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Operation specification for bunker survey

船用燃料油加油检验操作规范

(English Translation)

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Contents

Foreword

This document is drafted in accordance with the rules given in the GB/T 1.1—2020 *Guidelines for standardization Work — Part* 1 Rules for the: *Structure and drafting of standardizing documents.*

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This document was proposed and prepared by the Inspection and Appraisal Standardization Technical Committee of the China Entry-Exit Inspection and Quarantine Association (CIQA/TC1).

Operation Specification for Bunkering Survey

1 Scope

This document specifies the basic requirements for the measurement and sampling of marine bunkers during transfer process to vessels.

In this document, marine fuel oil refers to various grades of fuel oil for a vessel use, including distillate fuel oil and/or residual fuel oil.

2 Normative references

The following normative documents contain provisions which, through reference in this document, constitute indispensable provisions of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 1885-1998	Petroleum measurement table
GB/T 4756-2015	Method for manual sampling of petroleum liquids
GB/T 8170-2008	Rules of rounding off for numerical values & expression and judgment of limiting values
GB/T 8927-2008	Petroleum and liquid petroleum products- Temperature measurement - Manual method
GB/T 9109.5-2017	Petroleum and liquid petroleum products dynamic measurement- Part 5: Calculation of oil quantities
GB 17411-2015	Marine fuel oils
GB/T 25346-2020	Procedures for transfer of bunkers to vessels
GB/T 25347-2020	Marine fuel and lubricant supply terms
SN/T 3023.1-2011	Rules for the weight survey on import and export commodities -Part 1: General regulation for static measurement by ship’s tank
ISO 8217	Petroleum Products - Fuels (Class F) - Specifications of Marine Fuels
ISO 13739:2020	Petroleum Products - Procedures for the transfer of bunkers to vessels

3 Terms and definitions

3.1 reference height

vertical distance between the reference gauge point on the gauge hatch and the datum strike point on the tank floor or the gauge datum plate

3.2 bunker

various grades of fuel oil, including distillate fuel oil and residual fuel oil, for a vessel's consumption by the internal combustion engines and other equipment onboard

3.3 bunker barge/tanker

a dedicated barge/tanker engaged in the supply of bunkers to the vessels

3.4 supplier

the name of the supplying company on the bunker delivery note (Note: The supplier may not be the actual seller of the fuel.

3.5 cargo officer

a representative appointed or delegated by the supplier to act on behalf of the supplier in handling bunkering operations at the site

3.6 list

the state of a ship when it inclines to the portside or starboard side from its upright position, causing unequal draft on the port and starboard sides. The magnitude of the list is indicated by the heeling angle, which is the angle formed by the longitudinal section in center plane when ship inclines and on even keel

3.7 reference gauge point

the reference point designed for gauging

3.8 ullage

the distance between the reference gauge point and the surface of fuel oil inside the tank

3.9 sounding

the distance from the surface of fuel oil inside the tank to the gauge datum plate

3.10 bunker delivery note (BDN)

a document provided by the supplier to the vessel after the bunker supply is completed, containing information on the quantity of bunker supplied and partial information on the bunker quality, and

confirmed with signature by both parties as the primary document for settling charges

3.11 bunker surveyor

a person with professional capability from third party engaged to bunkering operation

3.12 vessel

a ship that receives the supply of bunkers

3.13 trim

difference between the fore and aft draught of the vessel. When the aft draught is greater than the forward draught, the vessel is said to be trimmed by the stern. When the aft draught is less than the forward draught, the vessels is said to be trimmed by the head

4 General Requirements

4.1 Vessel/Bunker tanker

4.1.1 The vessel/bunker tanker should be in normal condition, with drafting marks clear in order.

4.1.2 During measurements, the ship's mooring ropes should not be excessively tensioned, and it should be confirmed that the ship not carry out tranferring oil. Ship's lifting gear should not be used or moved.

4.1.3 The bunker tanker shall provide calibrated valid bunker tank capacity tables for trim and list correction calculations of the bunker barge.

4.2 Bunker surveyor

4.2.1 Bunker surveyor should be aware of health, safety, and environmental requirements as well as internationally and domestically recognized safety standards during the bunker supply process.

