
**Nafta in tekoči naftni proizvodi – Umerjanje navpičnih valjastih rezervoarjev –
3. del: Optična triangulacijska metoda**

Petroleum and liquid petroleum products; calibration of vertical cylindrical tanks;
part 3: optical-triangulation method

INTERNATIONAL
STANDARD

ISO
7507-3

First edition
1993-08-01

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

Part 3:
Optical-triangulation method

*Pétrole et produits pétroliers liquides — Étalonnage des réservoirs
cylindriques verticaux —*

Partie 3: Méthode par triangulation optique



Reference number
ISO 7507-3:1993(E)

Contents

	Page
1 Scope	1
2 Normative reference	1
3 Definitions	1
4 Precautions	1
5 Equipment	1
6 Equipment set-up and procedure	2
7 Measurement of distance between two theodolite stations ...	2
8 Procedure for internal optical tank wall measurements	3
9 Procedures for external measurements	5
10 Tolerances	7
11 Other measurements for tank calibrations	7
12 Calculations and development of tank capacity tables	8

Annexes

A Computation of internal radii from internal measurements	9
B Determination of the radius of the circle by the least-squares method	10
C Computation of internal radii from reference circumference and external measurements	12
D Computation of internal radii from reference distances between pairs of theodolite stations	13
E Method for calibrating bottoms of tanks	15
F Specification for dip-tape and dip-weight	16

© ISO 1993

All rights reserved. No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

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 7507-3 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*, Sub-Committee 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 methods*
- *Part 5: External electro-optical distance-ranging methods*

At the time of publication of this part of ISO 7507, parts 4 and 5 were in course of preparation.

Annexes A, B, C, D, E and F form an integral part of this part of ISO 7507.

Introduction

This method describes the calibration of vertical cylindrical tanks by means of optical triangulation using theodolites. The circumference of the tank is determined at different levels by reference to a base line which may be either a reference circumference measured by strapping or a base line between two stations of a theodolite measured by means of a tape or by an optical method. External circumferences are corrected to give true internal circumferences.

The method is an alternative to other methods such as strapping (ISO 7507-1) and the optical-reference-line method (ISO 7507-2).

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

Part 3: Optical-triangulation method

1 Scope

1.1 This part of ISO 7507 specifies a calibration procedure for application to tanks above 8 m in diameter with cylindrical courses that are substantially vertical. It provides a method for determining the volumetric quantity contained within a tank at gauged liquid levels. The measurement required to determine the radius may be made internally (clause 8) or externally (clause 9). The external method is applicable only to tanks that are free of insulation.

1.2 Abnormally deformed, e.g. dented or non-circular, tanks are excluded from this part of ISO 7507.

1.3 This method is suitable for tilted tanks up to 3 % deviation from the vertical provided that a correction is applied for the measured tilt as described in ISO 7507-1.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this part of ISO 7507. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this part of ISO 7507 are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

3 Definitions

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

4 Precautions

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

5 Equipment

5.1 Equipment for measurement of angles, as listed in 5.1.1 to 5.1.4 below.

5.1.1 Theodolites, with angular graduations and a resolution equal to or better than 0,000 2 grade¹⁾. Each theodolite shall be mounted on a tripod which is firm and stable. The legs of the tripod shall be steadied by means of magnetic bearers when being used for the internal method. Repeat readings shall agree to within 0,000 2 grade¹⁾.

5.1.2 Low-power laser-beam emitter, equipped with a device such as a fibre-optic light-transfer system and a theodolite-telescope eye-piece connection, by which the laser beam can be transmitted through

1) 1 grade = $\pi/200$ radians = 0,9°.

a theodolite. The laser beam shall be coincident with the optical axis of the telescope.

5.1.3 Heavy weights, to set round the theodolite stations to prevent movement of the tank bottom plate.

5.1.4 Lighting, for use inside the tank to allow measurements to be read accurately.

5.2 Stadia, 2 m long, such that the graduated length, between two marks, remains constant to within $\pm 0,02$ mm at the temperature at which it is used.

5.3 Equipment for bottom calibration:

Either

a) for a liquid method, equipment as specified in annex E;

or

b) for a survey method, theodolites, a dumpy level, a surveyor's level or water-filled tubes.

6 Equipment set-up and procedure

6.1 Preparation of tank

Fill the tank to its normal working capacity at least once and allow it to stand for at least 24 h prior to calibration.

If the tank is calibrated with liquid in it, record the depth, temperature and density of the liquid at the time of calibration. However, if the temperature of the wall surface could differ by more than 10 °C between the empty part and full part of the tank, the tank shall be completely full or empty. Do not make transfers of liquid during the calibration.

6.2 Theodolite set-up

6.2.1 Set up each theodolite with care according to the procedure and instructions given by the manufacturer. In addition, follow the procedures described in 6.2.2 and 6.2.3.

6.2.2 Set up the instrument so as to be stable.

For the internal method, steady the bottom of the tank near the theodolite station by installing weights or other heavy objects around the station. Mount the legs of the theodolite on magnetic bearers to prevent the legs from sliding on the tank bottom.

For the external method, drive the legs of the tripod fully home into the ground.

6.2.3 Set the bed plate of the instrument as near as possible to the horizontal.

NOTE 1 This will ensure verticality of the swivel axis of the theodolite.

6.3 Stadia set-up and procedure

6.3.1 Mount the stadia on the tripod with care according to the procedure and instructions given by the manufacturer. In addition, follow the procedures described in 6.3.2 and 6.3.3.

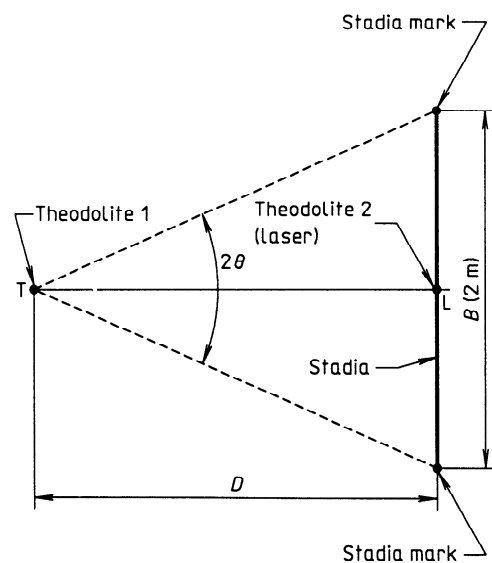
6.3.2 Mount the stadia horizontally and perpendicular to the aiming axis by adjusting the device on the stadia.

6.3.3 Once setting-up is complete, lock the stadia in position and verify the horizontality and the perpendicularity.

7 Measurement of distance between two theodolite stations

7.1 Take the measurement prior to the commencement of the optical readings. Set up the stadia as described in 6.3.

Measure the horizontal angle 2θ subtended at the theodolite (see figure 1) by the two marks on the stadia, using the theodolite.



NOTE — Points T and L are interchangeable.

Figure 1 — Measurement of distance between two theodolites