occupy.

Subdivision load line
A waterline used in determining the subdivision of the ship.

Summer loadline
An imaginary line, parallel to the keel passing through the upper edge of the summer mark which corresponds to the maximum draught permitted in the summer zone in sea water.

Summer mark
The line, surrounded by a circle, permanently marked by centre punch, or by welding, on the port and starboard sides of the vessel amidships as prescribed by the ship's Loadline Certificate. (See also Plimsoll line.)

Syndicated ship
A vessel that is owned by a group of entrepreneurs.

Tank
An enclosed space which is formed by the permanent structure of a ship and which is designed for the carriage of liquid in bulk.

Time charter
A transportation contract under which the charterer has the use of the vessel for a specified period of time.

Ton-mile
A unit of measure equal to one metric ton multiplied by one nautical mile.

Top-off
The process of adding additional cargo to complete the loading of a vessel at a port or berth other than that used for initial loading.

Tonnes per centimetre (TPC)
This is the mass which must be added to, or deducted from, a ship in order to change its mean draught by 1 cm. If
the ship changes its mean draught by 1 cm and if $AWm^2$ is the area in $m^2$ of the waterplane at which it is floating, then:

\[
\begin{align*}
\text{Change of volume} &= Aw \times 0.01 m^3 \\
\text{Change of displacement} &= Aw \times 0.01 \times 1.025 \\
\text{TPC} &= Aw \times 0.01025 \\
&= 97.5 \\
\text{or TPC} &= Aw \times 0.01 \text{ tonnes} \\
&\text{fresh water} \\
&= Aw \\
&= 100
\end{align*}
\]

**Transportable moisture limit**

Of a cargo which may liquefy, it represents the maximum moisture content of the material which is considered safe for carriage in ships not complying with the special provisions of I.M.O. Solid Bulk Cargoes Code. It is derived from the flow moisture point (flow table test appendix D.1 of I.M.O. Solid Bulk Cargoes Code) or from data obtained from other test methods approved by the appropriate authority of the port State as being equally reliable. (See also Cargoes which may liquefy, Angle or repose and Flow state.)

**Triangulation**

A voyage over three or more usually long passages in which a vessel may lift two or more cargoes. Normally entails ballast passages between discharge and subsequent loading ports.

**Trim**

Difference between the mean draught forward and the mean draught aft, both the measurements having been corrected to the forward and aft perpendiculars where necessary.

**Trim corrections**

The corrections applied to the displacement of the vessel when the vessel is not floating on an even keel.
Trim Correction Tables for Draught Readings

Many bulk cargo vessels are equipped with trim correction tables for draught readings. These tables, if available on board, are normally in a tabular presentation of correction values with the trim on X-axis as the entering argument and the draught on Y-axis. But interpolation is necessary when using these tables, and the interpolation does not always coincide with the computed value found by calculation.

The surveyor should make his own calculation if the data requested are available, according to the formula: trim (m) divided by length between draught marks (m) multiplied by distance between draught mark and respective perpendicular. This is to be preferred to the use of the interpolated correction value derived from the correction table.

Trimming

For the purposes of this Code trimming means any levelling of the material within a cargo space, either partial or total, by means of loading spouts or chutes, portable machinery, equipment or manual labour.

Ullage

Distance between the surface of the liquid in a tank and the top of the tank or corresponding sounding pipe.

U.N.

United Nations.

UNCTAD

United Nations Conference on Trade and Development.

UN/ECE

United Nations Economic Commission for Europe.

Use of correct hydrometer

The density of the water in which the vessel is floating and of any ballast water, should be measured with a hydrometer which is calibrated to show density in air (apparent density) at a standard temperature, usually 15°/15° C or 60°/60° F. When the volume of displacement is multiplied by the density, the resulting weight is the commercially accepted weight in air. Special draught survey hydrometers,
which are calibrated to read the density of liquids of medium surface tension (i.e. water) over the range 0.990-1.040 kg per litre are now available. These hydrometers are made of glass and can therefore be certificated. Hydrometers made of any other material should not be used. Loadline hydrometers measure the specific gravity of water (relative density). This is the ratio of the density of the water at whatever temperature to the density of pure water at 15° C or 60° F (depending on the hydrometer's calibration). To be absolutely accurate the sample density should be corrected for any temperature difference to 15° C/60° F, but this would only be required in extreme circumstances. If the same sample of seawater is measured with a draught survey hydrometer and a loadline hydrometer the readings will be 0.023 kg/litre and 1.025 SG respectively. If the draught survey hydrometer is being used for loadline calculations, .002 must be added to any reading to obtain specific gravity. No corrections for water temperature should be applied to the readings of a hydrometer, either draught survey or loadline. Although hydrometer will expand or contract for differences from the calibrated temperature, the ship will also expand or contract. The changes in volume are very small and the effects cancel or tend to cancel out. (See also Density and Specific Gravity.)

