



Methods of test for pulp and paper

Method 457: Determination of moisture content in paper, board and pulps



AS 1301.457:2020

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Preface

This Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee PK-019, *Methods of Test for Pulp and Paper*, to supersede AS/NZS 1301.457s:2006, *Methods of test for pulp and paper, Method 457s: Determination of moisture content in paper, board and pulps*.

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 a defined procedure for determining moisture content of paper and board products and pulps, which recognizes some specific properties of such materials. In particular, this Standard is suitable for determining the moisture content of a lot.

The major changes in this edition are as follows:

- (a) Specification of only one procedure for determining moisture content. The previous distillation method is now presented in an informative Appendix.
- (b) Inclusion of a definition for a lot of paper, board or pulp.
- (c) Re-specification of the accuracy of the balance to enable the precision required in the procedure to be achieved.
- (d) Insertion of a new Sampling clause to clarify that, while AS/NZS 1301.417 can be applied when testing papers and boards, and AS/NZS ISO 7213 can be applied when testing pulps, other sampling procedures may be used.
- (e) Clarification of recommendation that gloves be worn when handling a test piece.
- (f) Addition of formula to illustrate how to calculate the moisture content on either an “as received” basis or on an “oven-dry” basis.

At the time of publication of this Standard there was no corresponding ISO Standard.

The terms “normative” and “informative” are used in Standards to define the application of the appendices to which they apply. A “normative” appendix is an integral part of a Standard, whereas an “informative” appendix is only for information and guidance.

Introduction

The moisture content of many materials is commonly determined by oven-drying, the change in mass of the material being assumed to be due solely to removal of water. In the case of paper products and pulp this assumption is incorrect. Volatile constituents other than water may be lost in oven-drying and oxidation or decomposition of some constituents is possible at high temperatures.

The quantity of water removed depends on the method of drying adopted. In oven-drying the moisture values obtained are to some extent dependent on the temperature used, the humidity in the oven and also on the time of drying.

When other methods of water removal are used, for instance vacuum desiccation or distillation or extraction with solvents, moisture content values do not always agree with those obtained by an oven-drying method.

The moisture content of paper products and pulps therefore needs to always be defined in terms of a particular method. This Standard prescribes only the Oven-drying method. [Appendix A](#) (informative) describes a Distillation method.

The method of sampling for determination of moisture content is critical if the purpose is to determine the moisture content of a lot. Relevant standards that fully describe suitable procedures are as follows:

- (a) *AS/NZS 1301.417s, Methods of test for pulp and paper, Method 417s: Sampling paper to determine average quality*, is applicable to sampling of a lot of paper or board.
- (b) *AS/NZS ISO 7213, Pulps — Sampling for testing*, is applicable to sampling of a lot of pulp in bale or roll form.

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Methods of test for pulp and paper

Method 457: Determination of moisture content in paper, board and pulps

1 Scope

This document specifies a test method for determining moisture content in paper, board and pulps.

2 Normative references

There are no normative references in this document.

NOTE Documents referenced for informative purposes are listed in the Bibliography.

3 Terms and definitions

For the purpose of this Standard the following terms and definitions apply.

3.1

lot

aggregate of paper or board or pulp of a single kind with specified characteristics produced under conditions that are presumed uniform, and available for sampling at one time

3.2

may

indicates the existence of an option

3.3

shall

indicates that a statement is mandatory

3.4

should

indicates a recommendation

3.5

tare weight

indicates the weight of an empty container

3.6

test piece

piece or pieces of sampled material on which the moisture determination is to be carried out

4 Principle

A sample of paper, board or pulp from a lot is weighed before and after oven drying. The moisture content is calculated.

This oven-drying method applies to paper and board products and pulps that do not contain any appreciable quantity of material other than water which will escape from the paper at the temperature specified for the test.

5 Apparatus

5.1 Balance

A balance having an accuracy of 0.05 % of the mass to be weighed, or better.

5.2 Containers

Containers for preventing changes in moisture content during the transporting and weighing of test pieces, having airtight lids or other equivalent means of sealing, and made from a lightweight material not subject to change under conditions of drying specified in this document. Where test pieces are taken according to AS/NZS 1301.417s, the containers need to be large enough to contain sheets without cutting or tearing them. Before using a container, determine its tare weight.

