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Refrigerated light-hydrocarbon fluids — Calibration of spherical tanks in ships —

Part 1: Stereo-photogrammetry

*Hydrocarbures légers réfrigérés — Jaugeage des réservoirs sphériques
à bord des navires —*

Partie 1: Stéréo-photogrammétrie



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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.

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.

International Standard ISO 9091-1 was prepared by Technical Committee ISO/TC 28 *Petroleum products and lubricants*, Sub-Committee SC 5, *Measurement of light hydrocarbon fluids*.

ISO 9091 consists of the following parts, under the general title *Refrigerated light-hydrocarbon fluids — Calibration of spherical tanks in ships*:

- Part 1: *Stereo-photogrammetry*
- Part 2: *Triangulation measurement*

Annexes A, B, C, D, E and F of this part of ISO 9091 are for information only.

Introduction

Large quantities of light hydrocarbons consisting of compounds having 1 to 4 carbon atoms are stored and transported by sea as refrigerated liquids at pressures close to atmospheric. The liquids can be divided into two main groups: liquefied natural gas (LNG) and liquefied petroleum gas (LPG). Bulk transportation of these liquids requires a special technology in ship design and construction to enable shipborne transportation to be safe and economical.

Measurement of cargo quantities in ships' tanks for custody transfer purposes has to be of a high order of accuracy. The two parts of this International Standard, together with other standards in the series, specify methods of internal measurement of ships' tanks from which tank calibration tables can be derived.

For internal measurement, liquid calibration, physical measurement, optical measurement and stereo-photogrammetry are in general use. Liquid calibration cannot be used for large spherical tanks designed to operate at near atmospheric pressure with refrigerated light hydrocarbons because the hydrostatic pressure exerted by the calibrating liquid may exceed the design pressure when filled higher than a certain level. In view of its accuracy, the last-mentioned should be adopted as the referee method if calibration by another method is in doubt. Stereo-photogrammetry consists mainly of photographing targets on the tank wall and the analytical processing of the photographs in the laboratory.

This part of ISO 9091 specifically describes the method using a universal metric camera for the photographing and an analytical stereoplottor for the analysis.

Refrigerated light-hydrocarbon fluids — Calibration of spherical tanks in ships —

Part 1: Stereo-photogrammetry

1 Scope

1.1 This part of ISO 9091 describes a stereo-photogrammetric procedure for the internal measurement of spherical tanks in liquefied-gas carriers.

1.2 In addition to the actual process of measurement, this part of ISO 9091 also sets out the calculation procedures for compiling the calibration tables.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 9091. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 9091 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 7078:1985, *Building construction — Procedures for setting out, measurement and surveying — Vocabulary and guidance notes*.

ISO 8311:1989, *Refrigerated light hydrocarbon fluids — Calibration of membrane tanks and independent prismatic tanks in ships — Physical measurement*.

3 Definitions

For the purposes of this part of ISO 9091, the following definitions apply.

3.1 absolute orientation: The procedure of final correction of the stereoscopic models formed by inner and relative orientations, in which the scale in the stereoscopic model is converted to the actual length and the inclination of the model is adjusted to the actual condition of the tank.

3.2 calibration: The process of determining the total capacity or partial capacities of a tank corresponding to different levels.

3.3 calibration table (main gauge table): A table, often referred to as a tank table or a tank capacity table, showing the capacities of or volumes in a tank corresponding to various liquid levels measured from the gauge reference point, with the ship on an even keel and upright.

3.4 datum point: The south pole to which the tank table is referred.

3.5 deadwood: Any tank fitting which affects the capacity of a tank. Deadwood is referred to as "positive deadwood" when the capacity of the fitting adds to the effective capacity of the tank, or "negative deadwood" when the volume of the fitting displaces liquid and reduces the effective capacity.

3.6 equator: The largest horizontal circumference of a spherical shell.

3.7 floating mark: A mark seemingly occupying a position in the three-dimensional space formed by stereoscopic fusion of a pair of photographs and used as a reference mark in examining or measuring the stereoscopic model.

3.8 gauge reference point: The point from which the liquid depths are measured.