USVD

Ultra Shallow Draught Vessel. A vessel designed to lift large cargoes in draught restricted ports by nature of an extremely wide beam compared to conventional dimensions. Such vessels may have two engines and rudders to provide the necessary manoeuvrability.

Vessel fraud

The vessel's owners are paid freight for every tonne of cargo carried. It is unfortunate but true that unscrupulous ship's personnel may
attempt to increase the cargo figure in a draught survey result for a number of reasons - to increase the freight, because too much cargo has been previously discharged, because "surplus" cargo can be disposed of, etc. The draught surveyor should not be overly suspicious but must be conscious of the possibilities. If any of the following occur, particular care should be exercised:

(a) It is claimed that the Sounding Pipe for a void space cannot be opened or accessed.

(b) If the ship's personnel are taking soundings, and readings are taken quickly with no opportunity for verification.

(c) The sounding bob does not clearly strike the tank bottom.

(d) A bunker tank is stated to be empty and no opportunity is given to take a sounding.

Very Large Bulk Carrier. A class of bulk vessels which, for the purposes of this Code, is taken to be in excess of 160,000 dwt in size.

Very Large Oil/Ore Carrier. A vessel designed to carry oil or ore which is in excess of 160,000 dwt in size.

Volumes and areas in a ship shall be calculated in all cases to moulded.

The areas of the successive waterplanes of a ship may be found by using the Simpson's rule appropriate to the number of equally spaced ordinates. If a curve is drawn in which the ordinates at equally spaced intervals represent the areas of the various waterplanes, then the area under this curve represents the volume of displacement of the ship. The centroid of this area will give the position of the centre of buoyancy from the design waterline or the base.
Similarly, if a curve is drawn whose ordinates represent the transverse sectional areas of a ship on a base of length, then the area under the curve will represent the volume of displacement. The centroid of the area will give the position of the centre of buoyancy from either amidships or the AP.

**Voyage charter**

A single contract covering the transportation of a specific cargo for a single voyage only. (See also Spot market.)

**Voyage optimization**

Minimizing the ballast and delay time in a vessel's programme.

**Water layer samples**

The density of the water in which the vessel is floating may not be uniform. On vessels under 5,000 tonnes displacement, it is probably accurate enough to use one sample taken at half draught. On larger vessels it is necessary to take a minimum of three samples, at 0.15, 0.50 and 0.85 of the draught, at position 0.25 length and 0.75 length. The two sets of samples should be taken on opposite sides of the ship, ensuring that the sample position is well clear of ship's discharges or shore outfalls. If there is a marked variation in the readings obtained, further measurements should be taken, but the vertical intervals must be equal, with a half interval between the water level/first reading and the bottom reading/ship's bottom. To obtain the samples a proper layer sample bucket is required (inverting bucket, corked bucket or bottom filling bucket or equivalent approved instruments).

**Waterlines**

These are shown in their true form in the half-breadth plan, and are drawn parallel to the LWL at intervals above and below it.
Waterplane area coefficient (Cwp)

This is the ratio of the area $A_w$ of the waterplane to the area of the circumscribing rectangle having a length equal to the LBP and a breadth equal to B.

i.e., $Cwp = \frac{A_w}{LxB}$

The range of values is from about 0.70 for a fine ship to 0.90 for a full ship.

Weather conditions influence in draught reading

When the weather is fair, i.e. calm water surface, very accurate draughts can be obtained (say within one mm of the actual draught). Naturally in heavy weather, waves build up against the vessel and may tend to become irregular. Tolerances naturally then will grow and depend on capabilities of the surveyor. Sometimes means are available to suppress this influence by using a glass tube which damps the waves and satisfactory readings may still be obtained. In extreme heavy weather, fair results might be obtained from draught readings at vessel's lee side and calculation of the corresponding draughts at the weather side. This means of draught determination however requires the availability of a good clinometer and ship shape data.