5.3 Drying oven

A drying oven capable of being maintained at an air temperature of 105 ± 2 °C in the usable volume and having forced ventilation.

5.4 Desiccator

A desiccator equipped with freshly dried desiccant.

6 Sampling

Take a sample which is representative of the paper, board or pulp the moisture content of which is to be determined.

Two standard sampling procedures for determining the moisture content of a lot exist, although any alternative procedure may be followed

NOTE When the purpose is to obtain test pieces from a lot of paper or board, AS/NZS 1301.417s may be followed. When the purpose is to obtain test pieces from a lot of pulp in bale or roll form, AS/NZS ISO 7213 may be followed.

Throughout the chosen sampling procedure, minimize the chance of the sampled material losing or gaining moisture in exchange with the ambient air by wrapping the sample. Avoid moisture gain of the sampled material from contact with the skin by wearing gloves.

Take sufficient sample material to ensure that the mass of moisture in a test piece can be determined to within 0.05 % of the mass of the test piece and so that additional test pieces can be obtained to permit the performance of replicate measurements if required. Enclose each test piece in a tared dry container (see [Clause 5.2](#)).

7 Procedure

7.1 Weighing of test piece

If the test piece is hot when taken, allow to cool and equalize the air pressures inside and outside the container by momentarily opening and reclosing the lid immediately before weighing. Weigh the test piece in its container.

7.2 Oven-drying step

Dry the test piece in the oven, either in its container (with the lid removed), or taken from the container and spread out to expose the maximum surface area. If the nature of the test piece is such that removal from the container could result in fibre or other solids being lost, it shall be dried in the container.

If the test piece is taken from its container, dry the container and lid under the same conditions.

When the test piece is considered to be completely dry (allow at least one hour), prepare to transfer it to the desiccator. If the test piece has been removed from its container, replace it in the container and fit the lid loosely before the transfer. If the test piece has been in its container during the drying period, fit the lid loosely. The transfer shall be done promptly to minimize exposure of the test piece to the atmosphere outside the oven.

Allow the container to cool in the desiccator. As soon as the container is cool enough so that the potential reduction of pressure in the container resulting from continued cooling does not risk sucking moisture-laden air into the container, properly fit the lid while still in the desiccator.

Remove the assembled container and its contents from the desiccator and weigh.

7.3 Repeated drying

Replace the container and test piece in the oven as described above and dry for a further period of at least 30 min. Cool and reweigh the container and test piece as described in [Clause 7.2](#).

If necessary repeat this, until consecutive weighings do not differ by more than 0.1 % of the initial moist mass of the test piece.

8 Calculation

Calculate the percent moisture content from the loss of mass and the original moist mass of the test piece to the nearest 0.1 % by the following formula:

$$X = \frac{(W_1 - W_2) \times 100}{(W_1 - W_0)}$$

where

W_0 = the tared weight of the container as described in [Clause 5.2](#).

W_1 = the weight of the container and test piece before drying as described in [Clause 7.1](#).

W_2 = the weight of the container and test piece after drying as described in [Clause 7.3](#).

NOTE In the case of a lot, the precision of results will be affected by variation in moisture content throughout the lot being sampled, by the number of test results averaged, by handling and atmospheric exposure and by drying and weighing errors. The standard deviation of individual moisture tests on replicate test pieces of conditioned paper tested at the same time is the best indication of drying and weighing errors. This has been found to vary from 0.1 % to 0.3 % moisture.

9 Test report

The test report shall give the following particulars:

- (a) Complete identification of the sample.
- (b) The date and place of testing.
- (c) Explanation of the sampling method employed.

- (d) The calculated or average moisture content expressed to the nearest 0.1 % of moisture content.
- (e) The standard deviation of the results if several test pieces were tested and the number of replicate determinations.
- (f) A statement that the test was made in full conformance to this Standard AS 1301.457:2020. Results obtained using deviations from this Standard cannot be claimed as results obtained by AS 1301.457:2020.
- (g) Any other information which could assist in the interpretation of results.

