



## DRAFT SURVEY MANUAL

In Accordance with P&I Clubs, GAFTA Survey Rules No.124 and FOSFA Contractual Practice.

### 1. PURPOSE AND SCOPE

This manual provides a complete, technical and practical reference for conducting Draft Surveys in international bulk trade. It is designed for:

- Marine surveyors
- Deck officers and Masters
- Naval architects
- Operators, charterers and claims personnel

All procedures described herein reflect accepted practice of P&I Clubs, GAFTA Survey Rules No.124, and FOSFA contractual recognition.

### 2. FUNDAMENTAL PRINCIPLE OF DRAFT SURVEY

A Draft Survey determines cargo weight by comparing vessel displacement before and after cargo operations.

- Cargo Weight = Final Displacement – Initial Displacement ± Corrections
- The reliability of the result depends entirely on:
  - Accuracy of draft readings
  - Correct application of hydrostatic data
  - Proper density measurement
  - Complete accounting of all variable weights

### 3. VESSEL CONDITION REQUIREMENTS

Before conducting a Draft Survey, ensure:

- Vessel is upright or list is minimal
- Trim is stable
- Moorings are slack but controlled
- Gangway and hoses are clear of water
- No cargo operations are ongoing
- Surveys conducted under unstable conditions are frequently rejected in disputes.

### 4. DRAFT READINGS

#### 4.1 Draft Mark Locations

Draft marks are normally located:

- Forward (FP)
- Midship (port and starboard)
- Aft (AP)

#### 4.2 Number of Readings

Minimum required:

- Forward: Port and Starboard
- Midship: Port and Starboard
- Aft: Port and Starboard
- Total: 6 readings

#### 4.3 Reading Method

- Read at eye level
- Avoid wave crests and troughs
- Take repeated readings and average
- Photograph all draft marks



#### 4.4 Correction for List

Average port and starboard readings:

$$\text{Draft (corrected)} = (\text{Port} + \text{Starboard}) / 2$$

#### 5. TRIM AND MEAN DRAFT

##### 5.1 Trim Calculation

$$\text{Trim} = \text{Aft Draft} - \text{Forward Draft}$$

Positive trim: stern deeper

Negative trim: bow deeper

##### 5.2 Mean Draft Calculation

Longitudinal mean draft:

$$D_m = (\text{Forward} + 2 \times \text{Midship} + \text{Aft}) / 4$$

#### 6. TRIM CORRECTION USING LCF

Hydrostatic tables assume even keel.

Correction:

$$\Delta = (\text{Trim} \times \text{Distance from Midship to LCF}) / \text{LBP}$$

Corrected mean draft:

$$D_{\text{corrected}} = D_m \pm \Delta$$

Sign depends on LCF position.

#### 7. HYDROSTATIC TABLES

Use only:

- Vessel-specific
- Approved hydrostatic data
- Obtain:
- Displacement
- TPC
- MTC

Never extrapolate beyond table limits.

#### 8. LINEAR INTERPOLATION

Used when draft falls between tabulated values.

Formula:

$$\text{Value} = V_1 + [(D - D_1) / (D_2 - D_1)] \times (V_2 - V_1)$$

Applicable to displacement, TPC, MTC.

#### 9. WATER DENSITY MEASUREMENT

##### 9.1 Sampling

Take samples at vessel location

Minimum one sample forward and aft

More if stratification suspected

##### 9.2 Correction

Hydrostatic tables are based on standard density (usually 1.025 t/m<sup>3</sup>).

Corrected Displacement:

$$\text{Displacement}_{\text{corrected}} = \text{Displacement} \times (\text{Actual Density} / \text{Standard Density})$$

Density errors are a primary cause of disputes.

#### 10. SOUNDING OF BALLAST AND TANKS

##### 10.1 Tanks to be Measured

- Ballast tanks
- Fuel oil
- Diesel oil
- Fresh water
- Lubricating oil
- Slops



## 10.2 Measurement

Use sounding tape or ullage

Apply trim correction if required

Refer to vessel tank tables

## 10.3 Conversion to Weight

Weight = Volume × Density (temperature corrected)

**All liquids must be measured, never assumed.**

## 11. SHIP'S CONSTANT

### 11.1 Definition

Ship's constant represents unmeasured fixed weights such as:

- Structural additions
- Coatings
- Residual sediments

### 11.2 Calculation

Constant = Displacement – (Lightship + Measured Liquids)

### 11.3 Acceptance Criteria

Constant should remain consistent

Significant variation requires investigation

**Unexplained changes undermine survey credibility**

## 12. DETAILED MANUAL CALCULATIONS AND CORRECTIONS

This section explains how to calculate Draft Survey values manually, as expected by P&I Clubs, GAFTA and FOSFA.

## 12.1 List (Heel) Correction

When the vessel has list, drafts must be corrected by averaging both sides.

