INTERNATIONAL STANDARD

ISO 7507-5

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Petroleum and liquid petroleum products — Calibration of vertical cylindrical tanks —

Part 5: External electro-optical distance-ranging method

Pétrole et produits pétroliers liquides — Jaugeage des réservoirs cylindriques verticaux —

Partie 5: Méthode par mesurage électro-optique externe de la distance

Reference number
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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.

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 part of ISO 7507 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 7507-5 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*, Subcommittee SC 3, *Static petroleum measurement*.

ISO 7507 consists of the following parts, under the general title *Petroleum and liquid petroleum products — Calibration of vertical cylindrical tanks*:

— *Part 1: Strapping method*

— *Part 2: Optical-reference-line method*

— *Part 3: Optical-triangulation method*

— *Part 4: Internal electro-optical distance-ranging method*

— *Part 5: External electro-optical distance-ranging method*

— *Part 6: Recommendations for monitoring, checking and verification of tank calibration and capacity table*

Annex A of this part of ISO 7507 is for information only.

Introduction

This International Standard forms part of a series on tank calibration methods including the following:

a) ISO 4269-1, *Petroleum and liquid petroleum products — Tank calibration by liquid measurement — Part 1: Incremental method using volumetric meters.*

b) ISO 7507-1, *Petroleum and liquid petroleum products — Calibration of vertical cylindrical tanks — Part 1: Strapping method.*

c) ISO 7507-2, *Petroleum and liquid petroleum products — Calibration of vertical cylindrical tanks — Part 2: Optical-reference-line method.*

d) ISO 7507-3, *Petroleum and liquid petroleum products — Calibration of vertical cylindrical tanks — Part 3: Optical-triangulation method.*

e) ISO 7507-4, *Petroleum and liquid petroleum products — Calibration of vertical cylindrical tanks — Part 4: Internal electro-optical distance-ranging method.*

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

g) ISO 9091-1, *Refrigerated light-hydrocarbon fluids — Calibration of spherical tanks in ships — Part 1: Stereo-photogrammetry.*

h) ISO 9091-2, *Refrigerated light hydrocarbon fluids — Calibration of spherical tanks in ships — Part 2: Triangulation measurement.*

The method is an alternative to other calibration methods such as the strapping method (ISO 7507-1), the optical-reference-line method (ISO 7507-2), the optical-triangulation method (ISO 7507-3), and the internal electro-optical distance-ranging method (ISO 7507-4).

Petroleum and liquid petroleum products — Calibration of vertical cylindrical tanks —

Part 5: External electro-optical distance-ranging method

1 Scope

This part of ISO 7507 specifies a method for the calibration of non-insulated vertical cylindrical tanks having diameters greater than 5 m, by means of external measurement using an electro-optical distance-ranging method (EODR), and for the subsequent compilation of tank capacity tables.

This part of ISO 7507 is applicable to tanks with cone-up or cone-down bottoms as well as to tanks with flat bottoms.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 7507. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 7507 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 4512:—[1], *Petroleum and liquid petroleum products — Equipment for measurement of liquid levels in storage tanks — Manual methods.*

ISO 7507-1:1993, *Petroleum and liquid petroleum products — Calibration of vertical cylindrical tanks — Part 1: Strapping method.*

ISO 7507-4:1995, *Petroleum and liquid petroleum products — Calibration of vertical cylindrical tanks — Part 4: Internal electro-optical distance-ranging method.*

IEC 60079-10:1995, *Electrical apparatus for explosive gas atmospheres — Part 10: Classification of hazardous areas.*

IEC 60825-1:1998, *Safety of laser products — Part 1: Equipment classification, requirements and user's guide.*

3 Terms and definitions

For the purposes of this part of ISO 7507, the terms and definitions given in ISO 7507-1 and ISO 7507-4 and the following apply.

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[1] To be published.

3.1
“at” station
station currently occupied by the EODR instrument

3.2
“back” station
station to the rear of the "at" station presently occupied by the EODR instrument

3.3
bisect
sighting of the centre of a target through the telescope of a EODR instrument

3.4
changing face
rotation of both horizontal and vertical circles of the EODR instrument by 200 gon

3.5
“forward” station
station forward of the "at" station presently occupied by the EODR instrument

3.6
misclosure
difference between the sum of the horizontal angles measured between the various stations of a complete traverse of the tank and the sum of the theoretical angles for the same traverse

3.7
station
position from which measurements of angles and slope distance are made

3.8
tribrach
device, set on a tripod, which, by adjusting three or more foot screws, is set in a horizontal plane and upon which surveying instruments are mounted

4 Principle

The tank and its surrounds are visually inspected and, having calculated the number of stations required, the siting of the measurement stations is chosen.

Tripods, together with their respective measuring equipment, are placed at the initial stations. To establish the position of the "at" station, angular and distance measurements are made from the initial "at" station to the initial "back" and "forward" stations. Angular and distance measurements to the top and base of the tank are then taken together with tangential angular measurements bisecting (3.3) the tank shell to the right and left of the station. These measurements are made at the required positions on each course. The tripods at the initial "back" and "at" stations are left in position to enable closure of the traverse on completion of the calibration.

From each of the subsequent, predetermined stations, angular and distance measurements to the top and base of the tank are then taken, together with tangential angular measurements bisecting (3.3) the tank shell to the right and left of the station.

In moving to each new station, the old "forward" station becomes the new "at" station and the old "at" station the new "back" station. The final measurements are made from an "at" station which was the initial "back" station; the final "forward" station is the initial "at" station.

These measurements, after any adjustments for misclosure, allow the calculation of three dimensional coordinates which are fitted into a matrix describing the tank mathematically. The circumferences at the various vertical positions on the tank shell are calculated from this information and the capacity table developed in accordance with ISO 7507-1.

5 Precautions

The general and safety precautions contained in ISO 7507-1 shall apply to this part of ISO 7507.

In addition, the laser emitted by the distance ranging unit shall conform to IEC 60825-1 for a Class 1 or Class 2 laser.

The EODR instrument and other electrical equipment shall have a level of electrical protection appropriate for the area classification of the location of the tank to be calibrated. (See IEC 60079-10.)

6 Equipment

6.1 Electro-optical distance-ranging instrument

The angular and distance-measuring parts of the instrument shall conform to 5.1 of ISO 7507-4:1995.

6.2 Single-corner cubic prisms, (for use as target prisms) mounted on a prism holder

NOTE The prism holder should be mounted on a ranging pole or a tribrach mounted on a tripod.

6.3 Tribrach

A minimum of five are required.

6.4 Tripod

A minimum of five are required.

6.5 Ranging pole

6.6 Self-adhesive retro-reflective tape

NOTE The external surface is coated with small reflective prisms or facets.

6.7 Ancillary equipment

This equipment shall include

a) a paint thickness meter, and

b) a plate thickness meter.

6.8 Equipment for bottom calibration

This equipment shall be on accordance with annex C of ISO 7507-1:1993.

7 General considerations

7.1 The EODR instrument shall be maintained so that the values of its measurement uncertainty do not exceed the values given in 6.1.

7.2 Tanks shall only be calibrated after they have been filled at least once with a liquid of equal or greater density than the liquid which they will hold when in use.

NOTE The hydrostatic test applied to new tanks will satisfy this requirement in most cases.