Appendix A **(informative)**

Distillation method

A.1 Scope

This method employs the Dean and Stark apparatus. The method is suitable for materials such as waxed papers, varnished papers, laminates and other products which cannot be tested by the oven-drying method owing to the probable loss of volatile or fusible constituents. It cannot be used if there is a possibility of water being produced by decomposition of any material with which the paper has been treated.

A.2 Apparatus

A.2.1 Balance

A balance having a minimum accuracy of 0.1 % of the mass to be weighed.

A.2.2 Dean and Stark apparatus

An apparatus consisting of a one litre round-bottomed distillation vessel, a graduated receiver and a reflux condenser fitted at the top with a small drying tube filled with anhydrous calcium chloride. All components are fitted with ground glass joints and the apparatus is assembled as in [Figure A.1](#).

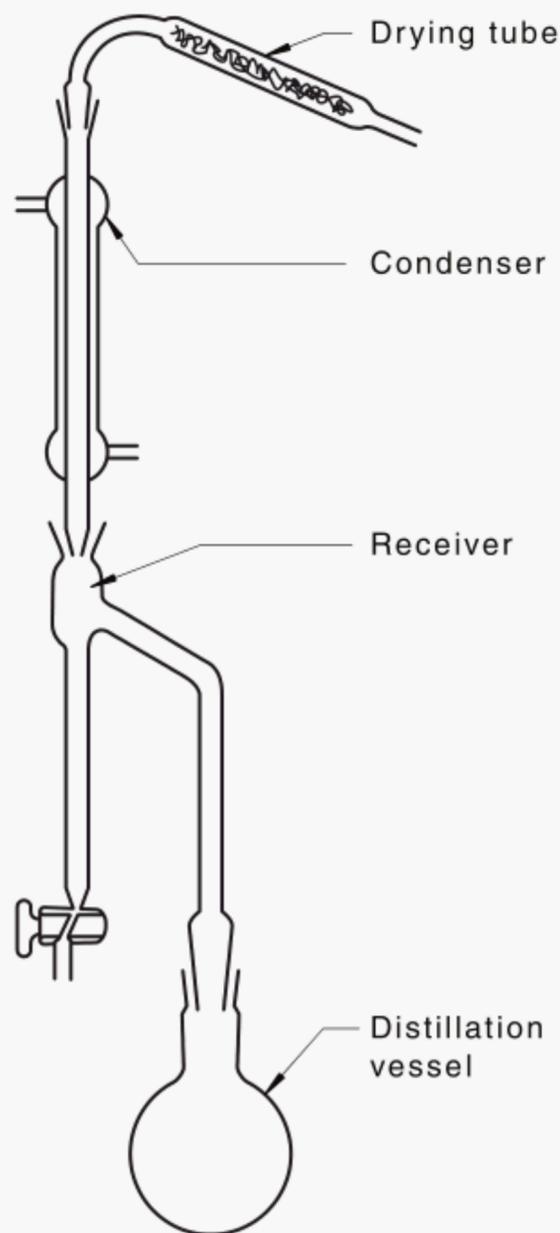


Figure A.1 — Arrangement of apparatus (individual items not to scale)

Use a 10 mL receiver unless small masses of paper are to be taken, or low moisture contents are anticipated, in which case a 2 mL receiver may be used.

Before use, calibrate the receiver by adding measured volumes of water from a micro-pipette of known accuracy. The receiver should contain a small quantity of the immiscible liquid (heptane or toluene) to be used for the test, since the surface tension of the particular liquid used will affect the shape of the meniscus formed at the glass-water interface.

Before testing any samples, prepare a graph showing the water recovery by adding known volumes of water to the immiscible liquid in the distillation vessel and distil, following normal laboratory practice, for 2 h. Read off the volume of water recovered and plot against the volume of water added.

A.2.3 Immiscible liquid

Use heptane or toluene as the immiscible liquid. Saturate the immiscible liquid by carrying out a preliminary distillation with the addition of water only to the distillation vessel. All of the solvent introduced needs to be retained in the system and all operations need to be done in an efficient fume cupboard and in accordance with AS/NZS 2243.2. Any equipment needs to be spark-free.

