INTERNATIONAL STANDARD

ISO 9403

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Crude petroleum — Transfer accountability — Guidelines for cargo inspection

Pétrole brut — Prise en compte des quantités chargées ou déchargées — Principes directeurs pour les contrôles des cargaisons

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 734 10 79
E-mail copyright@iso.ch
Web www.iso.ch

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 9403 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*, Subcommittee SC 6, *Bulk cargo transfer, accountability, inspection and reconciliation*.

Annexes A and B of this International Standard are for information only.

Introduction

This International Standard is intended to encourage uniformity of crude petroleum cargo measurement, accounting and reporting procedures. It is of necessity generalized in recognition of the fact that considerable variation in local conditions exists between seaboard terminals. The guidelines are intended to be implemented worldwide and used in agreements that can be clearly interpreted and executed between parties. The recommendations embodied in this International Standard are not intended to interfere in any way with business contracts, statutory regulations in force at a particular terminal, with safety considerations, or with relevant environmental practices required by any of the parties involved.

The procedures and practices relate to action by producers, buyers, sellers, shore terminal operators, vessel owners and their crews, customs authorities, independent inspectors, and other parties having an interest in crude petroleum measurements. Since the control of the cargo may pass from shore terminal to vessel, vessel to vessel, and vessel to shore terminal, the determination of quantity and quality at these interfaces is important to the crude petroleum supplier, the vessel operator and the cargo receiver.

Crude petroleum — Transfer accountability — Guidelines for cargo inspection

WARNING — This International Standard may involve hazardous materials, operations and equipment. This International Standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this International Standard to establish appropriate safety and health practices and determine the applicability or regulatory limitation prior to use.

1 Scope

This International Standard establishes procedures and describes the recommended practices for the manual and automatic measurement and accounting of bulk quantities of crude petroleum (including spiked, blended and reconstituted crude petroleum) transferred from one port to another by marine tank vessels.

This International Standard provides a reliable basis for establishing the quantities of crude petroleum transferred.

The procedures apply to the transportation of crude petroleum from loading to discharge.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 91-1:1992, *Petroleum measurement tables — Part 1: Tables based on reference temperatures of 15 °C and 60 °F.*

ISO 2714:1980, *Liquid hydrocarbons — Volumetric measurement by displacement meter systems other than dispensing pumps.*

ISO 2715:1981, *Liquid hydrocarbons — Volumetric measurement by turbine meter systems.*

ISO 3170:1988, *Petroleum liquids — Manual sampling.*

ISO 3171:1988, *Petroleum liquids — Automatic pipeline sampling*.

ISO 4267-2:1988, *Petroleum and liquid petroleum products — Calculation of oil quantities — Part 2: Dynamic measurement*.

ISO 7278-1:1987, *Liquid hydrocarbons — Dynamic measurement — Proving systems for volumetric meters — Part 1: General principles.*

ISO 7278-2:1988, *Liquid hydrocarbons — Dynamic measurement — Proving systems for volumetric meters — Part 2: Pipe provers.*

ISO 7278-3:1998, *Liquid hydrocarbons — Dynamic measurement — Proving systems for volumetric meters — Part 3: Pulse interpolation techniques.*

ISO 7278-4:1999, *Liquid hydrocarbons — Dynamic measurement — Proving systems for volumetric meters — Part 4: Guide for operators of pipe provers.*

3 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply.

3.1
bill of lading
B/L
document which states the quantity of crude petroleum delivered to the vessel

3.2
calibration table
table, often referred to as a tank table or tank capacity table, showing the capacity of, or volumes in, a tank corresponding to various liquid levels measured from a reference point

3.3
critical zone
vertical segment close to the bottom of a floating roof tank, where the roof is neither fully floating nor resting on its legs, in which there are complex interactions and buoyancy effects as the floating roof comes to rest on its legs

NOTE The zone is usually clearly marked on tank calibration tables, and measurements for custody transfer should not be made within it.

3.4
datum point
point at or near the bottom of a tank from which the reference height is established and from which all measurements for the calibration of a tank are related

SEE also **reference point** (3.27)

3.5
dip
innage
depth of a liquid in a tank, measured from the surface of the liquid to a fixed datum point

3.6
dissolved water
water contained within the crude petroleum forming a solution at the prevailing temperature

3.7
free water
FW
water that exists as a separate layer from the crude petroleum, and typically lies beneath the crude petroleum

3.8
gross observed volume
GOV
volume of crude petroleum including dissolved water, suspended water and suspended sediment, but excluding free water and bottom sediment, measured at the crude petroleum temperature and pressure prevailing

NOTE This may be either the volume in a tank or the difference between the volumes before and after a transfer.

3.9
gross standard volume
GSV
volume of crude petroleum including dissolved water, suspended water and suspended sediment, but excluding free water and bottom sediment, calculated at standard conditions

NOTE 1 The standard conditions are in general 15 °C and 101,325 kPa

NOTE 2 This may be either the volume in a tank or the difference between the volumes before and after a transfer.

3.10
gross apparent mass-in-air of oil
mass which a GSV of oil has when weighed in air

3.11
in-transit difference
difference between a vessel's total calculated volume immediately after loading and immediately before discharge

3.12
key person
person who, by virtue of his/her employment, has a direct interest in a transfer of a cargo of crude petroleum

NOTE Such persons could include representatives of the terminal, the vessel, the cargo supplier, the cargo receiver, independent inspectors representing those parties, and representatives of fiscal bodies.

3.13
letter of protest
letter issued by any participant in a custody transfer citing any condition with which issue is taken, which serves as a written record that the particular action or findings was questioned at the time of occurrence

3.14
line circulation
petroleum or other liquid delivered through a pipeline system into a receiving vessel or tank to ensure that the section of pipeline designated to load or discharge cargo is full of liquid

NOTE It should be ensured that there is sufficient material in the tank to prevent air from entering the line during the circulation. Properly performed, a line circulation is the preferred method of ensuring that a pipeline is full of liquid.

3.15
line displacement
operation to replace previous material in a pipeline to ensure that the section of pipeline designated to load or discharge cargo is full of liquid

3.16
line press (line pack)
pressurizing the contents of a designated pipeline system with a liquid to determine if gases are present

3.17
line drop
opening (venting to atmosphere) a vessel's piping system to allow drainage into a tank(s) where the material may be gauged and accounted for

NOTE When carried out prior to taking ullages, the line drop should include all deck cargo lines, risers and drops. When carried out at completion of a discharge, it should include the vessel's bottom cargo lines. For the purpose of accounting, it is recommended that the draining be confined to as few tanks as possible.

3.18.1
load on top
LOT
⟨procedure⟩ shipboard procedure of collecting and settling water and oil mixtures, resulting from ballasting and tank operations (usually in a special slop tank or tanks) and the subsequent preparation for loading of cargo onto such mixtures

3.18.2
load on top
LOT
⟨practice⟩ act of co-mingling an on-board quantity with cargo being loaded

3.19
meter factor
ratio of the actual volume of liquid passing through a meter to the volume indicated by the meter

3.20
net standard volume
NSV
volume of crude petroleum excluding total water and total sediment, calculated at standard conditions

NOTE 1 The standard conditions are in general 15 °C and 101,325 kPa.

NOTE 2 This may be either the volume in a tank or the difference between the volumes before and after a transfer.

3.21
net apparent mass-in-air of oil
value obtained by weighing the NSV of oil in air against standard masses without making correction for the effect of air buoyancy on either the standard masses or the object weighed

3.22
on-board quantity
OBQ
sum of liquid volume and non-liquid volume in cargo tanks just before loading, excluding clingage, hydrocarbon vapours and the contents of associated pipelines and pumps

3.23
outturn quantity
quantity of crude petroleum discharged from a vessel as measured in the shore system

3.24
outturn certificate
document issued by the receiving party, certifying the outturn quantity

3.25
outturn loss/gain
difference in NSV between the quantity shown on the bill of lading and the quantity shown on the outturn certificate

NOTE It may be expressed as a volume or a percentage of the bill of lading quantity.

3.26
quantity remaining on board
ROB
sum of liquid volume and non-liquid volume in cargo tanks just after completion of discharge, excluding clingage, hydrocarbon vapours and the contents of associated lines and pumps

3.27
reference point
point on the gauge hatch or top of a tank from which the reference height of the tank is established

SEE also datum point (3.4)

3.28
reference height
distance from the **datum point** (3.4) to the **reference point** (3.27)

3.29
slops
material contained in slop tanks or other designated tanks, resulting from tank washing, change of ballast, and oil-recovery procedures

3.30
suspended sediment
non-hydrocarbon solids present within the crude petroleum but not in solution

3.31
suspended water
water contained within the crude petroleum that is finely dispersed as small droplets

NOTE It may, over a period of time, either collect as free water or become dissolved water, depending on the conditions of temperature and pressure prevailing.

3.32
total calculated volume
TCV
gross standard volume plus the free water measured at the temperature and pressure prevailing

3.33
total observed volume
TOV
volume of crude petroleum, total water and total sediment, measured in a tank at the crude petroleum temperature and pressure prevailing

NOTE This may be either the volume in a tank or the difference between the volumes before and after a transfer.

3.34
ullage
outage
distance between the surface of a liquid in a tank and a fixed reference point on the top of the tank, or capacity of a tank not occupied by liquid

3.35
vessel experience factor
VEF
mean value of the vessel load ratios (VLRs) or vessel discharge ratios (VDRs) obtained after the required number of qualifying voyages

3.36
vessel load ratio
VLR
ratio of the TCV measured on board a vessel immediately after loading, less the OBQ, to the TCV measured by the loading terminal

3.37
vessel discharge ratio
VDR
ratio of the TCV measured on board a vessel immediately before discharge, less the ROB, to the TCV measured by the receiving terminal

3.38
vessel-shore difference
difference between the TCV recorded by the vessel corrected for OBQ or ROB as appropriate, and the TCV recorded by the shore

3.39
volume correction factor
VCF
factor for correcting oil volumes to a standard reference temperature

3.40
water cut
dip
procedure of locating the oil/water interface for the purpose of determining the volume of free water in a shore tank or vessel compartment

3.41
wedge formula
mathematical means to assess small quantities of measurable liquid and/or non-liquid material which is in a wedge configuration and does not touch all bulkheads of the vessel’s tank

NOTE 1 The formula is based on cargo compartments characteristics, vessel trim and the depth of the material.

NOTE 2 The wedge formula should be used only when the liquid does not cover the entire bottom of the vessel's tank.

3.42
weight conversion factor
WCF
factor for converting volumes to apparent mass-in-air

See ISO 91-1:1992, table 56.