4.2.2 In adverse weather conditions, such as wind at force of seven or higher, thunderstorms, heavy rain, heavy snow, etc., measurements and sampling should be suspended.

4.2.3 If any safety hazards that do not meet the safety requirements are found, they should be eliminated through consultation with the ship or reported to higher authorities. Only after ensuring safety can boarding the vessel/bunker tanker be allowed.

4.2.4 When bunker surveyor board the vessel, they should adhere to the ship's safety regulations regarding prevention of fire, explosion, slip, and collision. During bunkering operation, they

should wear at least the following personal protective equipment: safety helmets, anti-static clothing, life jackets, gloves, anti-static shoes, and use explosion-proof lighting equipment. Static electricity should be eliminated before boarding, and when measuring, they should stand on the windward side of the gauge point. If measurements need to be taken from the hatch or manhole, calibrated H2S and O2 detectors should be provided and correctly used throughout the measurement process.

4.2.5 Bunker surveyor should be independent, objective, and impartial in the performance of their third-party duties, ensuring that measurement data is true and accurate before and after bunkering. They must not engage in any unethical, fraudulent, or illegal activities during bunker survey. If any abnormal situations are discovered, they should be reported immediately.

5 Preparations before Bunkering Survey

5.1 Selection of Bunker Survey Equipment

5.1.1 Prepare measuring instruments and supplies as needed, such as gauging tape (minimum graduation value 1mm), thermometer (minimum graduation value 0.2°C), oil-indicating paste, water indicating paste, and others.

5.1.2 Prepare sampling containers, sample bottles, sample labels, seals, etc., as needed.

5.1.3 Prepare survey record forms, PC, gas detectors, explosion-proof flashlights, cameras, video recorders, and other equipment as needed.

5.2 Equipment Calibriation

5.2.1 Measuring instruments such as gauge tapes, thermometers, and gas detectors should be verified and calibrated in valid by qualified inspection or calibration institution. The use of instruments should comply with the technical requirements of relevant inspection standards and operating specifications.

5.2.2 The use of gauging tapes should be discontinued if any of the following conditions exist:

a) The tape is twisted, deformed, or spliced.

b) The tape scale is unclear, irregular, or has visual defects that affect visibility.

c) The scale error of the tape exceeds the allowable range.

d) The bob of tapes is damaged or deformed.

5.2.3 The use of thermometers should be discontinued if any of the following conditions exist:

a) The mercury column inside the capillary is broken or separated into segments.

b) The thermometer contains impurities, air bubbles, or other contaminants.

c) Visible shrinkage or expansion of the inner diameter of the capillary pipe within the reading range.

d) The inner and outer surfaces of the capillary have roughness or dirt, with bubbles affecting the reading.

e) Visible bending and distortion of the capillary tube.

f) Scratches and other defects or imperfections that affect the strength on the inner and outer surfaces of the thermometer's casing.

g) Roughness, air bubbles, etc., on the front casing of the thermometer, reducing clarity and causing reading difficulties.

5.2.4 When using digital thermometers to measure liquid temperature, they should not only meet the specified technical requirements but also comply with explosion-proof safety regulations. During use, anti-static devices should be correctly grounded to prevent generation of static electricity.

5.2.5 Oil-indicating paste should be evenly applied to the oil gauging tape. After immersion in the oil, the color changing should be clear and changed no more than 10 seconds, and reading change of no more than 0.5 millimeters when left for 20 seconds.

5.2.6 Water-indicating paste should be evenly applied to the water gauging tape. After immersion in the water for test, the color changing should be clear, and completed in no more than 10 seconds, with reading changes of no more than 0.5 millimeters when left for 5 seconds.

5.3 Pre-survey Checklist

5.3.1 Before bunkering, cross-check and confirm the bunkering plan with all parties concerned, including information such as the ship's name, bunker quantity, type and specification, quality inspection report, oil tank capacity, sampling method, sampling points, and the number of samples required by all relevant parties.

6 Bunker Quantity Survey

6.1 Bunker Quantity Determine

6.1.1 Measurement Methods

6.1.1.1Determine the bunker quantity mainly include manual sounding, volumetric flowmeter measurement, and mass flowmeter measurement.

