INTERNATIONAL STANDARD

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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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Contents

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.