Wing tank

Wing tank means any tank adjacent to the side shell plating.
ANNEX "A"

AUTOMATIC CALCULATION PROGRAM CONNECTED WITH THE DRAUGHT SURVEY
UN/ECE CODE OF UNIFORM STANDARDS AND PROCEDURES FOR THE PERFORMANCE OF DRAUGHT SURVEYS OF COAL CARGOES

Annex A

AUTOMATIC CALCULATION PROGRAM CONNECTED WITH THE DRAUGHT SURVEY

1. FOREWORD

To make easier the Surveyor's calculations, a specific automatic program has been developed. This program is compatible with the pocket computers available in the market as Sharp PC-1248. The surveyor after taking the necessary measures, will input their values (and the connected values taken from the ship tables) according to a sequence directly asked by the system. The computer will print step by step the results obtained.

2. PROCEDURE AND MATHEMATICAL CALCULATION UTILIZED BY THE PROGRAM

2.1 Measures taken by the Surveyor

The measures taken by the Surveyor are:

- draught
  - fore port
  - fore starboard
  - after port
  - after starboard
  - midship port
  - midship starboard

- sea density

- deductible weights:
  - Ballast water
  - fresh water
  - fuel oil
  - diesel oil
  - slops
  - lube oil
  - swimming pool
  - anchor & chain
  - others

These values, together with the data taken from the ship tables, will be utilized as input for the automatic calculation program.

2.2 Input sequence of data and calculations

A. At first the program asks the measure unit that the operator wants to utilize (metres, inches).

B. The program asks the LBP value (length between perpendiculars) and the 6 draught values measured. Every input is automatically printed.
C. The program executes the mean of the draughts that is:

\[
\begin{align*}
\text{FORE} &= \frac{FS + FP}{2} \quad \text{MID} = \frac{MS + MP}{2} \quad \text{AFT} = \frac{AS + AP}{2} \\
\text{(line 131)} & \quad \text{(line 147)} & \quad \text{(line 138)}
\end{align*}
\]

D. Perpendicular correction

Distance marks are asked by the program to correct the values reported at the point C:

\[
\begin{align*}
\text{Lf} &= \text{distance marks and fore perpendicular (line 101)} \\
\text{La} &= \text{distance marks and aft perpendicular (line 102)} \\
\text{Lm} &= \text{distance marks and mean perpendicular (line 103)}
\end{align*}
\]

The program, utilizing the mentioned data, calculates the correction of the draught values as follows:

\[
\begin{align*}
\text{STEM correction} &= \frac{\text{FORE} - \text{AFT}}{\text{LF}} \quad \text{(line 133)} \\
\text{STERN correction} &= \frac{\text{AFT} - \text{FORE}}{\text{LF}} \quad \text{(line 140)} \\
\text{MIDSHIP correction} &= \frac{\text{AFT} - \text{FORE}}{\text{LF}} \quad \text{(line 148)}
\end{align*}
\]

\[
(\text{LBD} = \text{LBP} - \text{La} + \text{Lf})
\]

F. Sign of the correction

The position of the marks related to the perpendiculars are asked by the program.

The algebraic sign of the corrections is given by the program as follows:

vessel trimmed by the stern:

\[
\begin{align*}
\text{corr FORE} - \\
\text{corr AFT} + \\
\text{corr MID} - \text{if the mid marks are toward the FORE} \\
&\quad \text{+ if the mid marks are toward the AFT}
\end{align*}
\]

vessel trimmed by the stern: (opposite signs)

\[
\begin{align*}
\text{corr FORE} + \\
\text{corr AFT} - \\
\text{corr MID} + \text{if the midship marks are toward the FORE} \\
&\quad \text{- if the midship marks are toward the FORE}
\end{align*}
\]
The algebraic sign of the correction is valid if the position of the fore and aft marks is "between" the respective perpendiculars. In case of opposite position, it is necessary to invert the algebraic sign; however this situation is uncommon.