6.1.1.2 Determine the measurement method for the bunker operation based on the type of fuel and mutual agreement between the bunker supplier and receiver/vessel.

6.1.1.3 After bunkering, the same measurement method used before bunkering should be applied to all cargo tanks and non-cargo tanks on the bunker tanker and vessels.

6.1.2 Manual Measurement

6.1.2.1 Before bunkering, surveyor should be jointly with representatives from the supplier and vessel verify at the site whether the layout of bunker tanks of bunker tanker and the vessel matches with the tank calibration table provided. The reference height of the tanks should be permanently and clearly marked around the sounding pipe, and it should match with the tank calibration table. If there is a difference between the measured reference height and the tank calibration table, the measured reference height should be recorded in the measurement record for the bunker, tanker or the vessel.

6.1.2.2 After both the bunker supplier and vessel have completed all preparations before bunkering, representatives from both parties and bunker surveyor should conduct preliminary measurements of all nominated and non nominated tanks of the bunker tanker and the vessel. After completing the measurements, bunkering can commence with mutual agreement of bunker supplier and vessel.

6.1.2.3 On completion of bunkering, gauging should be carried out after the pipeline and hoses drained, the liquid level in the tanks has stabilized, generally no foam. For diesel oil measurement, the diesel oil tanks should be set of idle for at least 30 minutes before measurement. For fuel oil measurement, the fuel oil tanks should be at rest for at least 60 minutes before measurement.

6.1.2.4 Sounding methodology involves directly measuring the actual height of the oil level in the tank and is mainly used for measuring distillate fuel oil such as MDO. Before

measurement, the total sounding height (reference height) of the tank to be measured should be understood. During measurement, hold the handle of the gauge, lower it slowly until the gauge bob strikes the tank bottom gently, check if the lowered height matches the expected height, and record the actual data. Then immediately coil up the gauge tape to the point where the oil mark is visible and read the oil cut.

6.1.2.5 Ullage methodology is the distance from the oil surface in the tank to the gauge point and is mainly used for measuring heavy fuel oil. Before measurement, surveyor should have a general idea on the reference height indicated in calibration table and approximate height of the oil level in the tank. The gauging should be conducted by lowering the gauge tape slowly, stopping when the tape touches the oil surface, recording the reading as H1, and then raising the gauging tape and reading oil cut as H2 where the tape is immersed by oil. H1-H2 is the ullage height of the fuel oil tank. When the calibration table does not include ullage calculations and there is a difference between the measured sounding pipe height and the reference height, surveyor need to measure the actual oil level for calculate.

6.1.2.6 Gauging should be done steadily while lowering the gauging tape gently and lightly touching the bottom. When the tape reaches the predetermined height or the gauge bob touches the tank bottom, coil up the gauge tape quickly. Gauging should be done continuously 3 to 5 times, and if consecutive gauging reading are the same that gauge reading should be taken. Otherwise, the arithmetic average of all measurements should be used. If the difference in measurements exceeds 20 millimeters, additional measurements should be taken. If the difference exceeds 40 millimeters for two consecutive measurements, gauging should be temporarily suspended. When sounding or ullage of easily volatile light oil, if the oil mark on the tape is not clear, oil-indicating paste should be used on gauging tape. When measuring free water, evenly apply water-indicating paste to the gauge bob and tape before measurement. After the bob of gauging tape touches the tank bottom, keep it vertical for 10 to 20 seconds, lift it, and read the water cut where the water paste changes color.

6.1.2.7 Reading draft, trim, and measurements process:

a) If conditions permit, no cargo handling, ballasting or de-ballasting, and lifting gear operations

(if equipped) during measurements. After gauging in allbunker tanks before and after bunkering, immediately read the forward and aft draught, as well as the list of the vessel.

b) If cargo handling, ballasting or de-ballasting, or lifting gear operations cannot be avoided, trim and list should be arithmetic average of before and after gauging for. If the measurement process is prolonged (significant changes in draft or trim), readings should be taken immediately after gauging each tank depending on the actual situation.

6.1.2.8 All measurement data from both before and after measurements, including vessel draft, fuel temperature, etc., should be recorded in the gauging record. The bunker quantity for each tank should be calculated based on the height of free water (only for diesel), oil height, oil temperature, and trim and list corrections. The difference in oil quantity before and after bunkering represents the bunker delivered quantity. The surveyor should issue an on-site bunker quantity report, which should be signed and stamped by both the supplier and vessel.