### Formula:

Corrected Draft = (Port Draft + Starboard Draft) / 2

### Example:

Forward Port = 10.42 m

Forward Starboard = 10.38 m

Corrected Forward Draft = (10.42 + 10.38) / 2 = 10.40 m

**This correction removes transverse inclination error.**

## 12.2 Trim Calculation

Trim is the difference between aft and forward drafts:

Trim = Aft Draft – Forward Draft

### Example:

Aft = 10.80 m

Forward = 10.40 m

**Trim = 10.80 – 10.40 = 0.40 m (by stern)**

## 12.3 Mean Draft Calculation

Longitudinal mean draft:

$D_m = (\text{Forward} + 2 \times \text{Midship} + \text{Aft}) / 4$



**Example:**

Forward = 10.40 m

Midship = 10.60 m

Aft = 10.80 m

$$D_m = (10.40 + 2 \times 10.60 + 10.80) / 4 = 10.60 \text{ m}$$

**12.4 Trim Correction Using LCF (Perpendicular Correction)**

**Hydrostatic tables assume even keel.**

Trim correction at midship:

$$\Delta = (\text{Trim} \times \text{Distance from Midship to LCF}) / \text{LBP}$$

**Example:**

Trim = 0.40 m

Distance Midship to LCF = 10 m (aft)

LBP = 200 m

$$\Delta = (0.40 \times 10) / 200 = 0.02 \text{ m}$$

Corrected Mean Draft:

$$D_{\text{corrected}} = D_m + \Delta = 10.60 + 0.02 = 10.62 \text{ m}$$

**(Sign depends on LCF position and trim direction.)**

**12.5 Forward and Aft Perpendicular Corrections**

If drafts are read away from perpendiculars, corrections are required:

$$\text{Correction} = (\text{Trim} \times \text{Distance from Perpendicular}) / \text{LBP}$$

This ensures correct draft at FP and AP.

**12.6 Linear Interpolation (Hydrostatic Tables)**

**Formula:**

$$\text{Value} = V_1 + [(D - D_1) / (D_2 - D_1)] \times (V_2 - V_1)$$

**Example:**

Draft 10.62 m between 10.50 m and 10.70 m

Displacement at 10.50 m = 52,000 t

Displacement at 10.70 m = 53,000 t

Interpolated Displacement:

$$52,000 + [(10.62 - 10.50) / (0.20)] \times 1,000 = 52,600 \text{ t}$$



### 12.7 Density Correction

Corrected Displacement = Displacement × (Actual Density / Standard Density)

#### Example:

Displacement = 52,600 t

Actual Density = 1.018 t/m<sup>3</sup>

Standard Density = 1.025 t/m<sup>3</sup>

Corrected = 52,600 × (1.018 / 1.025) = 52,241 t

### 12.8 Parallax Effect and Reading Correction

Parallax occurs when draft marks are read at an angle.

Best practice:

Always read at eye level

If unavoidable, take multiple readings and average

Photograph drafts for verification

There is no mathematical correction; prevention is mandatory.

### 12.9 Reading Only One Side – Calculating the Other Side

If only one side is readable (restricted conditions):

Other Side Draft = Observed Draft ± (List × Half Breadth / Draft Mark Height)

**However, this is not recommended and should only be used as last resort.**

**P&I Clubs consider single-side surveys high-risk and weak evidence.**

### 12.10 Complete Manual Calculation

- Read drafts (6 points if possible)
- Correct for list
- Calculate trim
- Calculate mean draft
- Apply LCF trim correction
- Interpolate hydrostatic values
- Apply density correction
- Measure all liquids
- Calculate ship's constant
- Determine cargo weight

### 13. COMMON ERRORS IDENTIFIED BY P&I CLUBS

- Poor density measurement
- Ignoring trim correction
- Incorrect interpolation
- Unmeasured consumables
- Inconsistent ship's constant
- Inadequate documentation

### 14. DOCUMENTATION REQUIREMENTS

A complete Draft Survey file should include:

- Draft photographs
- Density records
- Sounding sheets
- Calculation tables
- Surveyor report