G. Corrected draughts

The program calculates the corrected mean values of draughts as sum of the values of draughts found in point C + the relative corrections calculated in point D-F.

\[
\begin{align*}
F_c &= \text{FORE} + \text{STEM correction} & (\text{line 134}) \\
A_c &= \text{AFT} + \text{STERN correction} & (\text{line 141}) \\
M_c &= \text{MID} + \text{MID correction} & (\text{line 149})
\end{align*}
\]

H. Draught extreme corrected for hog or sag

The program calculates and prints the "draught extreme corrected for hog or sag" as follows:

\[
\begin{align*}
\text{Draught fore & aft mean} & \quad = \quad -\quad -\quad = \quad FA \\
(\text{line 143}) & 2 \\
\Rightarrow \text{mean of means} & \quad = \quad -\quad -\quad = \quad MM \\
(\text{line 151}) & 2 \\
\Rightarrow \text{draught extreme corr'd for hog or sag} & \quad = \quad -\quad -\quad = \quad DHSC \\
(\text{line 152}) & 2
\end{align*}
\]

This last draught value corrected for the keel thickness reported in the ship table - draught moulded corrected for hog or sag MMCO - is used by the surveyor to find the displacement in the ship tables (see point N).

I. True trim

\[
\begin{align*}
\text{AFT - FORE} & \quad \quad (\quad -\quad -\quad ) \\
100
\end{align*}
\]

The apparent trim as it results from the survey, is transformed by the program in the true trim as follows:

\[
\begin{align*}
\text{true trim} & \quad = \quad \frac{AC - FC}{100} \quad = \quad AR & (\text{line 155})
\end{align*}
\]
L. **First trim correction**

The program asks the following values found by the Surveyor in the ship tables:

- LCF = Longitudinal Centre of Flotation (line 100)
- TPC = Tonnes per centimetre (line 099)

These values, together with the true trim (AR) and the length between perpendiculans (LBP) are automatically utilized to calculate:

\[
\text{First trim correction} = \frac{\text{AR} \times \text{LCF} \times \text{TPC} \times 100}{\text{LBP}} \\
\text{(line 162)}
\]

The algebraic sign of this correction is automatically calculated by the program as follows:

- The correction will be "+" when both LCF and the trim are on the same side (direction) of midship
- The correction will be "−" when LCF and the trim are on different sides (of midship).

CO1, AR, LCF and TPC are printed.

M. **Second trim correction**

The Surveyor utilizes the ship tables that report the moments (MTC). The Surveyor finds in the table the following values:

- MTC 1 = correspondent to the mean of the mean corrected draught +50 cm (line 104)
- MTC 2 = correspondent to the mean of the mean corrected draught -50 cm (line 105)

The program after the input of these values calculates the second trim correction as follows:

\[
\frac{\text{dm/dz}}{} = \text{MTC 1} - \text{MTC 2} \\
\text{Second trim correction} = \text{CO2} = \frac{(\text{AR})^2 \times 50 \times \text{DMDZ}}{\text{LBP}} \\
\text{(line 163)}
\]

The algebraic sign of the correction is always "+".

The values DMDZ, CO2 and total trim correction will be printed.
N. **Total trim correction**

The Surveyor enters in the computer the displacement found on the ship table as described at point H.

The value of displacement is corrected by the program according to the two trim corrections (CO1, CO2) as follows:

\[ DCO = DISPL + CO1 + CO2 \]  
(line 166)

O. **Sea water density correction**

According to the measured density value, a further correction must be added to DCO.

The program asks the sea water density measured by the Surveyor and calculates the correction as follows:

\[ OD \]
\[ SD = DCO - DCO = DCO (-- - 1) \]
\[ TD \]  
(line 167)

\[ OD = \text{measured sea density} \]  
(line 157)

\[ TD = \text{ship's tables density} \]  
(line 158)

P. **Final corrected displacement**

The program calculates and prints the final corrected displacement as follows:

\[ \text{DISDEN} = \frac{DCO}{(line 168)} + \frac{SD}{(line 167)} \]
\[ = DISPL + CO1 + CO2 + SD \]

Q. **Net displacement**

In order to calculate the net displacement the program will ask the input of the measured values:

- Ballast water = BA  
(line 351)
- Fresh water = FW  
(line 352)
- Fuel oil = FO  
(line 353)
- Diesel oil = DO  
(line 354)
- Slops = SL  
(line 355)
- Lube oil = LO  
(line 356)
- Swimming pool = SP  
(line 357)
- Anchor & chain = AC  
(line 358)
- Others = MIS  
(line 359)
The program will deduct these weights from the final corrected displacement calculating the net displacement (DISPLNT) as follows:

\[
\text{DISPLNT} = \text{DISDEN} - \text{DED} = (\text{line 170}) \quad (\text{line 168}) \quad (\text{line 169})
\]

\[
= \text{DISDEN} - (\text{BA} + \text{FW} + \text{FO} + \text{DO} + \text{LO} + \text{SL} + \text{SP} + \text{AC} + \text{MIS})
\]

The net displacement will be printed.

3. COMPUTER PROGRAM

The program described at the point 2 can be loaded in the pocket computer as follows:

```plaintext
10 KEY OFF
20 CLS
30 REM =================================================================================
40 REM MAIN PROGRAM
50 REM =================================================================================
60 PRINT
70 PRINT "D R A U G H T S U R V E Y ed. October 1991 - 1.8"
80 PRINT
100 REM INPUT DATAS SUBROUTINE
115 OP$="Y"
120 GOSUB 10000
130 INPUT "Do you want to review your datas Y/N";CH$
150 REM CONTROL OF DATAS SUBROUTINE
170 IF CH$="Y" OR CH$="Y" THEN GOSUB 20000
175 REM RESTART OR INPUT
180 IF OP$="N" OR OP$="n" THEN GOTO 80
200 REM DRAUGHT CALCULATIONS SUBROUTINE
220 GOSUB 30000
240 REM RESULTS ON THE SCREEN SUB-Routine
260 GOSUB 40000
270 PRINT
280 PRINT "1. Datas on printer"
290 PRINT "2. Another Draught";
300 PRINT "3. Back to Dos"
310 INPUT "Select your option -->";OP
320 IF OP=1 THEN GOSUB 50000: CLS: GOTO 270
330 IF OP=2 THEN GOTO 80
340 IF OP=3 THEN SYSTEM
350 END
10000 REM =================================================================================
10003 REM =================================================================================
10005 REM =================================================================================
10007 INPUT "Meters or Inches MT(0) or IN(1)"; Y
10009 IF Y <1 AND Y>1 THEN GOTO 10007
10010 INPUT "Length between perpendiculars (LBP)"; LBD
10020 INPUT "Forward port (FP)"; FP
```
10030 INPUT "Forward stdb (FS)";FS
10040 INPUT "After port (AP)";AP
10050 INPUT "After stdb (AS)";AS
10060 INPUT "Mid port (MP)";MP
10070 INPUT "Mid stdb (MS)";MS
10080 INPUT "Dist. marks forward pp. (LF)";LF
10090 INPUT "Dist. marks after pp. (LA)";LA
10100 INPUT "Dist. marks midship pp. (LM)";LM
10110 INPUT "Stem aft(1) or fwd(-1)";STEMS
10120 INPUT "Stern aft(1) or fwd(-1)";STERNs
10130 INPUT "Mid aft(1) or fwd(-1)";MIDS
10140 INPUT "Keel";KE
10150 INPUT "Tonnes per centimetre (TPC)";TPC
10160 INPUT "Length between centre of flotation and amidships(LCF)";LCF
10170 INPUT "LCF aft(1) or fwd(-1)";LCFS
10180 INPUT "MTC-D";MTC1
10190 INPUT "MTC-D";MTC2
10200 INPUT "Displacement (DISPL)";DISPL
10210 INPUT "Table density (TD)";TD
10220 INPUT "Observed density (OD)";OD
10230 print "Input deductible:";
10240 PRINT 1. ballast 2. fresh water 3. fuel oil
10250 PRINT 4. diesel oil 5. lube oil 6. slops
10255 PRINT 7. swimming pool 8. anchor & chain 9. others
10260 DED=0
10270 FOR I=1 TO 9
10280 PRINT I;" :";
10290 INPUT WEL
10300 DED=DED+WEI
10310 NEXT I
10320 RETURN