4 General recommendations

4.1 General responsibilities

4.1.1 It is essential that safe practices be followed.

NOTE In addition to governmental safety regulations, these may include individual company requirements and those outlined in ICS/OCIMF, *International Safety Guide for Oil Tankers and Terminals* (ISGOTT).

4.1.2 Each party having facilities or equipment, or supplying equipment used for cargo transfer, measurements, sampling and testing, is responsible for the items being in safe and serviceable condition and if appropriate, with an accuracy traceable to national standards.

4.1.3 Each party involved, including inspectors appointed by the parties, is responsible within their domain, for ensuring that operations are conducted by persons trained in the use of measurement, sampling and testing equipment and the procedures given in this International Standard.

4.1.4 Each party involved in sampling/sample handling operations should ensure that the integrity of each sample is maintained, for example, samples are securely closed, properly labelled, not exposed to artificial heat or direct sunlight, and not unduly shaken.

4.1.5 Each party involved in the operation is responsible within their domain for contributing to a reconciliation of vessel and shore quantities, and for seeking explanation for any discrepancies.

4.1.6 Each party should maintain their own complete and accurate records of all relevant data. Such data should be available to all parties.

4.1.7 Each party should maintain up-to-date manuals or instructions describing the applicable procedures and methods of test for which they are responsible.

4.2 Volume measurement

4.2.1 Shore-tank measurement

The use of an automatic means of tank level measurement may be acceptable to parties by mutual agreement, in which case proof of accuracy should be provided, if requested, (e.g. by reference to proving records complying with appropriate standards, certification documents, etc.). If there is any doubt about the performance of the instrument, manual procedures should be followed.

It is important when tanks are being gauged that the temperature of the contents be measured and recorded.

4.2.2 Metering

It is the responsibility of the shore terminal to maintain and operate metering facilities in accordance with ISO 2714, ISO 2715 and ISO 7278.

Calculations should conform to ISO 4267-2.

4.2.3 Ship-tank measurement

If a ship's tanks are under inert gas pressure, agreement should be sought to allow depressurization to enable manual measurements and sampling.

If the vessel is fitted with a closed ullage system with facilities for the use of portable or permanently installed ullage/temperature and interface equipment whilst the tanks are under pressure, then this procedure can be adopted, provided that the equipment used is accurate and safe. Adequate data should be available in the calibration tables relating to the appropriate corrections to be applied to obtain the true ullage reading. Sampling by this method is limited and may have to be restricted to manifold sampling during operations.

If the vessel tanks are to be kept closed, readings from automatic gauging equipment, if available, should be recorded. When no means are available to make manual measurements or to take samples through pressure-tight gauge-hatch fittings, then it should be recognized that reconciliation between vessel and shore quantities may not be possible.

Temperatures should be taken whilst gauging.

4.3 Reconciliation and records

Discrepancies between shipboard measurements and shore measurements should be recorded. It is essential that every effort should be made to resolve such discrepancies before the vessel departs. Unresolved discrepancies may lead to a letter of protest being issued.

The vessel should maintain cargo records which should be available for inspection by all key persons (see 6.2.1 and 7.2.1).

Vessel documents which relate to cargo quantity and quality assessment should also be available for inspection by all key persons (see 6.2.1 and 7.2.1).

4.4 Independent inspectors

In many cases, the interested parties need an unbiased representative who will verify custody transfer volumes to their mutual satisfaction.

Independent inspectors will conduct or witness all gauging and sampling, verify and report quantities and complete a report which describes all facets of the operation including a reconciliation of quantity differences. They work together with shore personnel and ship officers in the performance of the necessary tasks in accordance with this International Standard. The role of an independent inspector may vary considerably from case to case in accordance with instructions received from their principals. Their presence is agreed upon by the parties involved.

It is recommended that reports prepared by independent inspectors should address all the matters and calculations described in, but not limited to, this International Standard.

4.5 Notices

If any problems occur at any stage of the transfer that may affect subsequent stages, all key persons involved should be notified promptly so that necessary and timely action can be taken. Any action not in accordance with the procedures given in this International Standard, or refusal to observe its procedures or existing contractual agreements, should be reported to the key persons.

5 Documentation

5.1 Data collection and reporting

This International Standard provides procedures for the collection of data in a systematic manner.

Calculation of oil quantities should be in accordance with International Standards. For the purpose of dynamic measurement, ISO 4267-2 should apply. Where no International Standard yet exists, other recognized methods and procedures, preferably those published by the American Society for Testing and Materials (ASTM)/Institute of Petroleum (IP)/American Petroleum Institute (API), should be used.

NOTE A set of forms has been designed which enable the data to be recorded and reported in a standard format, and a checklist has been added for quickly checking the completeness of the information. The checklist and the forms are not a normative part of this International Standard, and have been included as annexes A and B.

Their contents should be considered as minimum reporting requirements.

5.2 Signing of the forms

This International Standard recommends that forms should be signed by

— the party or parties designated to fill out the forms, and

— the party or parties witnessing the measurements and/or providing the indirect data mentioned above.

NOTE All parties have the right to include comments.

6 Procedure at the time of loading

6.1 Measurement, calculation and reporting

All measurements and calculations should be in accordance with International Standards. If no International Standard exists, other recognized methods and procedures, preferably those published by ASTM/IP/API should be used.

Measurements, calculations, other relevant checks and observations should be reported.

6.2 Procedure before loading

6.2.1 Key meeting

Before loading begins, a meeting or meetings should be held between the vessel's representatives, shore operational personnel and cargo inspectors, involved in the loading operation. The meeting should be called by one or more of the foregoing parties. At these meetings, key operational people are identified, responsibilities are defined, communication procedures are arranged, and loading procedures and plans are reviewed to ensure good operating practices and a full understanding of all activities by all concerned. Any of the above parties not able to attend the key meeting should be advised of the decisions taken at this meeting. The vessel's representatives should report any unusual events that may have occurred during the sea passage or at the previous port that may require special vigilance during loading. Shore and ship personnel should advise on any special conditions existing on shore and ship respectively, that may adversely affect the loading activity or measurements.

Any operational procedures not capable of yielding acceptable measurement control should be reviewed and (an) alternative procedure(s) investigated.

6.2.2 Shore measurements

6.2.2.1 Terminal loading lines

6.2.2.1.1 Record the total capacity of the terminal loading lines from the vessel's flange to the shore tank(s).

Ascertain the quantity and quality, and where possible the temperature, of the material in the terminal loading line. The contents of the terminal loading line forms an extension of the loading tanks, and changes in properties can result in a change of quantity which should be accounted for. If neglected, this can contribute to discrepancies.

6.2.2.1.2 Record the steps taken to determine that the terminal line is full of liquid.

6.2.2.1.3 The terminal should arrange for loading lines and valves to be set so as to avoid the risk of cargo being contaminated or lost to other lines and tanks, for example, as a result of ballasting operations or from other loading and discharge activities occurring at the same time. If deemed appropriate, the valves can be locked.

6.2.2.2 Tank measurements

6.2.2.2.1 General

Take opening dips or ullages, temperatures and samples, and measure the depth of free water in each tank to be used for the loading. Obtain the reference height from the calibration tables before taking level measurements and water cuts. Any discrepancy between the observed reference height and the reference height shown on the tank calibration tables should be noted, with an explanation, if possible. Under such circumstances, ullage measurements may be the best alternative. If the tank has recently been in active service, wait for the liquid level to reach equilibrium conditions. If it is impossible to wait, state the reasons for not doing so, and indicate in the remarks section of the inspection report how long the cargo was held in the tank before shipment.

On tanks having floating roofs, gauging should be avoided while the roof is in the critical zone. The placement of roof legs on the high or low position should be noted in the inspection report.

Estimate and report any material, including water or ice, on the floating roof, and the weather conditions under which measurements were taken.

6.2.2.2.2 Tank levels

All dips or ullages should be recorded. Carry out two measurements, and if they agree to within 3 mm, report the average; otherwise the average of at least three measurements should be reported.

Measure the depth of free water. Whilst determining free-water depth or taking a dip, the observed tank reference height should be noted.

6.2.2.2.3 Tank temperature measurement

6.2.2.2.3.1 General

A minimum of three temperatures (upper, middle and lower) should be taken. Preferably a temperature profile of the tank contents should be made. Taking the temperature of the liquid at equidistant intervals throughout its depth will improve the average temperature determination of the tank contents.

6.2.2.2.3.2 Portable electronic thermometers

Portable electronic thermometers (PET) are preferred for obtaining temperatures. They should have an accuracy of at least ± 0,25 °C.

The temperature probe should be considered to have reached stability when the readout varies by no more than 0,1 °C over a period of at least 30 s.

NOTE It is recommended that portable electronic thermometers be frequently checked in the laboratory, preferably directly prior to use, and that the checks be carried out at temperatures that bracket the expected cargo temperature.

6.2.2.2.3.3 Cup-case thermometers

NOTE Cup-case thermometers stand a high risk of being influenced by adverse weather conditions.

The cup-case thermometers should be of the mercury-in-glass type, have an accuracy of at least ± 0,25 °C, and be calibrated annually.

Cup-case thermometers should be immersed in the crude petroleum for sufficient time to allow them to reach the temperature of the crude petroleum.

The immersion times given in Table 1 are recommended.

Table 1 — Immersion times for cup-case thermometers

Density at 15 °C kg/m^3	**Immersion time** min	
	in motion	**in stationary conditions**
< 775	5	10
775 to 825	5	15
825 to 875	12	25
875 to 925	20	45
> 925	45	80

6.2.2.2.4 Automatic tank gauging

If an automatic tank level and temperature gauging system is used, the readings should if possible be verified by manual measurements or from proving records. Any adjustment should be recorded.

6.2.2.3 Dynamic quantity measurement

6.2.2.3.1 Meters and documentation

Terminals are responsible for the operation and proving of their meters in accordance with ISO 7278 and should ensure that appropriate meter-proving data are available. Meter measurement documentation should be provided for each custody transfer. Terminal operators or inspectors who are aware of meter difficulties which could affect accuracy should immediately report the problem to all parties involved in the custody transfer. Record the problem and its resolution in the inspection report.

Prior to loading, record the opening meter readings. It is strongly recommended that meters be proved during loading in accordance with International Standards. A completed meter-proving report and meter-measurement documentation for each meter used should be attached to a completed meter report.

If shore-tank measurements can be taken, show comparison of metered volumes to shore-tank volumes, preferably on volumes displacing the full height of the tank. If volumes cannot be reconciled, check meter factors and shore-tank measurements/calculations. Record the results in the report.

