International Standard

ISO 6996

Bunkering — Meter verification using master Coriolis mass flow meter

Soutage — Vérification des compteurs au moyen d'un compteur massique étalon à effet Coriolis

First edition
2024-03

Reference number
ISO 6996:2024(en)

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Published in Switzerland

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Foreword

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This document was prepared by Technical Committee ISO/TC 28, *Petroleum and related products, fuels and lubricants from natural or synthetic sources*, Subcommittee SC 2, *Measurement of petroleum and related products.*

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The objective of this document is to set qualifying requirements for the master Corolis mass flow meter in the bunkering context as well as to establish meter verification requirements and a verification procedure for using the master meter. The meter verification is performed to:

a) verify the mass flow meter (MFM) that is used for custody transfer;

b) track the meter stability of the duty meter used in the MFM system at regular intervals during its commercial service.

Regular meter verification provides another option to MFM users other than regular re-calibration. It is more efficient, less costly and less time-consuming to monitor the measurement performance of the MFM over time in compliance with the metrological requirements for custody transfer.

This document is intended to complement the meter verification requirements in ISO 22192 and ISO 6963.

In this document, the following verbal forms are used:

— “shall” indicates a requirement;

— “should” indicates a recommendation;

— “may” indicates a permission;

— “can” indicates a possibility or a capability.

Bunkering — Meter verification using master Coriolis mass flow meter

1 Scope

This document specifies the criteria and metrological requirements to qualify a master meter and subsequently maintain its qualification. It establishes requirements and procedures for meter verification, using a master mass flow meter to verify the accuracy and functionality of a duty meter installed on a bunker tanker or at a terminal.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
accuracy
closeness of agreement between a measured quantity value and a true quantity value of a measurand

[SOURCE: ISO/IEC Guide 99:2007, 2.13, modified — Notes 1, 2 and 3 to entry deleted.]

3.2
error
E
measured quantity value minus a reference quantity value

[SOURCE: ISO/IEC Guide 99:2007, 2.16, modified — Notes 1 and 2 to entry deleted.]

3.3
error percentage
E %
error (3.2) divided by the same reference quantity value

3.4
master meter
Coriolis mass flow meter which is qualified to verify the *meter under test* (3.9)

3.5
maximum mass flow rate
Q_{max}
maximum flow rate to which the *meter under test* (3.9) and the *master meter* (3.4) have been qualified to operate in compliance with the required accuracy

3.6
measurement uncertainty
non-negative parameter characterizing the dispersion of the quantity values being attributed to a measurand, based on the information used

[SOURCE: ISO/IEC Guide 99:2007, 2.26, modified — Notes to entry deleted.]

3.7
meter factor
totalized mass quantity from the master meter divided by totalized mass quantity from the meter under test

3.8
meter stability
property of a measuring instrument whereby its metrological properties remain constant over time

Note 1 to entry: Stability may be quantified in several ways:

— in terms of a time duration over which a metrological property changes by a stated amount;

— in terms of the change of a property over a stated time.

[SOURCE: ISO 22192:2021, 3.32]

3.9
meter under test
MUT
Coriolis mass flow meter or any mass flow meter approved for custody transfer that is undergoing *meter verification* (3.11)

3.10
meter verification report
report generated after the completion of the *meter verification* (3.11) containing the results and relevant critical data pertaining to meter verification

3.11
meter verification
verification of the *accuracy* (3.1) of a *meter under test* (3.9) from the start of the first run to the end of the final run

3.12
meter verification process
requirements and procedures for verifying the accuracy of the *meter under test* (3.9) by the *master meter* (3.4)

3.13
minimum mass flow rate
Q_{min}
minimum flow rate to which the *meter under test* (3.9) and the *master meter* (3.4) have been qualified to operate in compliance with the required *accuracy* (3.1)

3.14
nominal K factor
NKF
coefficient entered in the accessory equipment by the *verification officer* (3.23), which relates a frequency (mass) input from the Coriolis transmitter to a mass flow rate

Note 1 to entry: The nominal K factor is expressed in pulses per unit quantity (mass).

