
**Ships and marine technology —
Bunker fuel mass flow meters on
receiving vessel — Requirements**

*Navires et technologie maritime — Appareils de mesure du débit
massique des soutes sur le navire de réception — Exigences*

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 3, *Piping and machinery*.

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

Accurate measurement of large quantities of bunker fuels received by ships around the world has historically been difficult, with many ships relying on outdated methods of verification, such as before-and-after manual measurement of fuel tank levels. The potential for inaccuracies is significant and can result in disputes between the fuel supplier and the ship.

This document addresses the need for standardization of meters used to accurately measure the quantity of fuel received. Traditionally, volumetric flow meters have raised accuracy concerns because of the potential for air and other gases to affect the measurement of the fluid. Also, entrained air can cause inaccurate shipboard tank readings during and immediately after bunkering.

Accurate measurement of bunker fuel receipt quantities using mass flow meters will result in greater efficiencies in the ship bunkering process and reduce disputes.

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Ships and marine technology — Bunker fuel mass flow meters on receiving vessel — Requirements

1 Scope

This document specifies requirements for Coriolis mass flow meter (MFM) systems installed on and used by vessels for the accurate measurement of bunker fuels received. It defines metrology and security requirements as well as testing requirements of the MFM system for the receiving vessel. This document complements ISO 8217, ISO 22192 and OIML R117.

This document does not cover mass flow meters used for custody transfer, nor does it address overall bunker delivery procedural issues, such as delivery system integrity and transfer operations. It is not applicable to cryogenic fuels such as LNG.

For bunker delivery using a Coriolis mass flow meter system in a custody transfer role, refer to ISO 22192.

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.

3.1

bunker bunker fuel

fuel (Class F) supplied to a vessel for its propulsion and/or operation

Note 1 to entry: Class F fuels are specified in ISO 8217.

3.2

mass flow meter MFM

equipment designed to directly measure and indicate the mass of *bunker fuel* (3.1) received by a ship

3.3

maximum allowable working pressure MAWP

highest stress to which a piping system component can be subjected, based on materials and design calculations

3.4

maximum mass flow rate

Q_{\max}

maximum flow rate up to which the *MFM system* (3.5) has been qualified to operate in compliance with the required accuracy

Note 1 to entry: The maximum value is normally determined by the application.

3.5

MFM system

bunker fuel (3.1) receiving system, comprising the *mass flow meter* (3.2) and its ancillary devices, pipelines and seals between the vessel's bunker manifold and the mass flow meter

3.6

minimum mass flow rate

Q_{\min}

minimum flow rate to which the metering system has been qualified to operate, in compliance with the required accuracy

Note 1 to entry: The minimum value is normally determined by the flow metering system.

3.7

minimum measured quantity

MMQ

smallest quantity of liquid for which the measurement is metrologically acceptable for a given system or element

4 Symbols and abbreviated terms

AC	alternating current
DC	direct current
DN	nominal diameter
IEC	International Electrotechnical Commission
LFC	low flow cut-off
Q_{\max}	maximum flow rate
Q_{\min}	minimum flow rate
P	pressure
MAWP	maximum allowable working pressure
MFM	mass flow meter
MMQ	minimum measured quantity
OIML	International Organization of Legal Metrology

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5 Design and environment testing

5.1 Materials and equipment

MFM casings, as well as any pressure-retaining parts, shall be of metallic construction. Materials rendered ineffective by heat shall not be used in the construction of the meter casing or any pressure-retaining parts. All other parts shall be constructed of materials suitable for the service intended. Fasteners in contact with interior fluid shall be of corrosion-resistant materials.

Threaded fittings shall not be used in pipe sizes greater than DN 50.

5.2 Environmental tests

Unless otherwise specified, environmental tests shall be conducted on a prototype of each meter model.

MFM for marine applications should have documentation of completion of the following tests:

- a) vibration,
- b) temperature,
- c) weather tightness.

The tests above should be acceptable to a member of the International Association of Classification Societies (IACS), based on environmental testing requirements for shipboard electrical/electronic equipment.

5.3 Hydrostatic test

Each MFM shall be subjected to a hydrostatic test at 1,5 times the MAWP in accordance with an appropriate test standard.

5.4 Temperature

MFM shall be designed to operate within an ambient temperature range of -40 °C to +60 °C.

5.5 Pressure rating

MFM shall have a minimum pressure rating of not less than 1 MPa (145 psig).

The maximum pressure of the fluid measured shall not affect the sensitivity of the measuring device or indicating mechanism.

5.6 Non-metallic materials

Gaskets, seals and O-rings used for the installation and construction of the meter that can come in contact with the fuel being measured shall be suitable for the application. Security seals should be fabricated of materials that do not deteriorate due to corrosion or UV exposure.