To avoid the entrainment of air in meter assemblies, tanks from which crude petroleum is being withdrawn should not be operated below minimum dip (usually 2 m). For floating-roof tanks, this level will be above the critical zone.

6.2.2.3.2 Dynamic temperature measurement

The accuracy of the temperature probe in the shore line should be verified from calibration/proving records.

6.2.2.4 Sampling and sample handling

6.2.2.4.1 Manual samples from loading tanks

Each tank to be used in the loading should be sampled in accordance with ISO 3170.

NOTE 1 The tank contents should be as homogeneous and as sludge- and water-free as possible.

NOTE 2 Tank samples should not be composited prior to analysis. After analysis in the laboratory, they may be composited. If compositing is carried out after analysis, it should be carried out in accordance with ISO 3170.

6.2.2.4.2 Automatic in-line sampling

Automatic in-line samplers should be installed and operated in accordance with ISO 3171.

Manual tank samples before loading should be taken to back up a failure of the automatic sampling device.

6.2.2.4.3 Distribution and retention of loading tank samples

Sufficient samples should be obtained to meet the requirements of interested parties and regulatory agencies. Sampling and testing requirements are generally specified by interested parties.

Identical samples should be provided for

- the loading terminal,
- the cargo owner via the vessel's master,
- independent inspectors, and
- all other parties designated to receive them, and which may include the vessel owner.

Samples placed on board the vessel for delivery to the discharge port should be properly labelled and sealed, and be acknowledged by a receipt signed by the vessel's representative. A copy of the signed receipt should be included in the inspection report.

The length of time during which samples are to be retained should be established. This time should be consistent with the circumstances, experience and the policies of the parties involved in the custody transfer.

6.2.3 Vessel measurements

6.2.3.1 Valve sealing

Confirm, in the presence of vessel personnel, that sea valves and overboard discharge valves are in the closed position and sealed prior to loading. Seal valves in a manner that will reveal if valves were operated during the loading and/or subsequent voyage. Record the seal numbers.

If, during loading operations, simultaneous deballasting is performed, determine the reason from the vessel's representatives, record it in the inspection report and issue a letter of protest.

NOTE Under these conditions, valve sealing may have to be delayed until deballasting has been completed.

Record single/double valve separations, if any, between clean/dirty ballast and cargo systems.

6.2.3.2 Vessel lines

Request the vessel personnel to drain the deck lines into the aftmost centre tank, or tank(s), designated for this purpose. Measure the amount of cargo or ballast water dropped into the tank and sample if a sufficient quantity is collected. Also record the capacity of the lines drained.

6.2.3.3 Draft, trim, list and gauging locations

Record and report the draft, trim, list and gauging locations when measuring OBQ and vessel ullages.

6.2.3.4 Reference heights

Measure and record the tank reference heights. Compare these with those given in the calibration tables. Investigate and report any differences.

6.2.3.5 Remaining ballast

Measure and record the quantity and type of any ballast on board immediately prior to loading. Investigate and record the presence of any measurable hydrocarbon in any of the ballast tanks.

6.2.3.6 OBQ measurement

Determine the quantity and nature of all material on board (OBQ) prior to loading, including all in-transit cargo and material in non-designated cargo spaces. Describe the material remaining in tanks as

— liquid,

— non-liquid,

— free water.

If a temperature measurement is to be obtained when there is sufficient liquid available, this should be taken from the mid-point of the liquid layer. Solids and small quantities of liquid for which a temperature cannot be obtained may be assumed to be at the standard temperature applicable.

NOTE Most vessels intended for the transport of crude petroleum are now equipped to provide an inert gas under pressure in closed cargo tanks. If the vessel's tanks are to be kept closed and no means are available for manually taking samples and measurements through pressure-tight devices, then reconciliation of vessel and shore quantities may not be possible.

6.2.3.7 OBQ volume calculations

Determine the OBQ as follows:

a) use wedge formula/tables if liquid does not touch all four bulk heads;

b) use vessel calibration tables with appropriate trim/list corrections if liquid touches all four bulk heads;

c) use vessel calibration tables without trim/list correction for non-liquid material.

Record the nature of the material and the method used to determine the volume in each compartment. Material in non-designated cargo compartments should be measured and reported but should not be included in the totals.

A report on the findings should be signed by the vessel's representative and, if present, the independent inspector.

6.2.3.8 OBQ sampling

If a sufficient quantity of free water is found, take a sample of the water. Take samples of any significant quantities of crude petroleum remaining in the cargo compartments, particularly if agreement cannot be reached as to its identity and nature. Obtain a composite sample of all in-transit cargo quantities. Seal and retain. Retention and distribution of samples is to be specified by the parties concerned.

6.2.3.9 Slop tanks

Measure the slop tank(s) to determine the interface and the separate quantities of free water and slop oil. Take temperature(s) and sample(s) of the oily layer and free-water layer.

6.2.3.10 Bunker survey

If a bunker survey is required, the quantity of bunker oil on the vessel should be measured. Record whether or not the vessel is to be bunkered during the cargo transfer together with an indication of the quantity of bunkers expected to be supplied to the vessel. An estimate should be obtained from the master or chief engineer of the approximate quantity of bunkers to be used during the vessel's stay in port.

For safety purposes, the ullage spaces in the vessel's bunker tanks should be tested for hydrocarbon gas using a combustible gas indicator. Gas samples should be taken from each bunker tank vent pipe or through a tank hatch. In the event that this is not practicable, gas samples may be obtained through sounding pipes.

If the presence of hydrocarbon gas in excess of 50 % of the lower explosive limit is detected, notify the master, terminal representative and cargo owner, and, if so instructed, proceed to the following:

a) take a sample from each bunker tank, if possible;

b) carry out a flash point test on the samples.

If the flash point of any sample is below 60 °C, a letter of protest should be issued to the master and the terminal representative informed.

6.3 Procedure during loading

6.3.1 Communications

Personnel becoming aware of any problem that could affect subsequent events, at any stage of the transfer, should promptly notify all key personnel in order that timely action may be taken.

6.3.2 Sampling for terminal loading line quality control

At the commencement of loading, take a line sample from a convenient sample point at the vessel's manifold to verify the contents of the line. After the time necessary to displace the line contents completely, take another sample to verify that the density of the cargo being loaded is within $\pm$ 2,0 kg/m^3 of the density of the contents of the shore tank(s) from which the crude petroleum is being loaded. If the difference exceeds the above figure, an investigation should be carried out and appropriate action taken.

In addition, whenever possible, the line content should be loaded into a minimum number of designated tanks on board which can be measured, sampled and analysed, subject to agreement between parties.

6.4 Procedure after loading

6.4.1 Vessel inspection and calculations

6.4.1.1 Draft, trim, list and gauging locations

Record the draft, trim, list and gauging locations. Apply trim and list corrections if applicable as determined from the vessel's trim and list tables.

6.4.1.2 Vessel's lines

Before measuring, request that the vessel's lines be drained as far as possible, and record into which tanks lines were drained. Record the capacity of the lines drained. In all instances where the vessel has completed loading, the vessel should ensure that all internal transfer of cargo has ceased and that tank valves are secured prior to gauging. Loading lines should be vented prior to gauging.

6.4.1.3 Cargo compartments

Take ullages of all cargo compartments. Record the measurements. Record whether the measurements were made using manual or automatic equipment and if the vessel tanks were inerted during ullaging.

6.4.1.4 Slop tanks

If LOT has not been practised, the slop tank(s) should be treated according to 6.2.3.9.

If LOT has been practised, the slop tank(s) should be treated in accordance with 6.4.1.3, 6.4.1.5, 6.4.1.6 and 6.4.1.7.

6.4.1.5 Other relevant compartments

Inspect for the presence of crude petroleum in all non-designated cargo compartments. These include all void spaces, cofferdams and double bottoms. If crude petroleum is found, it should be measured and recorded. If necessary, appropriate action should be taken.

6.4.1.6 Water cut (dip)

Take water cuts whilst ullaging each compartment. Record the type of water-finding paste or device used to determine the oil/water interface. Record the interface. If emulsions are detected, it will be necessary for an agreed water dip to be recorded. If there is sufficient water, take a sample.

NOTE When determining free-water volumes, it may be necessary to apply the wedge formula/tables.

6.4.1.7 Vessel temperature

6.4.1.7.1 Portable electronic thermometers (PET) having an accuracy conforming to 6.2.2.2.3.2 are preferred. A minimum of three readings (upper, middle and lower) should be taken and the average reported and used for volume calculations.

6.4.1.7.2 In the absence of a PET, a spot temperature taken at mid-level using a cup-case thermometer, having an accuracy conforming to 6.2.2.2.3.3, should be determined and reported.

6.4.1.8 Automatic tank gauging

If an automatic tank level and temperature gauging system is used on board, verify the readings by manual measurements, if possible.

6.4.1.9 Ballast tanks

Inspect the ballast tanks and record the quantity of ballast on board. Investigate and report the presence of any gaugeable crude petroleum lying on the surface of the ballast water and, if possible, take a sample of it. Report any suspected leakage to and from cargo and ballast tanks.

6.4.1.10 Sampling

Take samples representative of the total cargo depth of each cargo tank such that a volumetric composite sample for each parcel may be prepared, preferably in the laboratory, for appropriate testing. Refer to ISO 3170. Obtain samples from slops separately.

6.4.1.11 Distribution/retention of vessel samples

Sufficient samples should be obtained to meet the requirements of interested parties and regulatory agencies. Sampling and testing requirements are generally specified by interested parties.

Identical samples should be provided for

a) the loading terminal;

b) the unloading terminal via the vessel's master;

c) independent inspectors, and

d) all other parties designated to receive them, which may include the vessel owner.

Samples placed on board the vessel for delivery to the discharge port should be properly labelled and sealed, and be acknowledged by a receipt signed by the vessel's representative. A copy of the signed receipt should be included in the inspection report.

The length of time that samples are to be retained should be established. This time should be consistent with the circumstances, experience and policies of the parties involved in the custody transfer.

6.4.1.12 Sea valves

If possible, confirm in the presence of the vessel's personnel that sea valves and overboard discharge valves are closed and that the seals are still intact. If the seals are not intact, attempt to ascertain the reasons why they were broken and issue a letter of protest.

Record the findings in the inspection report.

6.4.1.13 Bunker survey

The procedure described in 6.2.3.10 should be carried out.

6.4.1.14 Volume calculations

The GSV for each tank should be calculated using the ullage (see 6.4.1.3) corrected for trim/list as appropriate, and the average temperature of the tank. An average temperature for the entire vessel should not be used.

The records should also include the measurement and quantity for the free water, GOV, and the average temperature of each tank. Calculate the TCV and subtract the OBQ for comparison with the shore TCV loaded.

