



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/m³).

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 \times 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:

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

Example:

Forward Port = 10.42 m

Forward Starboard = 10.38 m

$$\text{Corrected Forward Draft} = (10.42 + 10.38) / 2 = 10.40 \text{ m}$$

This correction removes transverse inclination error.

12.2 Trim Calculation

Trim is the difference between aft and forward drafts:

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

Example:

Aft = 10.80 m

Forward = 10.40 m

$$\text{Trim} = 10.80 - 10.40 = 0.40 \text{ m (by stern)}$$

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 \times (Actual Density / Standard Density)

Example:

Displacement = 52,600 t

Actual Density = 1.018 t/m³

Standard Density = 1.025 t/m³

Corrected = $52,600 \times (1.018 / 1.025) = 52,241$ 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 \pm (List \times 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/m³

Distance Midship to LCF: 8.0 m (aft)

17.2 INITIAL SURVEY (BEFORE LOADING)

Draft Readings (meters)

Position

	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 + 2×6.34 + 6.59) / 4 = 6.34 m

Trim Correction (LCF)

$\Delta = (0.49 \times 8.0) / 200 = 0.020$ 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:

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

Density Correction

Measured density: 1.018 t/m³

Corrected displacement:

$18,672 \times (1.018 / 1.025) = 18,545$ 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) Deductible (Final)

Draft Readings (meters) Tank Weight (t)

Position	Port	Stb	Mean		
FWD		12.10	12.06	12.08	Ballast 300
MID		12.40	12.38	12.39	Fuel Oil 290
AFT		12.80	12.76	12.78	DO 65

Trim

Trim = 12.78 – 12.08 = 0.70 m by stern

Mean Draft

$$D_m = (12.08 + 2 \times 12.39 + 12.78) / 4 = 12.41 \text{ m}$$

Trim Correction (LCF)

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

$$\text{Corrected Mean Draft} = 12.41 + 0.03 = 12.44 \text{ m}$$

Hydrostatic Displacement (Interpolated)

At 12.40 m: 62,100 t

At 12.50 m: 62,900 t

Interpolated:

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

Density Correction

Measured density: 1.020 t/m³

Corrected displacement:

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

Total Deductible = 805 t

17.4 CARGO CALCULATION

Net displacement difference:

$$62,117 - 18,545 = 43,572 \text{ t}$$

Deductible difference:

$$2,705 - 805 = **1,900 \text{ t}$$