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

Part 6:

**Accurate in-tank determination of liquid
density in accountancy tanks equipped
with dip tubes**

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

*Partie 6: Détermination précise de la masse volumique d'un liquide
dans une cuve bilan équipée de cannes de bullage*



Reference number
ISO 18213-6:2008(E)

AVA Documents
Document Sharing Hub
© ISO 2008

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.



COPYRIGHT PROTECTED DOCUMENT

© ISO 2008

All rights reserved. Unless otherwise specified, 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 either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword.....	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Physical principles involved.....	2
4 Required data	4
5 Equipment required	4
6 Operating procedures	5
7 Calculation of probe separation and liquid density	5
7.1 General.....	5
7.2 Case 1: Fast bubbling rate.....	5
7.3 Case 2: Slow bubbling rate.....	8
8 Uncertainty estimation	10
8.1 Density	10
8.2 Local acceleration due to gravity	11
8.3 Changes in reference conditions	11
Bibliography	12

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 2.

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 18213-6 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), ISO 18213-5 (fast bubbling rate).

The procedure described in this part of ISO 18213 is a two-step procedure. First, a liquid of known density is used to determine the vertical distance between the tips of the two probes (i.e. to calibrate their separation). The calibration step requires synchronous (or as nearly synchronous as possible) measurements of the pressure exerted at the tips of two probes by the calibration liquid in which they are submerged. The measurements obtained are used to make an accurate determination of probe separation. Second, the unknown density of the process liquid is determined with the aid of the probe separation calibration. The density-determination step also requires (nearly) synchronous measurements of the pressure exerted at the tips of two probes by the process liquid of unknown density.

With careful technique, it is possible to make determinations of liquid density with in-tank measurements that approach the accuracy and precision of those made in the laboratory. Moreover, density determinations made with in-tank measurements are automatically made at the observed temperature of the tank liquid. Thus, no additional information about the liquid is required to infer its density at its tank temperature from determinations of its density at some other temperature.

Except that the density of the process liquid is generally not well characterized, the steps involved in determining the height of process liquid in the tank are the same as those for determining the height of calibration liquid. Thus, the method of density determination given in this part of ISO 18213 is very closely related to the procedures given in ISO 18213-4 and ISO 18213-5 for determining liquid height.