**Documentation quality often determines arbitration outcomes.**



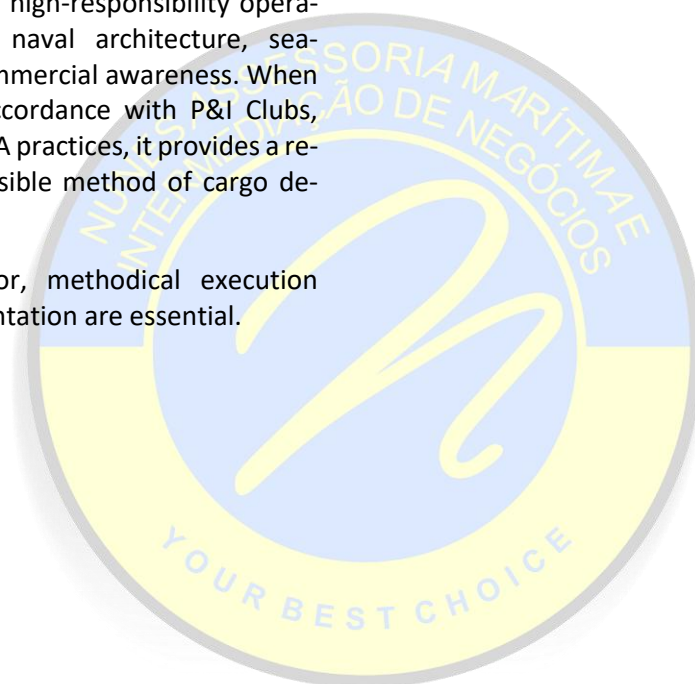
### 15. DRAFT SURVEY IN CLAIMS AND ARBITRATION

- Surveys are evaluated on:
- Technical correctness
- Compliance with GAFTA / FOSFA
- Transparency
- Professional conduct
- Surveys aligned with P&I guidance carry strong evidentiary weight.

### 16. CONCLUSION

Draft Survey is a high-responsibility operation combining naval architecture, seamanship and commercial awareness. When performed in accordance with P&I Clubs, GAFTA and FOSFA practices, it provides a reliable and defensible method of cargo determination.

Professional rigor, methodical execution and full documentation are essential.





**17. FULL REALISTIC NUMERICAL CASE STUDY (COMPLETE DRAFT SURVEY)**

This case study reflects a realistic bulk carrier operation, calculated fully by hand and aligned with P&I Clubs, GAFTA No.124 and FOSFA practice.

**17.1 Vessel Data**

Vessel type: Bulk Carrier

LBP: 200.00 m

Breadth: 32.20 m

Hydrostatic density basis: 1.025 t/m<sup>3</sup>

Distance Midship to LCF: 8.0 m (aft)

**17.2 INITIAL SURVEY (BEFORE LOADING)**

**Draft Readings (meters)**

Position	Mean		
	Port	StB	Mean
FWD	6.12	6.08	6.10
MID	6.35	6.33	6.34
AFT	6.60	6.58	6.59

**Trim**

Trim = 6.59 – 6.10 = 0.49 m by stern

Mean Draft

$$Dm = (6.10 + 2 \times 6.34 + 6.59) / 4 = 6.34 \text{ m}$$

**Trim Correction (LCF)**

$$\Delta = (0.49 \times 8.0) / 200 = 0.020 \text{ m}$$

Corrected Mean Draft = 6.34 + 0.02 = 6.36 m

**Hydrostatic Displacement (Interpolated)**

At 6.30 m: 18,450 t

At 6.40 m: 18,820 t

**Interpolated:**

$$18,450 + [(6.36 - 6.30) / 0.10] \times 370 = 18,672 \text{ t}$$

**Density Correction**

Measured density: 1.018 t/m<sup>3</sup>

Corrected displacement:

$$18,672 \times (1.018 / 1.025) = 18,545 \text{ t}$$

**Deductible (Initial)**

Tank	Weight (t)
Ballast	2,100
FO	350
DO	80
FW	120
LO	35
Slops	20

**Total Deductible = 2,705 t**



**17.3 FINAL SURVEY (AFTER LOADING)**

**Draft Readings (meters)**

Position	Port	Stb	Mean
FWD	12.10	12.06	12.08
MID	12.40	12.38	12.39
AFT	12.80	12.76	12.78

**Trim**

Trim = 12.78 – 12.08 = 0.70 m by stern

**Mean Draft**

$Dm = (12.08 + 2 \times 12.39 + 12.78) / 4 = 12.41$   
m

**Trim Correction (LCF)**

$\Delta = (0.70 \times 8.0) / 200 = 0.028$  m

Corrected Mean Draft = 12.41 + 0.03 = 12.44  
m

**Hydrostatic Displacement (Interpolated)**

At 12.40 m: 62,100 t

At 12.50 m: 62,900 t

**Interpolated:**

$62,100 + [(12.44 - 12.40) / 0.10] \times 800 =$   
62,420 t

**Density Correction**

Measured density: 1.020 t/m<sup>3</sup>

**Corrected displacement:**

$62,420 \times (1.020 / 1.025) = 62,117$  t

**Deductible (Final)**

Tank	Weight (t)
Ballast	300
Fuel Oil	290
DO	65
FW	95
LO	30
Slops	25

**Total Deductible = 805 t**

**17.4 CARGO CALCULATION**

**Net displacement difference:**

62,117 – 18,545 = 43,572 t

**Deductible difference:**

2,705 – 805 = \*\*1,900 t