6.4.2 Load-port inspection and calculations

6.4.2.1 Terminal loading lines

Determine the quantity and quality of material in the terminal loading lines prior to taking closing tank gauges or meter readings. Report findings and include line-content changes in the quantity calculations. Refer to 6.2.2.1.

NOTE When required, determine the difference in NSV of the line contents before and after loading, using the same procedure as above. Apply any difference to the quantities calculated above.

6.4.2.2 Tank measurements

Take closing gauges, temperatures and water cuts of each tank used in the loading. Record results on the shore measurement report. Refer to 6.2.2.2.

6.4.2.3 Tank samples

When required, take tank samples after loading in accordance with ISO 3170. Specify the locations from which the samples were obtained.

NOTE It is normal practice for the before-loading density and suspended sediment and water determinations (6.2.2.4) to be used in subsequent calculations. Therefore, tank samples after loading are not usually required.

6.4.2.4 Automatic in-line sampler

If an automatic in-line sampler was used, ascertain that it has performed in accordance with ISO 3171.

Report any difficulties (e.g. incorrect sample volume collected) encountered with the in-line sampling procedures.

6.4.2.5 Dynamic measurement

Record the closing meter readings and the meter factor utilized. Obtain a complete copy of all meter-proving forms and meter documentation. Attach them to the completed metered quantity reports and include in the inspection report. If the meter(s) was (were) not proved during loading, indicate the frequency of meter proving and attach a copy of all current meter-proving reports. ISO 4267-2 provides details of quantity calculation and reporting.

6.4.3 Load-port reconciliation

6.4.3.1 Vessel experience factor at loading port

Calculate the VEF (loading) from the vessel's records. Apply this factor to the ship's loaded figures. Compare shore and ship loaded figures.

If possible, reconciliation/comparison of shore and ship figures should be made prior to the vessel sailing. In the case of unreconcilable figures, an appropriate notice should be issued. Refer to 4.3.

NOTE If the loading terminal is unable to provide reliable loading figures, the VEF may be applied to a vessel's measurements to establish the quantity loaded to be entered on the bill of lading, subject to agreement between the parties. In this situation, load-port reconciliation is not possible. However, VEF (loading) applied to other than a full cargo may not necessarily be reliable.

6.4.3.2 Load-port voyage analysis

Prepare the load-port section of the voyage analysis report. Compare the shore TCV or metered quantities (including free water and sediment and water) to vessel TCV quantity received (GSV + FW – OBQ). If the difference on the same comparison basis is greater than that set by parties to the contract or stated policies of those companies after application of the VEF, recheck all measurements and calculations in an attempt to identify the difference. If the difference cannot be reduced to an acceptable level, appropriate notices should be issued.

6.4.3.3 Quality tests

Testing for quality should be specified by the interested parties. Report analytical methods used for testing. Responsibility for testing rests primarily with the shore.

All tests should be performed by qualified personnel. Other parties, or their representative, should be allowed to carry out the same tests on a duplicate sample or alternatively, to witness the testing carried out by the shore party.

6.4.3.4 Notices

All key persons involved should be notified promptly of any problems that could affect the transferred quantity, so that necessary, timely action can be taken. Any action or refusal to act in accordance with this procedure or prior contract agreements shall be reported to the personnel concerned, and should be documented by the issuance of an appropriate notice.

7 Procedure at the time of discharge

7.1 Measurement, calculation and reporting

All measurements and calculations should be in accordance with International Standards. Where no International Standard yet exists, other recognized methods and procedures, preferably those published by ASTM/IP/API should be used.

Report the specified measurements, calculations and other relevant checks and observations on the appropriate forms.

7.2 Procedure before discharge

7.2.1 Key meeting

Before discharging begins, a meeting or meetings should be held between the vessel's representatives, shore operational personnel and cargo inspectors, involved in the operation. The meeting should be called by one or more of the foregoing parties. At these meetings, key operational people are identified, responsibilities are defined, communication procedures are arranged, and procedures and plans are reviewed to ensure a full understanding of all activities by all concerned. Any of the above parties not able to attend the key meeting should be advised of the decisions taken at this meeting. The vessel's representative should report any unusual events that may have occurred during the sea passage or at the previous port, and that may require special vigilance during discharge. Shore and ship personnel should advise on any special conditions existing on shore and ship, respectively, that may adversely affect the discharge or measurements.

Any operational procedures not capable of yielding acceptable measurement control should be reviewed and an alternative procedure(s) investigated.

7.2.2 Shore measurements

7.2.2.1 Terminal discharge lines

7.2.2.1.1 Record the total capacity of the terminal discharge lines from the vessel's flange to the shore tank(s).

Ascertain the quantity, quality and, where possible, the temperature, of the material in the terminal discharge line. The contents of the terminal line forms an extension of the receiving tankage and any change in properties can result in a change of quantity which should be accounted for. If neglected, this can contribute to discrepancies.

7.2.2.1.2 Record the steps taken to determine that the terminal line was full of liquid.

7.2.2.1.3 The terminal should arrange for lines and valves to be set so as to avoid the risk of cargo being contaminated or lost to other lines and tanks, for example, as a result of ballasting or deballasting operations or from other loading and discharge activities occurring at the same time.

7.2.2.2 Tank measurements

7.2.2.2.1 General

Take opening dips or ullages, temperatures and samples, and measure the depth of free water in each tank to be used for the discharge. Obtain the reference height from the calibration tables before taking level measurements and water cuts. Any discrepancy between the observed reference height and the reference height shown on the tank calibration tables should be noted, with an explanation, if possible. Under such circumstances, ullage measurements may be the best alternative. If the tank has recently been in active service, wait for the liquid level to reach equilibrium conditions. If it is impossible to wait, state the reasons for not doing so.

On tanks having floating roofs, gauging should be avoided while the roof is in the critical zone. The placement of roof legs on the high or low position should be noted in the inspection report.

Estimate and report any material, including water or ice, on the floating roof and report weather conditions under which measurements were taken.

7.2.2.2.2 Tank levels

All dips or ullages should be recorded. Carry out two measurements, and if they agree to within 3 mm, report the average; otherwise the average of at least three measurements should be reported.

Measure the depth of free water. Whilst determining free-water depth or taking a dip, the observed tank reference height should be noted.

7.2.2.2.3 Tank temperature measurement

7.2.2.2.3.1 General

A minimum of three temperatures (upper, middle and lower) should be taken. Preferably a temperature profile of the tank contents should be made. Taking the temperature of the liquid at equidistant intervals throughout its depth will improve the average temperature determination of the tank contents.

7.2.2.2.3.2 Portable electronic thermometer (PET)

If a fixed temperature system is not available, portable electronic thermometers are the preferred means of measuring the temperature.

The portable electronic thermometers should have an accuracy of at least ± 0,25 °C.

The temperature probe should be considered to have reached stability when the readout varies by no more than 0,1 °C over a period of at least 30 s (see the note in 6.2.2.2.3.2).

7.2.2.2.3.3 Cup-case thermometers

See the note in 6.2.2.2.3.3.

The cup-case thermometers should be of the mercury-in-glass type, have an accuracy of at least ± 0,25 °C, and be calibrated annually.

Cup-case thermometers should be immersed in the crude petroleum for sufficient time to allow them to reach the temperature of the crude petroleum.

The immersion times given in Table 1 are recommended.

7.2.2.2.4 Automatic tank gauging

If an automatic tank level and temperature gauging system is used, the readings should, if possible, be verified by manual measurements or from proving records. Any adjustments should be recorded.

7.2.2.3 Dynamic quantity measurement

7.2.2.3.1 Meters and documentation

Terminals are responsible for the operation and proving of their meters in accordance with ISO 7278 and should ensure that appropriate meter-proving data are available.

Air elimination is mandatory since meters respond to all fluids passing through them, i.e. both crude petroleum and air.

Terminal operators or inspectors who are aware of meter difficulties which could affect accuracy should immediately report the problem to all parties involved in the custody transfer. Record the problem and its resolution in the inspection report.

Prior to discharge, record the opening meter readings. It is strongly recommended that meters be proved during discharge in accordance with International Standards. A completed meter proving report and meter measurement documentation for each meter used in a custody transfer should be attached to a completed meter report.

If manual shore-tank measurements can be taken, show comparison of metered volumes to manually determined volumes, preferably on volumes displacing the full height of the tank. If volumes cannot be reconciled, check meter factors and shore-tank measurements/calculations. Record the results in the report.

7.2.2.3.2 Dynamic temperature measurement

If a temperature probe in the shore line is used to determine the temperature for the correction of a metered quantity discharged, record in the inspection report the last two times the probe was checked for accuracy.

7.2.2.4 Sampling and sample handling

7.2.2.4.1 Manual samples from receiving tanks

Each tank to be used in the discharge operation shall be sampled in accordance with ISO 3170.

Obtain representative samples from the tanks designated to receive cargo. The tank contents should be as homogeneous and as sludge- and water-free as possible.

Preferably, tank samples should be analysed individually since this provides a better insight into the condition of the tank contents and/or the reliability of the samples.

If compositing of tank samples is required, this should be carried out in the laboratory, avoiding high temperatures and loss of light ends (see ISO 3170). Retain/distribute samples according to 6.2.2.4.3.

Homogenization in the laboratory of samples required for blending and subsampling should be carried out using a commercially available mechanical or static mixing device. Shaking or stirring for the purpose of homogenization of crude petroleum samples is not acceptable. Refer to ISO 3170 for proper homogenization procedures.

7.2.2.4.2 Automatic in-line sampling

Automatic in-line samplers should be installed and operated in accordance with ISO 3171.

Manual samples should be taken from the vessel and receiving tanks to back up a possible failure of the automatic sampling device.

7.2.3 Vessel inspection and calculations

7.2.3.1 Draft, trim, list and gauging locations

Record the draft, trim, list and gauging locations. Apply trim and list corrections where applicable as determined from the vessel's calculated trim and list tables.

7.2.3.2 Vessel's lines

Before taking measurements, ask the vessel's personnel to drain the lines into cargo tanks as far as possible. Record the capacity of the lines. In all instances, the vessel should ensure that all internal transfer of cargo has ceased and that tank valves are secured prior to gauging. Lines should be vented prior to gauging.

It is assumed that the bottom lines will be full.

7.2.3.3 Vessel ullages/arrival

Take ullages and temperatures (refer to 6.4.1) of all cargo compartments. This should include compartments not intended to be discharged. Inspect for the presence of oil in all non-designated cargo spaces. If oil is found, it should be measured and recorded. If necessary, appropriate action should be taken. Record measurements on the vessel ullage report. State if measurements were manual or automatic and if the vessel tanks were inerted during ullaging.