20000 REM=================================================================================================
20010 REM REVIEW OF DATA INPUT
20020 REM=================================================================================================
20030 CLS
20040 PRINT "FP";FP
20045 PRINT "FS";FS
20050 PRINT "AP";AP
20055 PRINT "AS";AS
20060 PRINT "MP";MP
20065 PRINT "MS";MS
20070 PRINT "LF";LF;
20080 IF STEMS=1 THEN PRINT "AFT" ELSE PRINT "FWD"
20090 PRINT "LA";LA;
20100 IF STEMS=1 THEN PRINT "AFT" ELSE PRINT "FWD"
20110 PRINT "LM";LM;
20120 IF MIDS=1 THEN PRINT "AFT" ELSE PRINT "FWD"
20130 PRINT "KE";KE
20140 PRINT "TPC";TPC
20150 PRINT "LCF";LCF;
20160 IF LCFS=1 THEN PRINT "AFT" ELSE PRINT "FWD"
20170 PRINT "MTC1";MTC1
20175 PRINT "MTC2=";MTC2
20180 PRINT "DISPL=";DISPL
20190 PRINT "TD=";TD
20195 PRINT "OD=";OD
20200 PRINT "Total deductibles (DED)=";DED
20210 PRINT
20220 INPUT "are the datas corrected Y/N";OP$
20230 RETURN
30000 REM ====================================================================
30010 REM DRAFT CALCULATIONS
30020 REM ====================================================================
30030 REM MEANS CALCULATIONS
30040 FORE=(FP+FS)/2
30050 AFT=(AP+AS)/2
30060 MID=(MP+MS)/2
30070 REM PP. CORRECTIONS
30080 J=ABS(AFT-FORE)
30090 IF FORE<AFT THEN S1=-1 ELSE S1=1
30100 P=ABS(LF+LA)
30110 STEMCO=J*LF/(LBP-P)*S1*STEMS
30120 STERNCO=J*LA/(LBP-P)*S1*STERNS
30130 MIDCO=J*LM/(LBP-P)*S1*MIDS
30140 FC=FORE+STEMCO
30150 AC=AFT+STERNCO
30160 MC=MID+MIDCO
30170 REM SAG AND HOG CORRECTION
30180 FA=(FC+AC)/2
30190 MM=(FA+MC)/2
30200 SH=MC-FA
30210 DHSC=(MM+MC)/2
30220 REM TRIM CORRECTIONS
30230 AR=ABS((AC-FC)*100)
30240 IF AC<FC THEN S2=1 ELSE S2=1
30250 CO1=ABS(AR*TPC/LCF/LBP)*S2*LCFS
30260 IF Y=1 THEN CO1=CO1/100
30270 DMDZ=MTC1-MTC2
30280 IF Y=0 THEN GOTO 30290 ELSE GOTO 30300
30290 CO2=AR*AR*5*DMDZ/(LBP*1000)
30300 CO2=AR/12*AR/12*6*DMDZ/(LBP/.0012)
30310 CO=CO1+CO2
30320 DCO=DISPL+CO
30330 REM DENSITY AND DEDUCTIBLES CORRECTIONS
30340 DISDEN=DCO/TD*OD
30350 SD=DISDEN-DCO
30360 DISPLNT=DISDEN-DED
30370 RETURN
40000 REM ====================================================================
40010 REM PRINTING RESULTS ON THE SCREEN
40020 REM ====================================================================
40030 CLS
40040 PRINT "Draught forward mean: ";FORE
40050 PRINT "Draught forward (corr.'d to f.pp.): ";FC
4. ADVANTAGES OF THE USE OF COMPUTER PROGRAM

The use of computer software has two main advantages:

- Saving of time which can then be spent to take more carefully the requested measures (draughts, sea density, deductible weights etc.) which would benefit strongly the accuracy of the survey results.

- Avoiding the mathematical mistakes which are due to the short time that normally the Surveyor can spend on the ship to make this calculation.

5. COMPUTERS PROGRESS

The above program is bound to become obsolete over time due to the continuous progress taking place in the field of computers. Modern communication channels will soon permit the ship master to communicate basic data on the vessel to the draught Surveyor even before the arrival of the vessel in a harbour.
UN/ECE CODE OF UNIFORM STANDARDS AND PROCEDURES FOR
THE PERFORMANCE OF DRAUGHT SURVEYS OF COAL CARGOES

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