6.1.2.9 Detailed methods for calculating bunker quantity for manual sounding are provided in Annex A.

6.1.3 Volumetric Flowmeter Measurement

6.1.3.1 If the use of volumetric flow meter is the contractually agreed method for the delivered bunker quantity, the bunker surveyor shall check before bunker delivery whether the flowmeter has intact seals from the calibration authority, as well as the last calibration date, and if within the validity period which indicating certificate.

6.1.3.2 Before bunkering, the bunker surveyor should inspect the volumetric flowmeter together with representatives from the bunker supplier and the vessel. Check if there are branch lines or flexible hose joints in the pipeline after the flowmeter and ensure that there are no bypasses from the flowmeter to the ship's fuel manifold. Both parties should confirm the initial reading of the volumetric flowmeter, and this should be recorded in the gauging record. Bunkering can commence only after mutual agreement is reached.

6.1.3.3 After bunkering, the volumetric flowmeter should be closed once pumping is stopped. The bunker surveyor and representatives from both the supplier and vessel should jointly confirm the final reading of the volumetric flowmeter and record it in the gauging record.

6.1.3.4 Based on the readings of the volumetric flowmeter before and after bunkering and the density of the fuel supplied, the bunker quantity supplied can be calculated. The bunker surveyor should issue a bunker quantity report on-site, which should be signed and stamped by both the supplier and receiver/vessel.

6.1.3.5 Detailed methods for calculating fuel quantity for volumetric flowmeters are provided in Annex B.

6.1.4 Mass Flowmeter Measurement

6.1.4.1 If the use of mass flow meter is the contractually agreed method for the delivered bunker quantity, the bunker surveyor should check before bunkering whether all seal points that may affect the measurement results have intact seals from the calibration authority, as well as the last calibration date of the flowmeter and if within the validity period which indicating certificate.

6.1.4.2 Before bunkering, the surveyor should jointly confirm the initial reading of the mass flowmeter (verify that it has been reset to zero) with representatives from both the supplier and receiver. After confirming that the mass flowmeter shows no alarms, they should sign and stamp on gauging record. The surveyor should also check if there are branch lines or flexible hose joints in the pipeline after the mass flowmeter and ensure that there are no bypasses from the mass flowmeter to the ship's fuel manifold. bunkering can commence only after mutual agreement is reached.

6.1.4.3 During bunkering, the supplier should take measures to minimize entrained gas passing through the flowmeter. The surveyor should check the aeration limit of the mass flowmeter during its operation. Once the pipeline is filled with fuel oil, the aeration limit should be reduced to less than 100%. If the aeration limit remains above 100% without reduction, the receiver should immediately take measures to increase the back pressure downstream of the flowmeter. If, after increasing the back pressure, the aeration limit is still above 100%, the supplier's personnel should take immediate action to remove entrained gas.

6.1.4.4 After bunkering, the pipeline should be drained empty, and the main valve for bunkering should be closed immediately. The bunker surveyor and representatives from both the

supplier and receiver should jointly check the condition of the seals once again, confirm the final reading of the mass flowmeter, and record it in the gauging record. The bunker supplier should print a mass flowmeter quantity ticket, which should be signed and stamped by both the supplier and receiver.

6.2 Temperature Measurement

6.2.1 Prerequisite for Temperature Measurement: Temperature measurements to liquid should be conducted after heating or stirring has stopped and immediately after the sounding(ullage) to the cargo tanks from hatch cover.

6.2.2 Temperature Measurement Points for bunker tanks:

a) For the liquid in depths below 3 meters, take measurement at the middle point of the liquid depth.

b) For the liquid in depths between 3 meters and 4.5 meters, take measurement at 1/6 and 5/6 of the liquid depth respectively and take their arithmetic average.

c) For the liquid in depths above 4.5 meters, take measurement at 1/6, 5/6 , and the middle of the liquid depth respectively. If the temperature at one of these points differs from the average temperature by more than 1°C, take additional measurement points between the upper and middle points and between the middle and lower points. Take the average of all temperature measurement points.