NOTE Most vessels intended for the transport of crude petroleum are now equipped to provide an inert gas under pressure in closed cargo tanks. If the vessel's tanks are to be kept closed and no means are available for manually taking samples and measurements through pressure-tight devices, then reconciliation of vessel and shore quantities may not be possible.

7.2.3.4 Water cut (dip)

Take water cuts whilst ullaging each compartment. Record the type of water-finding paste or device used to determine the oil/water interface. Record the interface. If emulsions are detected, it will be necessary for an agreed water dip to be recorded. If there is sufficient water, take a sample. See the note in 6.4.1.6.

7.2.3.5 Ballast tanks

Inspect the ballast tanks and record the quantity of ballast on board. Investigate and report the presence of any gaugeable crude petroleum lying on the surface of the ballast water and, if possible, take a sample of it. Report any suspected leakage to and from cargo and ballast tanks.

7.2.3.6 Sampling

Take samples representative of the total cargo depth of each cargo tank such that a composite sample for each parcel may be prepared, preferably in the laboratory, for appropriate testing.

When slops are present, both the oil and water layer should be sampled.

For sample handling refer to ISO 3170.

7.2.3.7 Distribution of vessel samples

Sufficient samples should be obtained to meet the requirements of interested parties and regulatory agencies. Sampling and testing requirements are generally specified by interested parties.

Identical samples should be provided for

a) the receiving terminal,

b) an independent inspector, and

c) all other parties designated to receive them, which may include the vessel owner.

Samples placed on board the vessel should be properly labelled and sealed, and be acknowledged by a receipt signed by the vessel's representative. A copy of the signed receipt should be included in the inspection report.

The length of time that samples are to be retained should be established consistent with the circumstances, experience and policies of the parties involved in the custody transfer.

7.2.3.8 Sea valves

Confirm, in the presence of vessel personnel, that sea valves and overboard discharge valves are in the closed position and that the seals are still intact. Ensure that valves sealed at the loading port remain closed and sealed until the unloading operation is completed. Record the seal numbers.

Compare and note if seal numbers differ from those recorded at load port.

If previously sealed valves are not intact, issue a letter of protest, and attempt to ascertain why the seals were broken. Record the findings in the inspection report.

7.2.3.9 Bunker survey

If a bunker survey is required, the quantity of bunker oil on board the vessel should be measured and recorded. Whether or not the vessel is to be bunkered during the cargo transfer should be recorded together with an indication of the quantity of bunkers expected to be supplied to the vessel. An estimate should be obtained from the master or chief engineer of the approximate quantity of bunkers to be used during the vessel's stay in port.

For safety purposes, the ullage spaces in the vessel's bunker tanks should be tested for hydrocarbon gas using a combustible gas indicator. Gas samples should be taken from each bunker tank vent pipe or through a tank hatch. In the event that this is not practicable, gas samples may be obtained through sounding pipes.

If the presence of hydrocarbon gas in excess of 50 % of the lower explosive limit is detected, notify the master, terminal representative and cargo owner, and, if so instructed, proceed to the following

a) take a sample from each bunker tank, if possible;

b) carry out a flash point test on the samples.

If the flash point of any sample is below 60 °C, a letter of protest should be issued to the master and the terminal representative informed.

7.2.3.10 Volume calculations

Use the vessel's ullage report or a similar form for the ullage calculations on arrival. Show both the actual ullage as measured and the trim-list corrected ullage on the vessel's ullage report. Calculate the GSV for each tank using the average temperature of the tank.

An average temperature for the entire vessel should not be used.

The vessel's ullage report should also include the measurement and quantity calculation of the free water, GOV and the temperature for each compartment. Obtain and copy the vessel's sailing ullage form prepared at the time of loading. Include this copy in the inspection report. Calculate the TCV prior to discharge.

7.2.3.11 In-transit difference

Before discharge, compare the TCV, i.e. GSV plus free water with the corresponding data determined at the load port prior to sailing. If the quantities vary by more than the amount specified by interested parties, or as mutually agreed in the charter party, notify the vessel's representative and all interested parties.

If, after rechecking the vessel, the discrepancy remains, issue a letter of protest to the vessel's representative.

Prepare the vessel comparison section of the voyage analysis report.

7.3 Procedure during discharge

7.3.1 Communications

Personnel becoming aware of any problems that could affect subsequent events, at any stage of the transfer, should promptly notify all key personnel so that timely action can be taken. Record these events in the inspection report.

7.3.2 Sampling at vessel's manifold

At the commencement and also during discharge, it is desirable to take line samples to verify the quality, i.e. density, of the line contents which should be within $\pm$ 2,0 kg/m^3 of the expected density. This is especially important when unloading multigrade cargoes.

If the difference exceeds the above figure, an investigation should be carried out.

7.3.3 Check on ballast movement

If ballasting operations into cargo tanks or via the cargo system are carried out simultaneously with unloading, determine the reason from the vessel's representatives, record it in the inspection report and issue a letter of protest. The tanks to be ballasted should be dipped before ballasting commences, to ascertain the quantity of crude petroleum residues remaining.

NOTE This is required since, under ideal conditions, only one movement at a time should take place thereby minimizing possible contamination of the cargo by sea water.

7.4 Procedure after discharge

7.4.1 Vessel inspection and calculations

7.4.1.1 Draft, trim, list and gauging locations

Record draft, trim, list and gauging locations on the OBQ/ROB report.

7.4.1.2 Vessel's lines

Before measuring, request that the vessel's lines be drained into cargo tanks after completion of discharge. Record their capacity and into which tank the lines were drained. In all instances where the vessel has completed discharging, the vessel should ensure that all internal transfer of cargo has ceased and the tank valves are secured prior to gauging. Discharge lines should be vented prior to gauging.

7.4.1.3 ROB determination

7.4.1.3.1 ROB measurement

After discharge lines and deck lines have been drained, determine the quantity and nature of any remaining material, ROB. Include in-transit cargo not discharged, non-designated volumes, and material in non-designated cargo spaces. Describe the material remaining in tanks as:

a) liquid;

b) non-liquid;

c) free water.

If inspection, measurement and bottom sampling indicates that any cargo remains on board, interested parties should determine if further attempts should be made to pump remaining quantities ashore to minimize ROB. If this is not done, report the reasons. If applicable, a letter of protest should be issued.

7.4.1.3.2 ROB volume calculation

The ROB report is to be filled out prior to sailing of the vessel.

Determine the ROB as follows:

a) use wedge formula/tables if liquid does not touch all four bulk heads;

b) use vessel calibration tables with appropriate trim/list corrections if liquid touches all four bulk heads.

Note on the OBQ/ROB report the nature of the material and the method used to determine the volume in each compartment.

Material in non-designated compartments should be measured and recorded on the OBQ/ROB report, but not included in the totals unless volumes have changed, intentionally or unintentionally, from those at the load port.

This report should be signed by the vessel's master and the inspector, if present. If the vessel representative signed under protest, it should be noted whether the vessel chose to have an inspection made by another company on its behalf. If there is a dispute, which cannot be reconciled, between the vessel personnel and the inspector(s) or other interested party, regarding the quantity and nature (liquid or non-liquid) of the ROB, this should be reported immediately to all parties concerned and noted on the OBQ/ROB report.

7.4.1.3.3 ROB sampling

If a sufficient quantity of free water is found, take a sample of the water. Take samples of any significant quantities of crude petroleum remaining in the cargo compartments, particularly if agreement cannot be reached as to its identity and nature. When slops are present, both the oil and water layer should be sampled.

Check ballast tanks for the presence of oil.

Obtain a composite sample of all in-transit cargo quantities. Seal and retain. Disposition of retained samples is to be specified by the concerned parties.

7.4.1.3.4 ROB temperature

A temperature measurement is to be obtained when there is sufficient liquid available. The temperature should be taken from the mid point of the liquid or liquid layer. Solids and small quantities of liquid for which a temperature cannot be obtained can be assumed to be at standard temperature. For the temperature measurement method, refer to 6.4.1.7.

7.4.1.4 Sea valves

Confirm, in the presence of vessel personnel, that sea valves and overboard discharge valves are closed, and that the seals are still intact. The vessel personnel should notify all parties concerned if and when seals are broken, to enable the vessel to take on ballast. If previously sealed valves are not intact, issue a letter of protest, and attempt to ascertain the reason why the seals were broken. Record the findings in the inspection report.

7.4.1.5 Bunker survey

The bunker survey should be conducted in accordance with 7.2.3.9.

7.4.1.6 Crude oil washing (COW)

Indicate when the vessel started and stopped the COW procedure. Indicate in the inspection report which tanks were crude oil washed and to what extent, i.e. top/bottom, times, pressures, number of passes, etc.

7.4.2 Shore inspection and calculation

7.4.2.1 Shore lines

Determine the nature, quantity and quality of material in the terminal discharge lines prior to taking shore closing tank gauges or meter readings. Report the findings and include the line volume in quantity calculations.

7.4.2.2 Tank measurement

All dips or ullages should be recorded. Carry out two measurements, and if they agree to within 3 mm, report the average; otherwise the average of at least three measurements should be reported.

Measure the depth of free water. Whilst determining free water depth or taking a dip, the observed tank reference height should be noted.

7.4.2.3 Sampling and sample handling

7.4.2.3.1 Manual samples from receiving tanks

When manually sampling shore tanks, the lowest sample should be taken 100 mm below the lowest point of the suction opening (so-called clearance sample) or at the lowest point permitted by the construction of the sample container.

Preferably, tank samples should be analysed individually, which provides a better insight into the condition of the tank and/or reliability of the samples.

Compositing of (tank) samples should be carried out in the laboratory, avoiding high temperatures and loss of light ends.

Homogenization of samples in the laboratory, such as required for blending and subsampling, should be carried out using an appropriate mechanical mixing device, following the procedures described in ISO 3170. Shaking for the purpose of homogenization of crude petroleum samples is not an acceptable method.

7.4.2.3.2 Automatic in-line sampling

Automatic in-line samplers should be installed and operated in accordance with ISO 3171.

Proving records in accordance with ISO 3171, showing the working range of the instrument in terms of liquid line velocities, should be available.

Manual samples should be taken after the discharge has terminated to back up a failure of the automatic sampling device.

7.4.2.3.3 Distribution and retention of samples

Each tank that has received cargo should be sampled in sufficient quantity to meet the requirements of the interested parties and regulatory agencies. Sampling and testing requirements are generally specified by interested parties.

Identical samples should be provided for

a) the discharge terminal,

b) an independent inspector, and

c) all other parties designated to receive them, which may include the vessel owner.

