

Australian Standard™

**Milk and liquid milk products—Density
hydrometers for use in products with
a surface tension of approximately
45 mN/m**



This Australian Standard was prepared by Committee FT-010, Chemical Analysis of Dairy Products. It was approved on behalf of the Council of Standards Australia on 20 January 2004 and published on 4 March 2004.

The following are represented on Committee FT-010:

Australian Food and Grocery Council
Department of Primary Industries Queensland
Food Standards Australia New Zealand
NSW Health Department
National Association of Testing Authorities Australia
New Zealand Dairy Board
Queensland Health Scientific Services
Safe Food Production NSW
The Royal Australian Chemical Institute

Keeping Standards up-to-date

Standards are living documents which reflect progress in science, technology and systems. To maintain their currency, all Standards are periodically reviewed, and new editions are published. Between editions, amendments may be issued. Standards may also be withdrawn. It is important that readers assure themselves they are using a current Standard, which should include any amendments which may have been published since the Standard was purchased.

Detailed information about Standards can be found by visiting the Standards Web Shop at www.standards.com.au and looking up the relevant Standard in the on-line catalogue.

Alternatively, the printed Catalogue provides information current at 1 January each year, and the monthly magazine, *The Global Standard*, has a full listing of revisions and amendments published each month.

Australian Standards™ and other products and services developed by Standards Australia are published and distributed under contract by SAI Global, which operates the Standards Web Shop.

We also welcome suggestions for improvement in our Standards, and especially encourage readers to notify us immediately of any apparent inaccuracies or ambiguities. Contact us via email at mail@standards.org.au, or write to the Chief Executive, Standards Australia International Ltd, GPO Box 5420, Sydney, NSW 2001.

This Standard was issued in draft form for comment as DR 03540.

Australian Standard™

**Milk and liquid milk products—Density
hydrometers for use in products with
a surface tension of approximately
45 mN/m**

Originated as AS N40.1—1962.
Previous edition AS 2148—1978.
Second edition 2004.

COPYRIGHT

© Standards Australia International

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher.

Published by Standards Australia International Ltd
GPO Box 5420, Sydney, NSW 2001, Australia

ISBN 0 7337 5751 0

 **Documents**
Document Sharing Hub

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee FT-010, Chemical Analysis of Dairy Products, to supersede AS 2148—1978. *Hydrometers for use in milk.*

This Standard is identical to and reproduced from ISO 2449:1974, *Milk and liquid milk products—Density hydrometers for use in products with a surface tension of approximately 45 mN/m.*

This Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee FT-010. After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian Standard rather than an Australian/New Zealand Standard.

The objective of this Standard is to provide specifications for glass hydrometers of constant mass, for use in milk and liquid milk products with a surface tension of approximately 45 mN/m, which indicate density (g/mL) at 20°C (27°C in tropical countries).

Two types of hydrometers are specified, a precision type and a wide-range type, which comply in all important respects with ISO/R 387, *Principles of construction and adjustment of hydrometers.*

Notes on the verification of the hydrometers are given in Annex A, a suitable hydrometer cylinder is described in Annex B and suitable thermometer is described in Annex C.

As this Standard is reproduced from an International Standard, the following applies:

- (a) In the source text, 'this International Standard' should read 'this Australian Standard'.
- (b) A full point substitutes for a comma when referring to a decimal marker.
- (c) Substitute 'mL' for 'ml' wherever it appears.

AUSTRALIAN STANDARD

Milk and liquid milk products—Density hydrometers for use in products with a surface tension of approximately 45 mN/m**0 INTRODUCTION**

The system of units known as the *Système International d'Unités* (SI), and adopted by ISO (see ISO 1000, *SI units and recommendations for the use of their multiples and of certain other units*), has been used in this International Standard as follows :

1) Instead of the surface tension unit "dyne per centimetre" (dyn/cm) used in ISO/R 387, *Principles of construction and adjustment of hydrometers*, the unit adopted in the present International Standard is the "millinewton per metre" (mN/m), the recommended submultiple of the SI unit of surface tension "newton per metre" (N/m); the newton (N), the SI unit of force, is defined as that force which, when applied to a body having a mass of 1 kg, gives it an acceleration of 1 m/s². (1 mN/m = 1 dyn/cm).

2) The SI unit of density, i.e. mass divided by volume, is the "kilogram per cubic metre" (kg/m³), a permitted submultiple of this unit being the "gram per cubic centimetre" (g/cm³). As a convenient synonym for the latter unit, the SI unit system permits the use of the "gram per millilitre" (g/ml), and this method of expressing density, accepted in ISO/R 387, has been adopted in the present International Standard. (1 g/ml $\equiv$ 1 g/cm³). It should be noted that "density (g/ml)" means "grams (mass) per millilitre" and not "grams (observed weight) per millilitre".

1 SCOPE AND FIELD OF APPLICATION

1.1 This International Standard gives specifications for glass hydrometers of constant mass, for use in milk and liquid milk products with a surface tension of approximately 45 mN/m, which indicate density (g/ml) at 20 °C (27 °C in tropical countries).

1.2 Two types of hydrometers are specified, a precision type and a wide-range type, which comply in all important respects with ISO/R 387.

1.3 Notes on the verification of the hydrometers are given in annex A, a suitable hydrometer cylinder is described in annex B and a suitable thermometer is described in annex C.

2 SCALE RANGES, SUBDIVISION OF SCALES AND TOLERANCES**2.1 Scale ranges**

The scale ranges shall be as follows :

- a) 1,025 to 1,035 g/ml for the precision hydrometer, and
- b) 1,015 to 1,045 g/ml for the wide-range hydrometer.

