
**Refrigerated hydrocarbon and non-
petroleum based liquefied gaseous
fuels — Dimethylether (DME) —
Measurement and calculation on
board ships**

*Hydrocarbures réfrigérés et combustibles gazeux liquéfiés à base
non pétrolière — Diméthyléther (DME) — Mesurage et calculs à
bord des navires*
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Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Terms and definitions	1
3 Characteristics and properties of DME	2
3.1 General.....	2
3.2 General characteristics.....	2
3.3 Chemical and physical properties.....	2
4 General precautions	3
4.1 General.....	3
4.2 Equipment precautions.....	3
5 Tank capacity table	4
5.1 General.....	4
5.2 Contents of tank capacity table.....	4
6 Level gauges	4
6.1 Type of level gauges.....	4
6.2 Accuracy of level gauge.....	4
6.3 Use of designated level gauge.....	5
7 Temperature measuring equipment	5
7.1 Type of temperature sensor.....	5
7.2 Accuracy of temperature measuring equipment.....	5
7.3 Number and position of temperature sensors.....	5
8 Pressure gauge	5
8.1 Type and number of pressure gauges.....	5
8.2 Accuracy of pressure gauge.....	5
9 Preparation for custody transfer	6
9.1 Facilities for cargo operation.....	6
9.2 Pipelines.....	6
9.3 Ship/shore meeting.....	6
10 Custody transfer measurement	7
10.1 General.....	7
10.2 Measurement of liquid level.....	7
10.3 Measurement of temperature.....	7
10.4 Measurement of vapour pressure.....	7
11 Quantitative calculation	8
11.1 General.....	8
11.2 Concept of quantitative calculation.....	8
12 Preparation for sailing	9
12.1 Pipelines and other facilities.....	9
12.2 Ship/shore meeting.....	9
12.3 Information to cargo receiver.....	9
Annex A (informative) Estimation of density of DME	10
Bibliography	11

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.

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The main task of technical committees is to prepare International Standards. 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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 16384 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*, Subcommittee SC 5, *Measurement of refrigerated hydrocarbon and non-petroleum based liquefied gaseous fuels*.

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Introduction

Measures for environmental protection are required on a global scale. In this connection, various methods of achieving these aims have been independently studied or undertaken in many countries. One such project, the development of the use of dimethylether (DME) as a new form of energy has been undertaken in several countries. Use of DME generates neither sulfur-oxide nor any other particulate matter known to cause environmental pollution at the time of combustion.

Another benefit of the use of DME as a petroleum alternative is that it can be produced easily from natural gases, coals and biomasses with only slight additional development of the existing techniques of production, transportation, storage and consumption.

In international trade, liquefied gases in bulk are carried by specialized ships which are equipped with fully refrigerated or semi-refrigerated type tanks, or pressurized type tanks. For assessing the quantity, measurement on board these ships is preferable because shore tanks at loading/discharging ports usually engage in transferring to/from tank cars by pipelines, etc. simultaneously with the delivery/receipt of the cargo to/from the ships.

To prevent dispute over the delivered quantity of DME, uniform practice of volumetric measurement and consequent calculation methods is called for.

Since detailed requirements on installation, calibration and verification of level gauges and thermometers are standardized in their own respective International Standards, this International Standard focuses on the practice of custody transfer and subsequent calculation of DME.

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Refrigerated hydrocarbon and non-petroleum based liquefied gaseous fuels — Dimethylether (DME) — Measurement and calculation on board ships

1 Scope

This International Standard provides guidance on the practices for custody transfer of dimethylether (DME) on board ships, at both the loading and the discharging ports. It covers such aspects of volumetric calculation on board as measurement of liquid volume, vapour volume, temperature and pressure; and accounting for the total quantity of DME on board before and after loading/discharging, regardless of the type of ship's tank.

2 Terms and definitions

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

2.1

absolute pressure

pressure in excess of a perfect vacuum, equal to the algebraic sum of atmospheric pressure and effective pressure

2.2

automatic tank gauge

ATG

instrument that continuously measures liquid height (dip or ullage) in storage tanks

[ISO 18132-1:2011, definition 2.1.1 and ISO 18132-3:2011, definition 2.1.1]

NOTE 1 An automatic tank gauge usually includes a level sensor, a gauge head and associated mounting hardware, and in some cases local display.

NOTE 2 Automatic tank gauges are also known as automatic level gauges (ALGs).