5.7 Marking

MFM shall be marked with the following minimum information:

- a) manufacturer's identification mark, trademark or name;
- b) designation selected by the manufacturer, if appropriate;
- c) maximum allowable working pressure;
- d) fluid flow direction, by an arrow or another indicator;
- e) serial number (MFM);
- f) transmitter model and serial number;
- g) year of manufacture.

6 Metrological requirements

6.1 General

This clause specifies the MFM's metrological traceability, calibration and re-calibration requirements for the approval of the MFM system applicable to non-custody transfer bunkering. The MFM system should be operated within rated conditions as set out in these requirements to meet the 0,5 % expanded

measurement uncertainty for bunker fuel application (see 6.3.1). The MFM system performance should be confirmed during the commissioning and maintained during operation.

Verification on board shall be performed by a qualified and independent party (see Clause 9).

6.2 MFM requirements

6.2.1 Every MFM shall be calibrated before being installed on the ship and shall include its adjustment device(s) and ancillary device(s).

The device shall be calibrated with water as the fluid with a certification issued by either a national metrology institute or an appointed OIML Issuing Authority in accordance with the relevant OIML Recommendations, accompanied by relevant supporting documents, confirming that the MFM performance meets the requirement of maximum measurement uncertainty for bunker fuel fluid flow measurement to be not more than 0,2 %.

Alternatively, any hydrocarbon or synthetic oil with a density/viscosity similar to that of the bunker fuels specified in ISO 8217 may be used as the calibration fluid.

6.2.2 MFM shall be calibrated with direct traceability to an SI unit of mass by a laboratory meeting the requirements of ISO/IEC 17025. The calibration shall cover flowrates across the measurement range applications. See Annex A for an example of a MFM test.

6.3 MFM system requirements

6.3.1 The guideline of 0,5 % expanded measurement uncertainty should take into consideration the following uncertainty sources influenced by:

- MFM calibration; <https://standards.iteh.ai/catalog/standards/sist/38478512-b46b-4660-b19a-382645481f89/iso-21562-2020>
- product condition, e.g. viscosity and density;
- process flow condition, e.g. aeration flow and flow turbulences, etc.;
- piping line system configuration and meter installations, which can affect measurement conditions;
- any other source that may influence the mass flow measurement.

6.3.2 Requirement of zero offset limit and zero verification.

- Zero setting is required during commissioning.
- Zero stability should be periodically checked by zero verification.
- Maximum permissible zero offset shall be not more than 0,2 % of Q_{\min} .

6.3.3 The low flow cut-off (LFC) setting value shall be not more than 20 % of Q_{\min} .

6.3.4 The process flow rate range shall not be less than Q_{\min} and not more than Q_{\max} .

7 Security requirements

7.1 General

This clause specifies the general requirements and procedures to ensure that the system integrity of the MFM system is confirmed during commissioning and maintained during operation.

System integrity aims to ensure that the MFM system:

- measures all bunker fuel received and there shall be no diversion of bunker fuel before the receiving MFM; and
- performs and operates to its intended purpose without external interference that affects the measurement.

Refer to [Annex B](#) for the schematic diagram of a MFM system on a receiving vessel.

The vessel shall keep onboard an updated bunker receiving procedure and a piping and instrumentation diagram (P&ID) showing the MFM system.

7.2 Security features

7.2.1 Equipment security

The MFM system shall be secured against unauthorised adjustment, tampering or dismantling.

No foreign object(s)/device(s) that could cause irregularity and/or affect the measurement shall be placed on, or in the vicinity of, the MFM or any part of the MFM system during the entire bunkering operation.

7.2.2 Software security

All MFM system software shall be protected to meet the requirements for fuel measurement. This is to prevent any unauthorised changes to the software and parameter settings. The MFM system shall be able to trace any changes affecting the fuel measurement.

7.2.3 Measurement data recording ISO 21562:2020

History of operations with supporting documents should be recorded.

8 MFM selection and installation requirements

8.1 General

This clause covers the selection and installation of the MFM system to meet the requirements set in this document, in particular in [Clause 5](#) and [Clause 6](#), as well as the owner's operational requirements. This includes pre-selection evaluation and site survey.

8.2 MFM selection

Successful and accurate measurements begin with proper meter selection. The MFM shall be applicable for bunker receipt application with appropriate characteristics and specifications.

The MFM selected shall consider the process flow rate range for the bunker received. This includes the following:

1. Q_{\min}
2. Q_{\max}
3. MMQ

Refer to [Annex C](#) for the checklist of typical parameters required from the vessel owner/operator for meter selection.