6.2.3 Temperature Measurement Dwell Time

6.2.3.1 When measuring the temperature of a heated liquid using a mercury thermometer, the thermometer should remain in the liquid for at least 10 to 15 minutes. For unheated liquid temperature measurements, the thermometer should remain in the liquid for at least 5 minutes.

6.2.3.2 When using a digital electronic thermometer to measure liquid temperature, it should be calibrated before use, and the reading should be taken after the temperature display stabilizes for 15 seconds.

6.3 Automatic Measurement

6.3.1 For automatic liquid level measurement devices (such as UTI, float-type level meters, etc.) and automatic temperature measurement devices provided by the ship, their calibration

certificates and corresponding correction charts should be checked for validity before use.

6.3.2 If anomalies are detected during use, manual measurement results should take precedence.

6.4 Free Water Detection

6.4.1 When gauging to the bunker tankers, the height of free water in the tank bottom should be determined as same method of sounding, and the measurement results should be recorded in the gauging record.

6.4.2 Based on the height of the free water at the tank bottom, the volume of the free water should be determined from the tank calibration table, and this volume should be deducted when calculating the bunker delivery quantity.

6.5 Verification of Bunker Delivery Quantity

6.5.1 The calculated bunker delivery quantity should be compared with the quantity received by the vessel, the outturn quantity from shore tank, or the quantity recorded in the bunker transferring records. If there is a significant difference or anomalies, recheck the related data, the calculation , and original record, including image records.

6.5.2 If sound reading is zero and the tank calibration table still shows a volume, this volume should be used in the quantity calculation.

6.5.3 If the depth measurement height of the cargo tank of the bunker tanker is 0 and the corresponding tank capacity shows a volume of 0, the hatch cover of the cargo tank should be opened for inspection to confirm that there is no flowing fuel, and the volume should be calculated as 0.

7 Sampling

7.1 Basic Sampling Requirements

7.1.1 The bunker supplier's representative should have the necessary sampling equipment, clean receiving containers, and sample containers. The sampling equipment shall conform to the relevant requirements of ISO 13739:2020, and the sample container should have a capacity of at least 600 milliliters in volume. Before sampling, check whether the sampling equipment and containers are clean and dry.

7.1.2 The sampling equipment should be connected at the first flange of the inlet bunker manifold

on the receiving vessel. It may also be installed near the flange at the outlet manifold on the bunker tanker in the event that there is an agreement between both parties. The sampling equipment should be securely sealed during sampling and should not be disassembled or adjusted.

7.1.3 The sampling process should be jointly supervised throughout. Do not accept pre-prepared samples provided by the bunker supplier.

7.2 Sampling Methods

7.2.1 The sampling method should be agreed by both the supplier and vessel prior to bunkering, and should comply with the provisions of GB/T 4756-2015. The following methods may be used:

a) Continuous drip sampling throughout the process.

b) Time-proportional sampling.

c) Flow proportional sampling.

7.2.2 When using the continuous drip sampling method, the residual liquid from previous bunkering inside the sampling pipe should be removed, the regulating valve should be closed, and then the receiving container should be connected. After the pump is started, adjust the valve opening to control the drip rate. Before stopping the pump or finishing the draining of pipelines, close the sampling device, remove the receiving container. And after fully mixing the sample in the receiving container, the sample is then poured equally portions into sample bottles, making three or four passes to fill each bottle in turn to obtain nominally identical samples. The sample bottles shall be closed and sealed in the presence of all parties. The security seal should be marked with a unique numbered.

7.2.3 When using time-based or flow rate-based sampling, the sampling methods should comply with the provisions of GB/T 4756-2015.

7.2.4 If continuous drip sampling is not applicable, and the bunker tanker provides fuel by different tanks, sampling should be done separately from each tank, and the samples should be mixed proportionally based on weight after sampling.

7.3 Sample Labels and Seals

7.3.1 All samples should be labeled with the following information: date and location of the

survey, name of vessel and IMO number, name of the bunker tanker, type and grade of the fuel, bunker quantity, sampling method, and sampling point. Sample labels should be signed and stamped by all parties.

7.3.2 All samples should be sealed with uniquely numbered seals. A sample witnessing and receipt report should be issued, and the corresponding seal numbers should be recorded on the sampling report.