Samples placed on board the vessel should be properly labelled and sealed, and be acknowledged by a receipt signed by the vessel's representative. A copy of the signed receipt should be included in the inspection report.

The length of time that samples are to be retained should be established consistent with the circumstances, experience and policies of the parties involved in the custody transfer.

7.4.2.4 Dynamic measurement

Record the closing meter readings and the meter factor utilized. Obtain a completed copy of all meter-proving forms and meter documentation. Attach them to the completed metered quantity report (see annex B) and include in the inspection report. If the meter(s) was (were) not proved during discharge, indicate the frequency of meter proving and attach a copy of all current meter-proving reports.

7.4.2.5 Quantity calculations on shore

Calculation of oil quantities should be in accordance with International Standards. For the purpose of dynamic measurement, ISO 4267-2 should apply. Where no International Standard yet exists, other recognized methods and procedures, preferably those published by ASTM/IP/API, should be used.

7.4.3 Discharge-port reconciliation

7.4.3.1 Vessel experience factor at discharge terminal

Calculate the VEF (discharge) from the vessel's records. Apply this factor to the vessel's arrival figures. Compare the adjusted figure to the bill of lading and the outturn.

If possible, reconciliation/comparison of shore and ship figures should be made prior to the vessel sailing. In the case of unreconcilable figures, an appropriate notice should be issued.

7.4.3.2 Discharge-port voyage analysis

Record voyage analysis information. Compare the shore TCV or metered quantities (including free water and sediment and water) to the vessel TCV quantity delivered (GSV + FW – ROB). If the difference on the same comparison basis is greater than that set by parties to the contract or stated policies of those companies after application of the VEF, recheck all measurements and calculations in an attempt to identify the discrepancy. If differences cannot be reconciled, an appropriate notice should be issued to all interested parties.

Whenever possible, reconciliation should be made before the vessel sails.

7.4.3.3 Voyage analysis report

All the relevant data from the load port and discharge port should be entered on the voyage analysis report form, and an analysis made so as to provide an overall view of the voyage performance. Include, in the voyage analysis summary, relevant comments that may help to explain any significant discrepancies.

7.4.3.4 Quality tests

Testing for quality should be specified by the interested parties. Report analytical methods used for testing. Responsibility for testing primarily rests with the shore. All tests should be performed by qualified personnel. Other parties or their representative should be allowed to carry out the same testing on a duplicate sample, or alternatively to witness the testing carried out by the shore party.

7.4.3.5 Notices

All key persons involved should be notified promptly of any problems that could affect the transferred quantity, so that necessary, timely action can be taken. Any action or refusal to act in accordance with this procedure, or specific prior to contract agreements, should be reported to the personnel concerned, and should be documented by the issuance of an appropriate notice.

Annex A
(informative)

Checklist — Typical information to be reported

A.1 Information pertaining to loading

Terminal:

Vessel:

Date:

Grade:

A.1.1 Figures determined or advised by inspector

A.1.1.1 Vessel before loading

OBQ total volume (exclude slop if not LOT)

OBQ free-water volume (exclude slop water if not LOT)

Ballast quantities

Bunker quantities and LEL test

Slop tank TCV, GSV, NSV, free water

Quantity of slop water decanted on voyage

Tanks washed with crude oil

Tanks washed with water

A.1.1.2 Vessel after loading

TCV

Free-water volume

GSV

NSV

Gross apparent mass-in-air

Temperatures of vessel’s tanks

Suspended water and sediment

Density at 15 °C of the cargo

VEF

Bunker quantities and LEL test

A.1.1.3 Vessel's loaded figures

TCV

GSV

Gross apparent mass-in-air

TCV ship/shore difference, VEF not applied (volume and %)

TCV ship/shore difference, VEF applied (volume and %)

A.1.1.4 Shore's loaded figures

TCV

GSV

NSV

Density at 15 °C of cargo loaded

Gross apparent mass-in-air

Net apparent mass-in-air

Gross mass

Net mass

Suspended water

Suspended sediment

Temperatures of loading tanks(s)

A.1.2 Bill of lading

GSV

NSV

Density at 15 °C

Gross apparent mass-in-air

Net apparent mass-in-air

Gross mass

Net mass

Suspended water

Suspended sediment

A.1.3 Figures determined by vessel

A.1.3.1 Before loading

OBQ total volume (exclude slop if not LOT)

OBQ free water (exclude slop water if not LOT)

Ballast quantities

Slop tank TCV, GSV, free water

A.1.3.2 Vessel after loading

TCV

Free-water volume

GSV

Gross apparent mass-in-air

A.1.3.3 Vessel's loaded figures

TCV

GSV

Gross apparent mass-in-air

A.1.3.4 Notices

Notice of readiness tendered

Notice of readiness received

Delays

A.1.3.5 Remarks

A.2 Information pertaining to discharge

Terminal:

Ship:

Date:

Grade:

A.2.1 Measurements at load terminal

A.2.1.1 Bill of lading

TCV

GSV

NSV

Density at 15 °C

Suspended water

Suspended sediment

A.2.1.2 Vessel after loading (sailing figures)

TCV

Free-water volume

GSV

OBQ total volume

OBQ free-water volume

Slop tank TCV

Slop tank GSV

Slop tank free water

A.2.2 Measurements at discharge port

A.2.2.1 Figures determined or advised by inspector

A.2.2.1.1 Vessel prior to discharge

TCV

Free-water volume

GSV

NSV

Gross apparent mass-in-air

Density at 15 °C

Suspended water

Temperatures of vessel's tanks

Slop tank(s) TCV

Slop tank(s) GSV

Slop tank(s) NSV

Quantity of slop decanted on voyage

TCV difference sailing/arrival figures

GSV difference sailing/arrival figures

Bunker quantities and LEL test

COW report

A.2.2.1.2 ROB volume

Liquid

Non-liquid

Free water

(If part of the cargo is discharged, include TCV, GSV and free-water volume.)

A.2.2.1.3 Vessel discharged

TCV

GSV

NSV

Gross apparent mass-in-air

TCV ship/shore difference (volume and %)

GSV ship/shore difference (volume and %)

Bunker quantities and LEL test

A.2.2.1.4 Shore figures received

TCV

GSV

NSV

Density at 15 °C

Gross apparent mass-in-air

Net apparent mass-in-air

Gross mass

Net mass

Suspended water

Suspended sediment

Temperatures of receiving tanks

TCV difference bill of lading/outturn (volume and %)

GSV difference bill of lading/outturn (volume and %)

NSV difference bill of lading/outturn (volume and %)

A.2.3 Figures determined by terminal

A.2.3.1 Outturn

TCV

GSV

NSV

Density at 15 °C

Gross apparent mass-in-air

Net apparent mass-in-air

Gross mass

Net mass

Suspended water

Suspended sediment

A.2.4 Figures determined by vessel

A.2.4.1 Before discharge

TCV

Free-water volume

GSV

Gross apparent mass-in-air

A.2.4.2 ROB volume

Liquid

Non liquid

Free water

(If part of the cargo is discharged, include TCV, GSV and free-water volume.)

A.2.4.3 Ship discharged

TCV

GSV

Gross apparent mass-in-air

A.2.5 Notices

Notice of readiness tendered

Notice of readiness received

Delays

A.2.6 Remarks

Annex B
(informative)

Typical forms

The typical forms given in this annex, each identified with a number, are listed below.

No.	**Title**
B.1	Vessel and terminal information
B.2	OBQ/ROB report
B.3	Slops report
B.4	Load on top and tank water washing report
B.5	Vessel ullage report
B.6	Vessel discharge record
B.7	Bunker survey
B.8.1	Terminal tank and line data report — Manual sampling
B.8.2	Terminal tank and line data report — Automatic line sampling
B.9.1	Metered quantity report
B.9.2	Meter-proving report
B.10	Voyage analysis report
B.11	Sampling and testing report
B.12	Sample(s) receipt form
B.13	Certificate of quality

FORM B.1
(page 1 of 2)

VESSEL AND TERMINAL INFORMATION

VESSEL	
TERMINAL	

DATE	

LOADING	YES/NO
UNLOADING	YES/NO

VOYAGE No.	

Weather conditions:	
Wind speed/direction	/
Temperature air/sea, °C	/

VESSEL

TANKS

No. of centre tanks			
No. of wing tanks			
Crude origins of last 3 cargoes			
Heating coils YES/NO			

OPERATING PLAN

ORDER OF CARGO MOVEMENT

	Planned	**Actual**
Tank No.		
Line No.		
Manifold No.		
Tanks to be COW'd		

INERT GAS SYSTEM

Fitted	YES/NO
Functioning	YES/NO
Pressurized: on arrival	YES/NO
during loading	YES/NO
during discharge	YES/NO
Depressurized	YES/NO

MEASUREMENT EQUIPMENT		VESSEL	TERMINAL
Measuring tape	Manual/electronic		
	Manufacturer		
	Condition: Satisfactory/Unsatisfactory by reason of		
Thermometers	Manual/electronic		
	Manufacturer		
	Date last calibrated and deviation, ± °C		
Automatic temperature gauges	Date last calibrated by recognized independent calibration authority		
Automatic level gauges	If otherwise, specify		

FORM B.1
(page 2 of 2)

VESSEL AND TERMINAL INFORMATION

TERMINAL

MOORING

Type of mooring (jetty, SBM, platform, floating storage, etc.)	

LINES

Total capacity of off-shore plus on-shore line system used for this loading/unloading operation, m^3	
Condition of line	
Contents of line (crude type)	

OPERATING PLAN

ORDER OF CARGO MOVEMENT

	Planned	Actual
Tank No.		
Line No.		
Manifold No.		

SAMPLING

Line, automatic	– flow proportional	YES/NO
	– if other, specify	
Describe location of automatic sampler: e.g. ……… m from jetty hose or ……… m from load pump, ship's rail, etc.		
Tank, manual		YES/NO

TERMINAL QUANTITY DETERMINATION

Date tanks were last calibrated		
Tank level measurement	automatic	YES/NO
	manual	YES/NO
Tank temperature measurement	automatic	YES/NO
	manual	YES/NO
Cargo quantity metered		YES/NO

COMMENTS

FORM B.2

OBQ/ROB REPORT
(slops details on form B.3)

OBQ	YES/NO	ROB	YES/NO
VESSEL			
TERMINAL			

DATE	
VOYAGE No.	