3.15
repeatability
proximity of a match among a series of results obtained with the same method on identical test material, under the same conditions (same operator, same apparatus, same laboratory and short intervals of time)

[SOURCE: ISO 22192:2021, 3.39]

3.16
run
activity during which a quantity of flow is measured and assessed during *meter verification* (3.11)

3.17
run density
average density recorded during a *run* (3.16)

3.18
run pressure
average pressure recorded during a *run* (3.16)

3.19
run temperature
average temperature recorded during a *run* (3.16)

3.20
test service provider
company that is competent in all provisions of this document and qualified as a *third party* (3.21) to carry out the *meter verification process* (3.12) for custody transfer purposes

3.21
third-party
person or organization that is unrelated to the manufacturer or supplier of the object of conformity or their customers

3.22
verification flow rate
flow rate during *meter verification* (3.11) that is between the *minimum mass flow rate* (Q_{min}) (3.13) and the *maximum mass flow rate* (Q_{max}) (3.5) of the *meter under test* (3.9) and the master meter's Q_{min} and Q_{max} calibrated on oil

Note 1 to entry: The verification flow rate is determined from the data on historical operational flow rates of a bunker tanker/terminal in consultation with a *test service provider* (3.20) during a pre-test meeting.

Note 2 to entry: Historical operational flow rates data show the data on flow rate typically used during bunkering. This data lies between the duty meter's minimum mass flow rate and maximum mass flow rate, accumulated over time during bunkering, from which the verification flow rate is determined.

3.23
verification officer
person who is competent and qualified as a *third party* (3.21)

4 Safety, health and environment during meter verification

4.1 The requirements expected to be observed by all personnel during meter verification are set out in Annex A.

NOTE Relevant local requirements and international safety standards can apply to the personnel of both a bunker tanker/terminal and a test service provider.

4.2 The masters of the bunker tanker and the test service provider shall remain responsible for the safety of their vessel, crew, cargo and equipment at all times and should not permit safety to be prejudiced by the actions of others.

4.3 All parties involved in the meter verification process shall equip themselves with the following minimum personal protective equipment (PPE) safety items:

— safety helmet;

— safety shoes;

— gloves;

— life jacket.

All parties involved in the meter verification shall wear PPE at all times while on board the bunker tanker and at the terminal. They shall equip themselves with multi-gas detectors [hydrogen sulphide (H_2S) and oxygen (O_2), carbon monoxide (CO), low explosion limit (LEL)] and use them on site at all times.

WARNING — The meter verification process shall only be performed by qualified persons. All parties involved in the meter verification process should be able to execute their work safely and efficiently, without any impairment to their personal health.

5 Metrological requirements for master meter

5.1 General

This clause specifies a master meter's metrological traceability, calibration and re-calibration requirements in this application and the maintenance of its master meter metrological status.

5.2 Master meter requirements

5.2.1 The master meter shall be calibrated in water in a laboratory.

NOTE Laboratories meeting ISO/IEC 17025 are deemed to be competent with the approved calibration and measurement capability (CMC) to cover the flow measurement.

5.2.2 For water calibration with direct traceability to an SI unit of mass, the master meter calibrated errors between its evaluated and certified flow rates between the minimum mass flow rate, $Q_{min,}$ and the maximum mass flow rate, Q_{max}, shall be not more than ±0,033 %, which is one-third of the water calibration requirement (level 1) for the duty meter. The water calibration rig shall have a measurement uncertainty of not more than 0,017 %.

The uncertainty components of the master meter shall include the calibration of the meter, meter error, repeatability, reproducibility and zero stability. The components for uncertainty estimation for meter verification under site conditions are listed in the uncertainty budget table as shown in Table B.1.

5.2.3 The water and oil calibration of the master meter shall meet the combined measurement uncertainty of 0,1 %, which is one-third the combined measurement uncertainty of the duty meter. As evidence to meet this requirement, it is expected that there is a report (or reports) with supporting documents issued by:

a) a national metrology institute; or

b) an appointed International Organization of Legal Metrology (OIML) issuing authority.

5.2.4 The oil calibration shall use bunker fuels or equivalent and shall cover from Q_{min} to Q_{max}, with a total of five or more flow calibration points evenly distributed from Q_{min} to Q_{max}. Each flow calibration point shall have three runs.

5.2.5 In deciding the Q_{max} of the master meter for oil calibration, it is important to consider that the verification flow rate shall be within the Q_{min} and Q_{max} during meter verification.

5.2.6 The master meter can only be used for meter verification for the flow direction for which it was calibrated.