NOTE — Additional precision hydrometers of scale range of 1,015 to 1,025, 1,035 to 1,045 or 1,040 to 1,050 g/ml may be required for certain purposes.

2.2 Subdivision of scales

The scale shall be subdivided at each 0,000 2 g/ml for a precision hydrometer, and at each 0,000 5 g/ml for the wide-range hydrometer.

2.3 Tolerances

The density indication shall not be in error at any point on the scale by more than $\pm 0,000 2$ g/ml for a precision hydrometer, or by more than $\pm 0,000 5$ g/ml for a wide-range hydrometer.

3 ADJUSTMENT**3.1 Reading level**

The hydrometer shall be adjusted to be read at the top of the liquid meniscus, i.e. where the meniscus appears to meet the stem. (See clause 8 b).)

3.2 Immersion

The hydrometer shall be adjusted to give correct readings when the emergent stem is wetted by the liquid to a level not more than 3 mm above the top of the meniscus.

3.3 Temperature and surface tension

The hydrometer shall be adjusted to indicate density in grams per millilitre at 20 °C when floating in a liquid at 20 °C with a surface tension of 45 mN/m.

NOTES

1 The value 45 mN/m is taken as the average surface tension at 20 °C of a freshly formed surface of cows' milk, i.e. obtained by pouring milk into a vessel until some has overflowed.

2 It is recommended that in tropical countries the hydrometers should be adjusted to indicate density (g/ml) at 27 °C. No significant error will be introduced by assuming that the value 45 mN/m is applicable at this temperature.

3.4 Adjustment level

A precision hydrometer or a wide-range hydrometer shall be regarded as correctly adjusted when its reading at the level of the flat surface of a transparent liquid at 20 °C, with a surface tension of 45 mN/m, exceeds the density of the liquid by 0,000 3 g/ml and 0,000 8 g/ml respectively, values that correspond to the height of each meniscus (see note 1).

NOTES

1 These values were derived from a modification of Langberg's formula for meniscus height (see below), and also from experimental observations, for hydrometers whose scales and dimensions comply with this International Standard.

$$h = \frac{\sigma i}{9,81 d \rho s} \left[\sqrt{\left(1 + \frac{19,62 d^2 \rho}{\sigma}\right)} - 1 \right]$$

where

- h is the meniscus height in terms of grams per millilitre;
- σ is the surface tension of the liquid in millinewtons per metre;
- i is the scale range in grams per millilitre (for example 0,01 for a precision hydrometer);
- d is the external diameter, in millimetres, of the stem;
- ρ is the density, in grams per millilitre, of the liquid;
- s is the mean scale length in millimetres (for example 64 for a precision hydrometer).

2 It is not essential for the transparent liquid used for adjustment to have a temperature of 20 °C and a surface tension of 45 mN/m, provided that appropriate corrections are applied.

4 MATERIALS AND CONSTRUCTION

4.1 The bulb and stem of the hydrometer shall be made of transparent glass, and shall be as free as possible from strain and visible defects. In particular the external surface shall be smooth and free from irregularities. The base of the bulb may be strengthened by internal thickening of the wall.

4.2 The loading material should preferably be lead shot, securely embedded in a suitable cementing material in the bottom of the bulb. The loading material shall be such that, if the hydrometer is kept in a horizontal position for 1 h at 40 °C, it will float afterwards with its axis within 1,5° of the vertical. When the loading material is mercury, the mercury shall be confined in the bottom of the bulb.

4.3 There shall be no loose material in the hydrometer.

NOTE — Mercury, when used as described in 4.2, is not regarded as "loose material".

4.4 The scale paper should preferably be white, shall be of high quality (see note), and shall have a smooth surface which permits the graduation lines, numbers and inscriptions to be marked finely and clearly on it. All scale markings shall be permanent.

The scale paper in a hydrometer shall show no evidence of charring, and when exposed to a temperature of 80 °C for 24 h shall not become discoloured or distorted.

NOTE — It is recommended that the paper be an esparto paper (65 to 75 % esparto is suitable) and that the scale strips be cut with their length in the machine direction of the paper.

4.5 The scale paper shall be securely fastened in place. The scale paper shall have a scale mark, a few millimetres above the top graduation line, consisting of a short horizontal line with a "V" at each end, thus : >———< . A fine reference line of uniform thickness shall be cleanly etched on the hydrometer stem, at a position coincident with the horizontal portion of the scale mark, so that the ends of the etched line project into the "V" at each end of the scale mark.

A hydrometer shall be deemed not to comply with this International Standard if there is any displacement of the scale paper, i.e. if the scale mark and the reference line do not coincide exactly.

5 FORM

5.1 The outer surface of the hydrometer shall be symmetrical about its axis; there shall be a smooth transition between the bulb and the stem and no other abrupt changes in cross-section.

5.2 The tapered design shown in figure 1 is preferred, but any similar design that does not permit air bubbles to be trapped is acceptable.

5.3 The hydrometer shall float so that its axis does not deviate by more than 1,5° from the vertical position.

6 SCALES

6.1 Figure 2 shows the sequence and numbering of graduation lines which shall be followed, and illustrates acceptable scales.

6.2 General

6.2.1 The scale shall be straight and without twist.

6.2.2 There shall be no irregularities in the spacing of the graduation lines.

6.2.3 The graduation lines shall be at right angles to the axis of the hydrometer.

6.2.4 The graduation lines shall be of uniform thickness not exceeding 0,2 mm.