WARNING — TOLUENE AND HEPTANE ARE HIGHLY FLAMMABLE IN LIQUID OR VAPOUR FORM AND FORM EXPLOSIVE MIXTURES WITH AIR. PROLONGED EXPOSURE TO THE VAPOUR MAY CAUSE DROWSINESS OR DIZZINESS. TOLUENE IS A CARCINOGEN WHEN ABSORBED THROUGH THE SKIN OR INHALED AS A VAPOUR. IT IS ALSO POISONOUS. FOR FURTHER DETAILS OF HAZARDOUS MATERIALS REFER TO THE AS 2508 SERIES.

A.2.4 Containers

Containers for preventing changes in moisture content during the transporting and weighing of test pieces, having airtight lids or other equivalent means of sealing, and made from a lightweight material. Where test pieces are taken according to AS/NZS 1301.417s, the containers need to be large enough to contain sheets without cutting or tearing them. Before using a container, determine its tare weight.

A.3 Sampling

Two standard sampling procedures may be followed, though any alternative procedure may be followed. When the purpose is to obtain test pieces from a lot of paper or board, AS/NZS 1301.417s may be followed. When the purpose is to obtain test pieces from a lot of pulp in bale or roll form, AS/NZS ISO 7213 may be followed.

Throughout the chosen sampling procedure, minimize the chance of the sampled material losing or gaining moisture in exchange with the ambient air by wrapping the sample. Avoid moisture gain of the sampled material from contact with the skin by wearing gloves.

Take sufficient sample material to ensure that the mass of moisture in a test piece can be determined to within 0.1 % of the mass of the test piece and so that additional test pieces can be obtained to permit the performance of replicate measurements if required. Enclose each test piece in a tared dry container (see [Clause A.2.4](#)).

A.4 Procedure

A.4.1 Pre-cleaning the glassware

Clean all glass components thoroughly and dry by baking in an oven. While the glass is still warm, wet the inner surface of the distillation vessel, receiver and condenser with a small quantity of the immiscible liquid, so as to lessen the probability of water globules sticking to the glass surface. This can be done conveniently by pouring a quantity of the liquid through the condenser tube into the assembled apparatus. The flask should be about one-quarter filled with the immiscible liquid.

A.4.2 Weighing the test piece

If the test piece is hot when taken, allow to cool and equalize the air pressures inside and outside the container by momentarily opening and reclosing the lid immediately before weighing. Weigh the test piece in its tared container and calculate the mass of the undried test piece by difference.

A.4.3 Drying by distillation

Remove the weighed test piece from its container and transfer as rapidly as possible to the flask, tearing into pieces of suitable size if necessary. Reconnect the apparatus and boil the liquid in the flask gently until no further water collects in the receiver, a time of 2 h usually being sufficient.

A.4.4 Measurement of water removed by distillation

When distillation is complete, clear any bubbles of the immiscible liquid entrapped below the surface of the water by stirring with a suitable thin rod. Read off the volume of water collected and correct from the graph (see [Clause A.2.2](#)).

A.5 Calculation

Calculate the percentage moisture content from the corrected mass of water collected and the original moist mass of the test piece to the nearest 0.1 %.

NOTE With hot samples some condensation of moisture may occur on the inside walls of the container. When this is the case, determine the quantity of condensed moisture from the loss of mass of the empty container on drying in an oven. Add the mass of condensed moisture to that recovered by distillation when calculating the percentage moisture content.

A.6 Test report

The test report may give the following particulars:

- (a) Complete identification of the sample.
- (b) The date and place of testing.
- (c) Explanation of the sampling method employed.
- (d) The calculated or average moisture content expressed to the nearest 0.1 % of moisture content.
- (e) The standard deviation of the results if several test pieces were tested and the number of replicate determinations.
- (f) Any other information which could assist in the interpretation of results.

Bibliography

AS 2508, *Safe Storage and handling information card (series)*

AS/NZS 1301.417s, *Methods of test for pulp and paper, Method 417s: Sampling to determine average quality*

AS/NZS 2243.2, *Safety in laboratories, Part 2: Chemical aspects*

AS/NZS ISO 7213, *Pulps — Sampling for testing*

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