7.4 Distribution and Retention of Samples

Prior to bunkering, the number of samples required by each party for testing and retention should be determined. Samples are normally distributed as follows (or as per customer instructions):

a) Three samples are provided to the vessel (one for analysis, one for vessel retention, one for MARPOL).

b) Two samples are provided to the bunker tanker (one for MARPOL, one for quality traceability).

c) Two samples are provided to the bunker surveyor (one for analysis, one for retention).

8. Records and Reports

8.1 Bunker Surveyor should use controlled records and reports that comply with requirements of quality management system, which should also include the registered name and logo of the company. The records and reports include:

a) Vessel gauging record;

b) Vessel measurement report;

c) Bunker tanker gauging record;

d) Bunker tanker measurement report;

e) Sampling report;

f) Bunkering time log report;

g) Statement of Fact (filled out in case of bunker quantity disputes);

h) Flowmeter delivery report (filled out when using a flowmeter as the delivery method for bunker quantity);

i) Pre-survey vessel acknowledgement.

8.2 The gauging record is an original record used on site to record the measurement of gauging data and temperature of all nominated and non-nominated tanker, ship drafts, before and after bunkering. After completion measurement, and confirmation no errors, it should be signed bu all parties immediately.

8.3 The vessel/bunker tanker measurement reports were a important evidence issued on-site by the bunker surveyor, which includes data for calculation such as gauging data, temperatures, and density for each tank before and after bunkering. Generally, it should be co-signed by both the bunker supplier and the vessel and serves as valid evidence for issuing the final bunker survey report.

8.4 The sampling report should include all relevant information about the samples, including the names of the vessel and the bunker supplier, the fuel type, sampling location, sampling method, quantity of samples, seal numbers，distribution and retention of the samples, and etc. This report serves as an attachment to the bunker survey report.

8.5 The time log report should list relevant time points, such as the vessel berthing time, the time of the bunker tanker alongside the vessel, time of connecting and disconnecting hose, measurement time before and after pumping, commencement time of bunkering and sampling, completion time of bunkering and sampling , etc. Any exceptional time points should be recorded in the remarks column, and a complete time log report should be issued.

8.6 The precision of various measurement and calculation data in records and reports should be rounded according to the requirements of GB/T 8170. Precision requirements are as shown in Table 1.

Table 1 Precision Requirements for Data

Item	Unit Name and Symbol	Precision	
		Measurement	Calculation
sounding, ullage	Meters (m)	0.001	0.001
Ship's draft	Meters (m)	0.01	0.01
Temperature	Celsius degrees (℃)	0.1	0.1
Density	Kilograms per cubic meter	0.1	0.1

	(kg/m3)		
Density	Metric tons per cubic meter (t/m3)	0.0001	0.0001
Volume temperature correction factor			0.0001
Density temperature correction factor			0.0001
Volume	m^3		0.001
Weight	t		0.001

8.7 Original records can be handwritten record or electronic version record. If they are electronic version records, all processes of oil tank measurements, including temperature measurements, ship's draft, and weather conditions at the berthing location before and after bunkering, should be recorded through an image recording device to ensure the traceability of the calculation results. All records and reports should be properly in order and clear, keep in file.

Annex A

(Normative)

Manual Measurement Method for Oil Quantity Calculation

A.1 Cargo Tank Capacity Table Marked Oil and Water Volume

The cargo capacity table used for measurement and calculation should be include list correction and trim correction tables. The cargo capacity table's oil and water volume is obtained by checking the cargo tank's oil level and applying incline corrections.

A.2 Volume of Free Water

The volume of free water at the bottom of the tank is obtained by referring to the cargo capacity table based on the tank's bottom water level.

A.3 Fuel Oil Volume

The fuel oil volume is calculated using Formula (A.1):

$$V_t = V_b - V_{bs} \quad \text{.....(A.1)}$$

Where:

V_t - Fuel oil volume in cubic meters (m^3);

V_b - Cargo capacity table oil and water volume in cubic meters (m^3);

V_{bs} - Ship's cargo tank bottom water volume (measured for distillate fuel oil, generally not need measuring for residual fuel oil, $V_{bs} = 0$) in cubic meters (m^3).