2.2.1

float-type ATG

ATG that uses a float to detect the liquid level

[ISO 18132-1:2011, definition 2.1.5 and ISO 18132-3:2011, definition 2.1.4]

NOTE The float is guided by a tape or wire that is connected to a drum or a ratchet in the gauge head, where the level measured is displayed locally and/or remotely.

2.2.2

magnetic-type ATG

ATG that measures the liquid level by magnetic reed switches with a float sensor including magnets, or by magneto-strictive principle

[ISO 18132-3:2011, definition 2.1.7]

2.2.3

radar-type ATG **microwave-type ATG**

ATG that utilizes an antenna to transmit electromagnetic continuous waves toward the liquid in a tank, and to receive electromagnetic waves which are reflected at the surface of the liquid

[ISO 18132-1:2011, definition 2.1.7 and ISO 18132-3:2011, definition 2.1.8]

2.3

custody transfer

measurement of liquid level, liquid and vapour temperature, and vapour pressure of the DME to be delivered to/from a tank, by which volume and other data are determined as the basis of payment or the assessment of duty

2.3.1

closing custody transfer

custody transfer implemented after loading or discharging cargo from the tank(s)

2.3.2

opening custody transfer

custody transfer implemented before loading or discharging cargo from the tank(s)

2.4

heel

amount of cargo retained in a cargo tank prior to loading or after discharge

[ISO 10976:2012, definition 3.1.16]

2.5

saturated vapour pressure **vapour pressure**

pressure exerted by the vapour above the liquid in equilibrium at a given temperature

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3 Characteristics and properties of DME

3.1 General

DME has the following typical characteristics and properties (see ISO 29945), in consideration of which, safety precautions should be taken.

3.2 General characteristics

DME has the following general characteristics, which should be considered with respect to personal safety precautions:

- a) non-corrosive;
- b) relatively small temperature coefficient of volume expansion;
- c) acts as an effective solvent of many materials;
- d) hydrophilic.

3.3 Chemical and physical properties

DME has the following general chemical and physical characteristics:

- a) boiling point: $-25,1\text{ }^{\circ}\text{C}$ at atmospheric pressure;
- b) saturated vapour pressure: $0,61\text{ MPa}$ at $25\text{ }^{\circ}\text{C}$;

- c) explosive range: 3,4 volume % to 27,0 volume %;
- d) relative gas density: 1,59 relative to air;
- e) liquid density: 677 kg/m³ at 15 °C.

4 General precautions

4.1 General

Nothing contained in this International Standard is intended to supersede any regulatory requirements or recommended operating practices issued by organizations such as the International Maritime Organization (IMO), International Chamber of Shipping (ICS), Oil Companies International Marine Forum (OCIMF), International Association of Classification Societies (IACS) and individual operating companies, nor is this International Standard intended to conflict with any safety or environmental considerations, local regulations, or the specific provisions of any contract.

4.2 Equipment precautions

4.2.1 Accuracy inspection and verification of gauges

Level gauges, temperature measuring equipment and pressure gauges to be used for custody transfer shall be subject to accuracy inspection at the time of installation on board and at subsequent periodic inspections as required by regulation and/or the sales contract.

Certificates of these accuracy verifications shall document the inaccuracies of gauges and provide statements with regard to their operational condition and suitability for use. They shall be dated and indicate the person and company performing the verification. The most current certificate(s) shall be kept on board for inspection by any party to subsequent custody transfer operations.

4.2.2 Maintenance of gauges

Level gauges, temperature measuring equipment and pressure gauges shall be maintained by ship's personnel so as to guarantee effective cargo control and accurate custody transfer.

4.2.3 Operation of gauges

Level gauges, temperature measuring equipment and pressure gauges shall be operated by ship's personnel designated by the shipmaster.

4.2.4 Malfunction of gauges

In the event that a level gauge, temperature measuring equipment or a pressure gauge malfunctions during a voyage, the shipmaster shall endeavour to repair it and report the incident and outcome of any actions taken at the destination without delay.

4.2.5 Tolerance of gauges against cargo nature

In accordance with the type of tank, i.e. fully refrigerated, semi-refrigerated or fully pressurized, level gauges, temperature measuring equipment and pressure gauges shall be designed to withstand low temperatures or high pressure as well the solubility of DME.

4.2.6 Change of gauges

Any changes to level gauges, temperature measuring equipment and pressure gauges require the approval of the ship's flag administration and/or classification society, and require external verification