			Non-liquid		Liquid		Free water		
Tank No.	Reference height m	Total gauged height m	Innage m	Volume m^3 (1)	Innage m	Volume m^3 (2)	Innage m	Volume m^3 (3)	Gross observed volume m^3 (2 – 3)
			TOTALS	A				B	C
			SLOPS (see form B.3)					D	E
							TOTALS	F	G

		Volumes m^3
Total sediment volume	A	
Total free-water volume	F = B + D	
Total oil volume	G = C + E	
Total OBQ/ROB	A + F + G	
Total slops volume	D + E	

Tanks not used for cargo	
Ballast tanks used for this voyage	
Total volume not used for cargo, m^3	
Total OBQ volume for cargo, m^3	

Sea valve Seal Nos.	Port	
	Starboard	
	Overboard	

	Stripped Yes/No	Dropped Yes/No	Tank No.
Top lines			
Bottom lines			
Hoses/arms			

FORM B.3

SLOPS REPORT

VESSEL				DATE	
TERMINAL				VOYAGE No.	

SLOP TANK NUMBER				SAMPLES
TOTAL: ULLAGE/DIP	m			NUMBER DRAWN
TRIM CORRECTED: ULLAGE/DIP	m			
TOTAL OBSERVED VOLUME	m^3			
FREE WATER: ULLAGE/DIP	m			
TRIM CORRECTED: ULLAGE/DIP	m			SEAL NUMBERS
FREE WATER VOLUME	m^3			
GROSS OBSERVED VOLUME	m^3			
OBSERVED DENSITY	kg/m^3			
OBSERVED TEMPERATURE	°C			DISTRIBUTION
DENSITY AT 15 °C				
VOLUME CORRECTION FACTOR				
GROSS STANDARD VOLUME OF OIL	m^3			
WEIGHT CONVERSION FACTOR				
QUANTITY	t			

TOTALS:

TOTAL GSV	m^3		
TOTAL QUANTITY	t		

TANK (Nos.) WASHED PRIOR TO ARRIVAL		
TOTAL CAPACITY OF TANKS WASHED	m^3	
VESSEL SUMMER DEADWEIGHT	t	
100 % CAPACITY OF CARGO TANKS	m^3	
ARE LINES DRAINED INTO SLOP TANKS?		
CARGO TO BE LOADED ON TOP OF SLOPS?		YES/NO
IF NOT, STATE REASONS		
PREVIOUS CARGO-TYPE/GRADE		
ARE SLOP TANKS SEALED?		
SEAL NUMBERS		
REMARKS		

FORM B.4

LOAD ON TOP AND TANK WATER WASHING REPORT

VESSEL			DATE	
TERMINAL			VOYAGE No.	

1.

Was LOT procedure followed for this voyage?	YES/NO
If NO, give reasons:	
No. of tanks water-washed during this voyage	
Total capacity of tanks washed, m^3	

2.

	GSV	Free water
Volume of slops before washing, m^3		
Volume of slops after washing, m^3		
Volume of oil recovered, m^3		

3.

Comments (to include reason for apparent low oil recovery)

FORM B.5
(page 1 of 2)

VESSEL ULLAGE REPORT

VESSEL	

TERMINAL	

DATE	

DRAFT	m	FWD
	m	AFT
LIST	m	

CARGO GRADE	

VOYAGE No.	

WEATHER CONDITIONS		
WIND SPEED/DIRECTION		
TEMPERATURE AIR	°C	

SEA CONDITIONS:		
WAVE HEIGHT	m	
TEMPERATURE SEA	°C	

TANK STATUS

☐ BEFORE LOADING ☐ BEFORE DISCHARGE ☐ BEFORE LIGHTENING

☐ AFTER LOADING ☐ AFTER DISCHARGE ☐ AFTER LIGHTENING

SEA VALVE SEAL Nos.

PORT	
STB'D	
OVERBOARD	

VESSEL'S LINES

CAPACITY	m^3	
ESTIMATED FILL	%	

SUMMARY OF TOTAL CARGO QUANTITIES (details on next page)

		BEFORE.................. (*)	AFTER..................... (*)	DIFFERENCE
GROSS STANDARD VOLUME	m^3			
FREE WATER	m^3			
TOTAL CALCULATED VOLUME	m^3			
WEIGHT CONVERSION FACTOR				
GROSS APPARENT MASS-IN-AIR OIL	t			

(*) Fill in data according to applicable situation.

FORM B.5

(page 2 of 2)

VESSEL ULLAGE REPORT

				FREE WATER									
TANK No.	OBSERVED ULLAGE m	TRIM CORRECTED ULLAGE m	TOV m^3	OBSERVED DIP m	CORRECTED DIP m	VOL m^3	GOV m^3	TEMP. °C	DENSITY AT 15 °C kg/m^3	VCF	GSV m^3	WCF	APPARENT MASS-IN-AIR t
			FREE WATER TOTAL					**1. GSV/TOTAL**				**TOTAL**	
			FREE WATER OBQ/ROB					**2. FREE-WATER TOTAL**					
			FREE WATER LOADED/DISCHARGED					**3. TCV TOTAL**				**1 + 2**	
								4. TOTAL OBQ/ROB					
								5. TCV LOAD/DISCHARGE				**3 - 4**	

FORM B.6

VESSEL DISCHARGE RECORD

VESSEL	
TERMINAL	
BERTH	

DATE	
VOYAGE No.	

LOCATION OF GAUGE:	SHORE:	VESSEL:

TIME	VESSEL PRESSURE kPa	SHORE PRESSURE kPa	DISCHARGE RATE m^3/h	VOLUME DISCHARGED m^3	TANKS COW'D	COMMENTS

COMMENTS

FORM B.7

BUNKER SURVEY

NOTE One form per grade of bunkers

VESSEL	
TERMINAL	

DATE	
VOYAGE	

Diesel oil	YES/NO
Fuel oil	YES/NO

Motor	YES/NO
Turbine	YES/NO

(1) VESSEL HISTORY FROM CHIEF ENGINEER

	At sea	In port	At anchorage
Average bunker consumption tonnes/day			

(2) SURVEY

Last port of call	
Sailing date/time	
Bunkers on sailing from last port, t	

(3) INSPECTION ON ARRIVAL

VESSEL TANKS	ULLAGE m	GOV m³	TEMP. °C	VCF Table	DENSITY AT 15 °C kg/m³	GSV m³	WCF Table	GROSS APPARENT MASS-IN-AIR t	LOWER EXPLOSIVE LIMIT %
TOTAL									

Laboratory test results

Analysis	Flash point, °C	Viscosity, mm^2/s at ....°C	Sulfur, % (*m/m*)
Method			
Result			

(4) INSPECTION BEFORE SAILING

VESSEL TANKS	ULLAGE m	GOV m³	TEMP. °C	VCF Table	DENSITY kg/m³	GSV m³	WCF Table	GROSS APPARENT MASS-IN-AIR t	LOWER EXPLOSIVE LIMIT %
TOTAL									

(5) EXPLOSIVITY — LOWER EXPLOSIVE LIMIT

Did vessel bunker at this port?	YES/NO

Quantity loaded m^3	

FORM B.8.1
(page 1 of 2)

TERMINAL TANK AND LINE DATA REPORT
Manual sampling

VESSEL			VESSEL LOADING	YES/NO		DATE	
TERMINAL							
CARGO GRADE			VESSEL DISCHARGE	YES/NO		VOYAGE No.	

			TANK NUMBER		TANK NUMBER		TANK NUMBER	
DESCRIPTION			OPEN	CLOSE	OPEN	CLOSE	OPEN	CLOSE
01	Reference height	m						
02	Measured height	m						
03	Dip/ullage	m						
04	Auto-gauge reading	m						
05	Water cut/dip	m						
06	Tank temperature	°C						
07	Density at 15 °C	kg/m^3						
08	Suspended water	%						
09	Suspended sediment	% (*m/m*)						
10	Suspended sediment	% (*V/V*)						
11	Suspended water + sediment	% (*V/V*)						
12	Volume equivalent to dip/ullage	m^3						
13	Floating-roof correction	m^3						
14	Total observed volume	m^3						
15	Free water	m^3						
16	Gross observed volume	m^3						
17	Volume correction factor	Table 54A						
18	Gross standard volume	m^3						
19	Volume of suspended water	m^3						
20	Volume of suspended sediment	m^3						
21	Net standard volume	m^3						
22	Weight conversion factor	Table 56						
23	Gross apparent mass-in-air	t						
24	Assumed density of water	kg/m^3						
25	Assumed density of sediment	kg/m^3						
26	Weight of suspended water	t						
27	Weight of suspended sediment	t						
28	Net apparent mass-in-air	t						
29	Total calculated volume	m^3						

FORM B.8.1
(page 2 of 2)

TERMINAL TANK AND LINE DATA REPORT
Manual sampling
Quantity differences and totals

TANK No.	GSV (18) m^3	NSV (21) m^3	Gross apparent mass-in-air (23) t	Net apparent mass-in-air (28) t	WATER AND SEDIMENT: Free water (15) m^3	Suspended water (19) m^3	Suspended sediment (20) m^3	TCV (18) + (15) m^3
TOTAL								

FORM B.8.2
(page 1 of 2)

TERMINAL TANK AND LINE DATA REPORT
Automatic line sampling

VESSEL	
TERMINAL	
CARGO GRADE	

VESSEL LOADING	YES/NO
VESSEL DISCHARGE	YES/NO

DATE	
VOYAGE No.	

				TANK NUMBER	
TANK DATA				OPEN	CLOSE
01	Calibrated reference height	m			
02	Measured reference height	m			
03	Dip/Ullage	m			
04	Auto-gauge reading	m			
05	Volume equivalent to Dip/Ullage	m^3			
06	Floating-roof correction	m^3			
07	Water cut	m			
08	Free water	m^3			
09	Tank temperature	°C			
10	Tank density	kg/m^3			
11	TOV (= GOV)	m^3			
12	VCF	Table 54A			
13	GSV	m^3			
AUTOSAMPLER DATA					
14	Density	kg/m^3			
15	Water content	%			
16	Total water	m^3			
17	Sediment content	% (*m*/*m*)			
18	Sediment content	% (*V*/*V*)			
19	Sediment volume	m^3			
20	Assumed density of water	kg/m^3			
21	Assumed density of sediments	kg/m^3			
22	Density/(WCF)	(Table 56)			
TRANSFERRED QUANTITIES					
23	GSV transferred (13 open − 13 close)	m^3			
24	NSV transferred (23 − 16 − 19)	m^3			
25	Gross mass/(Apparent mass-in-air) (14 × 24)	t			
26	Water content (16 × 20)	t			
27	Sediment content (19 × 21)	t			
28	Net mass/(Apparent mass-in-air) (25 − 26 − 27)	t			

COMMENTS

FORM B.8.2
(page 2 of 2)

TERMINAL TANK AND LINE DATA REPORT
Automatic line sampling
Quantity differences and totals

					WATER AND SEDIMENT		
TANK No.	GSV (23) m^3	NSV (24) m^3	Gross apparent mass-in-air (25) t	Net apparent mass-in-air (28) t	Water (17) m^3	Sediment (20) m^3	TCV (23) + (08) m^3
TOTAL							

FORM B.9.1

METERED QUANTITY REPORT

☐ LOAD PORT ☐ DISCHARGE PORT DATE:

VESSEL:	TERMINAL:	CARGO GRADE:	VOYAGE No.