A.4 Calculation of Standard Volume

A.4.1 Volume Correction Factor

The volume correction factor for converting fuel oil volume to standard volume at 15° C is obtained from the volume correction factor table for fuel oil temperature and the standard density of 15° C (Petroleum Measurement Table 54B).

A.4.2 Standard Volume

The standard volume is obtained by multiplying the determined fuel oil volume by the volume correction factor for 15° C, as per Formula (A.2):

$$V_{15} = V_t \times VCF_{15} \quad \text{.....(A.2)}$$

Where:

V_{15} - Fuel oil standard volume at 15° C in cubic meters (m3);

VCF_{15} - Volume correction factor for 15° C for fuel oil.

A.5 Calculation of Apparent Mass

The apparent mass is calculated using Formulas (A.3) and (A.4):

$$WCF=\rho_{15}-0.0011 \quad \text{(A.3)}$$

$$m=V_{15} \times WCF \quad \text{(A.4)}$$

Where:

ρ_{15} - Standard density of fuel oil at 15° C in tons per cubic meter (t/m^3);

WCF - Mass conversion correction factor in tons per cubic meter (t/m^3);

m - Apparent mass in tons (t).

A.6 Calculation Method for Fuel Oil Density at 20° C

For the calculation of fuel oil density at 20° C, refer to the volume correction factor table (Petroleum Measurement Table 60B) for the corresponding volume correction factor based on the fuel oil temperature and the standard density at 20° C. Replace the standard volume and density values in the above formulas with the values at 20° C.

$$V_{20}=V_t \times VCF_{20} \quad \text{(A.5)}$$

$$WCF=\rho_{20}-0.0011 \quad \text{(A.6)}$$

$$m=V_{20} \times WCF \quad \text{(A.7)}$$

Where:

V_{20} - Fuel oil standard volume at 20° C in cubic meters (m^3);

VCF_{20} - Volume correction factor for 20° C for fuel oil;

ρ_{20} - Standard density of fuel oil at 20° C in tons per cubic meter (t/m^3).

A.7 Rounding Method

In the above steps for calculating the fuel oil quantity, rounding should only be applied to the final result of the fuel oil quantity. If intermediate results need to be reported, data rounding should be carried out according to the requirements of GB/T 8170, but rounded results should not be inserted into the calculation process.

Annex B

(Normative)

Volume Flow Meter Method for Oil Quantity Calculation

B.1 Volume Calculation

B.1.1 The volume of fuel shall be calculated according to formula (B.1):

Vt = Vt2 - Vt1.....(B.1)

Where:

Vt - The volume of fuel in cubic meters (m3)

Vt2 - The final reading of the volume flow meter in cubic meters (m3)

Vt1 - The initial reading of the volume flow meter in cubic meters (m3)

B.1.2 The gross standard volume of fuel in air shall be calculated according to formula (B.2):

Vgs = Vt x (MF x Ctl x Cpl).....(B.2)

Where:

Vgs - The gross standard volume of fuel under reference conditions in cubic meters (m3)

MF - Flow meter coefficient

Ctl - Volume temperature correction factor for fuel

Cpl - Volume pressure correction factor for fuel

B.1.3 The net standard volume of fuel in air shall be calculated according to formula (B.3):

Vns = Vgs x Csw.....(B.3)

Where:

Vns - The net standard volume of fuel under reference conditions in cubic meters (m3)

Csw - Volume correction factor for water content in fuel.

Note: Csw = 1 - SW, where SW is very small, so Csw $\approx$ 1, and Vns = Vgs.

B.2 Calculation of Fuel Weight in Air

The net weight of fuel in air shall be calculated according to formulas (B.4) and (B.5):

WCF = ρ20 - 0.0011.....(B.4)

m = Vns x WCF.....(B.5)

Where:

ρ20 - The standard density of fuel at 20° C in metric tons per cubic meter (t/m3)

WCF - Mass conversion correction value in metric tons per cubic meter (t/m3)

m - The weight of fuel in air in metric tons (t).

B.3 Calculation Method for Fuel Density at 15° C

Based on the density conversion table in GB/T 1885 Petroleum Measurement Tables, first convert the fuel density at 15° C to the standard density at 20° C, and then use the above formulas for calculation.