
**Nuclear fuel technology — Tank
calibration and volume determination for
nuclear materials accountancy —**

Part 5:

**Accurate determination of liquid height in
accountancy tanks equipped with dip
tubes, fast bubbling rate**

*Technologie du combustible nucléaire — Étalonnage et détermination
du volume de cuve pour la comptabilité des matières nucléaires —*

*Partie 5: Détermination précise de la hauteur de liquide dans une cuve
bilan équipée de cannes de bullage, bullage rapide*



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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.

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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 18213-5 was prepared by Technical Committee ISO/TC 85, *Nuclear energy*, Subcommittee SC 5, *Nuclear fuel technology*.

ISO 18213 consists of the following parts, under the general title *Nuclear fuel technology — Tank calibration and volume determination for nuclear materials accountancy*:

- *Part 1: Procedural overview*
- *Part 2: Data standardization for tank calibration*
- *Part 3: Statistical methods*
- *Part 4: Accurate determination of liquid height in accountancy tanks equipped with dip tubes, slow bubbling rate*
- *Part 5: Accurate determination of liquid height in accountancy tanks equipped with dip tubes, fast bubbling rate*
- *Part 6: Accurate in-tank determination of liquid density in accountancy tanks equipped with dip tubes*

Introduction

ISO 18213 deals with the acquisition, standardization, analysis, and use of calibration data to determine liquid volumes in process tanks for accountability purposes. This part of ISO 18213 is complementary to the other parts, ISO 18213-1 (procedural overview), ISO 18213-2 (data standardization), ISO 18213-3 (statistical methods), ISO 18213-4 (slow bubbling rate) and ISO 18213-6 (in-tank determination of liquid density).

The procedure presented herein for determining liquid height from measurements of induced pressure applies specifically when a fast bubbling rate is employed. A similar procedure that is appropriate for a very slow bubbling rate is given in ISO 18213-4.

Measurements of the volume and height of liquid in a process accountancy tank are often made in order to estimate or verify the tank's calibration or volume measurement equation. The calibration equation relates the response of the tank's measurement system to some independent measure of tank volume.

Beginning with an empty tank, calibration data are typically acquired by introducing a series of carefully measured quantities of some calibration liquid into the tank. The quantity of liquid added, the response of the tank's measurement system, and relevant ambient conditions such as temperature are measured for each incremental addition. Several calibration runs are made to obtain data for estimating or verifying a tank's calibration or measurement equation. A procedural overview of the tank calibration and volume measurement process is given in ISO 18213-1. An algorithm for standardizing tank calibration and volume measurement data to minimize the effects of variability in ambient conditions that prevail during the measurement period is given in ISO 18213-2. The procedure presented in this part of ISO 18213 for determining the height of calibration liquid in the tank from a measurement of the pressure it induces in the tank's measurement system is a vital component of that algorithm.

In some reprocessing plants, the volume of liquid transferred into or out of a tank is determined by the levels of two siphons. The high level corresponds to the nominal volume, and the low level to the heel volume. If the transfer volume cannot be measured directly, then it is necessary to calibrate this volume (as described in the previous paragraph) because the difference between the actual volume and that used for inventory calculations will appear as a systematic error.

The ultimate purpose of the calibration exercise is to estimate the tank's volume measurement equation (the inverse of the calibration equation), which relates tank volume to measurement system response. Steps for using the measurement equation to determine the volume of process liquid in the tank are presented in ISO 18213-1. The procedure presented in this part of ISO 18213 for determining the height of process liquid in a tank from a measurement of the pressure it induces in the tank's measurement system is also a key step in the procedure for determining process liquid volumes.