1	METER NUMBER				
2	CLOSING METER READING, m^3				
3	OPENING METER READING, m^3				
4	INDICATED VOLUME, m^3				
5	METER FACTOR (see note 1)				
6	AVERAGE STREAM TEMPERATURE, °C (see note 2)				
7	DENSITY AT 15 °C, kg/m^3				
8	VOLUME CORRECTION FACTOR (C_{tl}) (see note 2) TABLE ...				
9	AVERAGE METER PRESSURE, kPa (volumetric weighted average)				
10	PRESSURE CORRECTION FACTOR (C_{pl})				
11	COMPOSITE [FOR NON-TEMPERATURE-COMPENSATED METERS ONLY (LINE 5 × 8 × 10)] CORRECTION FACTOR [FOR TEMPERATURE-COMPENSATED METERS ONLY (LINE 5 × 10)]				
12	TOTAL CALCULATED VOLUME (LINE 4 × 11)				
13	FREE WATER (see note 3)				
14	GROSS STANDARD VOLUME, m^3				
15	SEDIMENT AND WATER, % (V/V)				
16	SEDIMENT AND WATER, VOLUME, m^3				
17	NET STANDARD VOLUME, m^3				

SUMMARY

TOTAL CALCULATED VOLUME, m^3	
FREE-WATER VOLUME, m^3	
GROSS STANDARD VOLUME, m^3	
SEDIMENT AND WATER, % (V/V)	
NET STANDARD VOLUME, m^3	
DENSITY at 15 °C, kg/m^3 (Table ...)	
WEIGHT CONVERSION FACTOR	
TOTAL CALCULATED MASS, t	

NOTE 1 ATTACH TO THIS FORM COPIES OF METER-PROVING REPORTS.

NOTE 2 NON TEMPERATURE-COMPENSATED METERS ONLY.

NOTE 3 ONLY TO BE USED WITH NON IN-LINE SAMPLER MOVEMENT.

(...............) UNITS OF MEASUREMENT

FORM B.9.2

METER-PROVING REPORT

Report No. ………………………………………………………

Date: ………………………………………………………

Vessel: ………………………………………………………

Location: ……………………………………………………… ………………………

Grade: ……………………………………………………… ………………………

Meter number:		Serial number:		Model:	

Prover base volume (BV)					

Meter data	Run 1	Run 2	Run 3	Run 4	Run 5
Total pulses					
Average meter temperature					
Average meter pressure					
Total run time, s					
Flow rate, m^3/h					

Test volume data	Run 1	Run 2	Run 3	Run 4	Run 5
Average prover temperature					
Average prover pressure					
Prover K factor/1 000					

Correction factors	C_{tl}	C_{pl}	C_{ts}	C_{ps}
To prover volume (C_p)				
To meter volume (C_m)				

Overall averages			
Average meter temperature		Average prover pressure	
Average prover temperature		Average flow rate	
Average run time, s		Average total pulses	
Average meter pressure		Average prover K factor	

$$\text{Meter factor (MF)} = \frac{[\ldots\ldots\ldots\ldots\ (\text{BV}) \times \ldots\ldots\ldots\ldots\ (C_p)]}{[\ldots\ldots\ldots\ldots\ (V) \times \ldots\ldots\ldots\ldots\ (C_m)]}$$

Performance curve value	
Previous meter factor	
Frequency of meter-proving variations	
Units used Temperature Pressure Flow rate	

FORM B.10

VOYAGE ANALYSIS REPORT

VOYAGE No.	**DATE**

VESSEL	CARGO
LOAD PORT	
ARRIVAL TIME	SAILING TIME & DATE
DISCHARGE PORT	
ARRIVAL TIME & DATE	SAILING TIME & DATE

	GSV m^3	S & W m^3	S & W %	NSV m^3	NSV % volume	DENSITY kg/m^3
BILL OF LADING AT 15 °C						
SHORE RECEIPTS AT 15 °C						
SHORE RECEIPTS – B/L					*	

* Net outturn loss/gain (% of B/L)

I. VESSEL RATIO AT LOAD PORT					
		GSV, m^3 +		FREE WATER, m^3 =	TCV, m^3
SHORE MEASUREMENTS		+		=	(1)
VESSEL MEASUREMENTS	sailing TCV	+		=	(A)
	before loading (OBQ)	+		=	(B)
COMPARISON OF VESSEL/SHORE MEASUREMENTS	VESSEL	Sailing TCV (A)	less	OBQ (B)	Vessel – Total received
			less	=	(C)
	SHORE–TOTAL DELIVERED				(1)
	(C) MINUS (2) = VESSEL/SHORE DIFFERENCE			=	
	(C) DIVIDED BY (1) = VESSEL LOAD RATIO			=	
	AVERAGE LOAD RATIO OF VESSEL			=	
II. VESSEL RATIO AT DISCHARGE PORT					
		GSV, m^3 +		FREE WATER, m^3 =	TCV, m^3
SHORE MEASUREMENTS		+		=	(2)
VESSEL MEASUREMENTS	arrival TCV	+		=	(D)
		LIQUID +		NON-LIQUID =	ROB, m^3
	after discharge (ROB)	+		=	(E)
COMPARISON OF VESSEL/SHORE MEASUREMENTS	VESSEL	Arrival TCV (D)	less	ROB (E)	Vessel – Total delivered
			less	=	(F)
	SHORE–TOTAL RECEIVED (TCV)				(2)
	(F) MINUS (2) = VESSEL SHORE DIFFERENCE			=	
	(F) DIVIDED BY (2) = VESSEL DISCHARGE RATIO			=	
	AVERAGE DISCHARGE RATIO OF VESSEL			=	

III. COMPARISON OF LOAD PORT AND DISCHARGE PORT			
VESSEL COMPARISON		SHORE COMPARISON	
sailing TCV, m^3	(A)	delivered volume (TCV), m^3	(1)
arrival TCV, m^3	(D)	received volume (TCV), m^3	(2)
gain/(loss) m^3	(D) – (A)	gain/(loss) m^3	(2) – (1)
%	%	%	%
	ADJUSTED NET OUTTURN LOSS		
	adjusted gain/(loss) = (1) less (3) + (E) less (B) =		
	adjusted gain/(loss) divided by (2) =		

COMMENTS

FORM B.11
(page 1 of 2)

SAMPLING AND TESTING REPORT

VESSEL		LOADING	YES/NO	DATE	
TERMINAL		DISCHARGE	YES/NO	VOYAGE No.	
CARGO GRADE					
VESSEL TANK	YES/NO			MANUAL SAMPLE	YES/NO
SHORE TANK	YES/NO			AUTOMATIC SAMPLE	YES/NO

DATE/ TIME	ORIGIN (1)	SAMPLING METHOD (2)	SAMPLE SIZE litres (3)	SEAL No.	DESTINATION

(1) Specify tank No., line, other

(2) Specify

Manual sample (ISO 3170)
- (i) apparatus used
- (ii) upper/middle/lower; bottom; running sample etc.
- (iii) composited at site or in laboratory; compositing details

Automatic sample (ISO 3171)
- (i) location
- (ii) make and type

(3) Report type, condition of sample containers

COMMENTS

FORM B.11
(page 2 of 2)

SAMPLING AND TESTING REPORT
Laboratory data

DATE/ TIME	SAMPLE IDENTIFICATION	SAMPLE SIZE	ANALYTICAL RESULTS (2)			
			Density at 15°C kg/m^3	Water content % (*V/V*)/ % (*m/m*)*	Sediment content % (*V/V*)/ % (*m/m*)*	Other
		litres	Method:	Method:	Method:	Method:

(1) If samples have been composited in the laboratory, this should be noted and composition specified.
(2) In case results have been calculated, please note and specify calculations used.

Calculated average cargo density	kg/m^3	(report calculation below)
Calculated average water content of cargo	%	(report calculation below)

COMMENTS

* Delete as applicable.

FORM B.12

SAMPLE(S) RECEIPT FORM

VESSEL		LOADING	YES/NO	DATE	
TERMINAL		DISCHARGE	YES/NO	VOYAGE No.	
CARGO GRADE					
VESSEL TANK	YES/NO			MANUAL SAMPLE	YES/NO
SHORE TANK	YES/NO			AUTOMATIC SAMPLE	YES/NO

SAMPLE CONTAINER(S) IN GOOD CONDITION	YES/NO
SAMPLE CONTAINER(S) PROPERLY LABELLED	YES/NO

UNDERSIGNED, REPRESENTATIVE OF:	
VESSEL	
CARGO RECEIVER	
HEREBY CERTIFIES THE RECEIPT OF THE SAMPLE(S) AS SPECIFIED BELOW	

GRADE	SAMPLE DESCRIPTION/ IDENTIFICATION/ MARKINGS	SEAL No.	VOLUME litres
COMMENTS			

FORM B.13

CERTIFICATE OF QUALITY
(one for each grade)

VESSEL		LOADING	YES/NO	DATE	
TERMINAL		DISCHARGE	YES/NO	VOYAGE No.	
CARGO GRADE					

Sample taking and testing report attached YES/NO

Sample history (summary) A. Manual sampling YES/NO

B. Automatic sampling YES/NO

A. Manual sampling

Samples obtained from: Vessel tanks YES/NO

Shore tanks YES/NO

Lines YES/NO

Other YES/NO

Cargo quality data below were the result of testing:

Single sample YES/NO

Multiple samples/calculations YES/NO

Representative duplicate sample(s) of the cargo has (have) been prepared YES/NO

B. Automatic sampling

Sample was homogenized before subsampling YES/NO

Cargo quality data below were the result of testing:

Single subsample YES/NO

Multiple subsamples/calculations YES/NO

Representative duplicate sample(s) of the cargo have been prepared YES/NO

Cargo quality

			TEST METHOD	
		TEST RESULTS	ISO	OTHER
DENSITY AT 15 °C	kg/m^3			
WATER CONTENT	% (*V*/*V*)			
SEDIMENT CONTENT	% (*m*/*m*)			

COMMENTS

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[6] ISO 9029:1990, *Crude petroleum — Determination of water — Distillation method.*

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