

Australian/New Zealand Standard™

**Performance of household electrical
appliances—Dishwashers**

**Part 1: Methods for measuring
performance, energy and water
consumption**



AS/NZS 2007.1:2005

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee EL-015, Quality and Performance of Household Electrical Appliances. It was approved on behalf of the Council of Standards Australia on 29 November 2005 and on behalf of the Council of Standards New Zealand on 9 December 2005. This Standard was published on 22 December 2005.

The following are represented on Committee EL-015:

Australian Consumers' Association
Australian Electrical and Electronic Manufacturers Association
Australian Industry Group
Australian Retailers Association
Business New Zealand
Consumer Electronics Suppliers Association
Consumers' Federation of Australia
Department of Energy, Utilities and Sustainability (NSW)
Department of Industrial Relations (QLD)
Electrical Compliance Testing Association
Energy Efficiency and Conservation Authority of New Zealand
Institution of Professional Engineers New Zealand
National Appliance and Equipment Energy Efficiency Committee
National Association of Testing Authorities Australia
Office of the Chief Electrical Inspector
Office of the Technical Regulator (SA)

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 Standards may also be withdrawn.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 joint Australian/New Zealand Standards can be found by visiting the Standards Web Shop at www.standards.com.au or Standards New Zealand web site at www.standards.co.nz and looking up the relevant Standard in the on-line catalogue.

Alternatively, both organizations publish an annual printed Catalogue with full details of all current Standards. For more frequent listings or notification of revisions, amendments and withdrawals, Standards Australia and Standards New Zealand offer a number of update options. For information about these services, users should contact their respective national Standards organization.

We also welcome suggestions for improvement in our Standards, and especially encourage readers to notify us immediately of any apparent inaccuracies or ambiguities. Please address your comments to the Chief Executive of either Standards Australia or Standards New Zealand at the address shown on the back cover.

This Standard was issued in draft form for comment as DR 05236.

Australian/New Zealand Standard™

**Performance of household electrical
appliances—Dishwashers**

**Part 1: Methods for measuring
performance, energy and water
consumption**

Originated as AS 2007—1977.
Jointly revised and redesignated as AS/NZS 2007.1:1998.
Fifth edition 2005.

COPYRIGHT

© Standards Australia/Standards New Zealand

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.

Jointly published by Standards Australia, GPO Box 476, Sydney, NSW 2001 and Standards New Zealand, Private Bag 2439, Wellington 6020

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL-015, Quality and Performance of Household Electrical Appliances, to supersede AS/NZS 2007.1:2003, *Performance of household electrical appliances—Dishwashers, Part 1: Energy consumption and performance* on publication.

The AS/NZS 2007 series comprises two Parts, as follows:

AS/NZS

| | |
|--------|---|
| 2007 | Performance of household electrical appliances—Dishwashers |
| 2007.1 | Part 1: Methods for measuring performance, energy and water consumption (this Standard) |
| 2007.2 | Part 2: Energy efficiency labelling requirements |

The Parts of AS/NZS 2007 are summarized as follows:

- (a) *Part 1* Includes performance test procedures and minimum performance criteria for dishwashers.
- (b) *Part 2* Includes algorithms for the calculation of the energy efficiency star rating and projected energy usage, performance requirements, details of the energy label and requirements for the valid application for registration for energy efficiency labelling. It also includes the application form for registration for water efficiency labelling. It has been structured to be suitable for reference in regulatory legislation and to be used in conjunction with Part 1.

The overall objective of the AS/NZS 2007 series is to promote high levels of performance, energy efficiency and water efficiency in electric dishwashers.

This Standard includes a number of requirements from the third edition of IEC 60436, published in February 2004, which will bring this Standard closer to the IEC Standard. It also incorporates the following significant changes in comparison to earlier editions of the Standard.

- (i) Test methods have generally been made more repeatable and reproducible.
- (ii) It is intended to phase out the AS/NZS test load by December 2007, until that date, the AS/NZS test load (without serving utensils and bowls) is allowed as an alternative to the IEC test load in this Standard.
- (iii) A ‘test program’ has been defined and it has been clarified that any program can be tested to this Standard, but the performance requirements in Section 4 only apply to the program recommended for a normally soiled load. The program for a normally soiled load is the program mandated for energy efficiency labelling in AS/NZS 2007.2.
- (iv) Definitions in this Standard are now generally aligned with IEC definitions.
- (v) Program time and cycle time have been added to the definitions.
- (vi) Power measurements on a number of standby modes are now required. Standby modes have been added to the definitions and examples of the types of standby modes have been added in Appendix M.

NOTE: The impact of communication by appliances over a network is under consideration.

- (vii) There are improved instructions regarding the use of the reference machine.

- (viii) A recommendation to purchase all test materials from the sources referred to at <http://www.energyrating.gov.au> has been added to minimize variations in test results. These materials will be used for check testing.

A summary of differences between this edition and the IEC 60436 Ed. 3 is included in the Foreword.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance.

CONTENTS

| | <i>Page</i> |
|--|-------------|
| SECTION 1 SCOPE AND GENERAL | |
| 1.1 SCOPE | 8 |
| 1.2 OBJECTIVE..... | 8 |
| 1.3 REFERENCED DOCUMENTS | 8 |
| 1.4 DEFINITIONS | 9 |
| 1.5 ROUNDING..... | 11 |
| SECTION 2 MEASUREMENTS TO BE PERFORMED AND REQUIREMENTS FOR TESTING | |
| 2.1 GENERAL | 12 |
| 2.2 TEST CONDITIONS, INSTRUMENTATION AND MATERIALS | 12 |
| 2.3 PREPARATION OF A DISHWASHER FOR TESTING | 12 |
| 2.4 GENERAL TEST PROCEDURES | 12 |
| 2.5 CHECK OF RATED CAPACITY | 12 |
| 2.6 PREPARATION AND SOILING OF LOADS | 12 |
| 2.7 DETERMINATION OF WASHING PERFORMANCE..... | 12 |
| 2.8 DETERMINATION OF ENERGY CONSUMPTION AND STANDBY POWER.... | 12 |
| 2.9 MEASUREMENT OF WATER CONSUMPTION | 12 |
| 2.10 DETERMINATION OF DRYING PERFORMANCE..... | 12 |
| 2.11 EVALUATION AND CALCULATION OF WASHING AND DRYING INDICES | 12 |
| 2.12 SAMPLE CALCULATIONS..... | 12 |
| 2.13 REFERENCE MACHINE SPECIFICATION..... | 13 |
| SECTION 3 USE OF REFERENCE MACHINE | |
| 3.1 GENERAL | 14 |
| 3.2 PROGRAM | 14 |
| 3.3 DETERGENT..... | 14 |
| 3.4 WATER SOFTENER | 14 |
| 3.5 TEST CONDITIONS..... | 14 |
| 3.6 USE OF REFERENCE MACHINE | 15 |
| 3.7 REFERENCE MACHINE LOG | 15 |
| 3.8 RESULTS RECORD..... | 15 |
| 3.9 CALIBRATION CHECKS | 15 |
| SECTION 4 PERFORMANCE REQUIREMENTS | |
| 4.1 GENERAL | 17 |
| 4.2 WATER PRESSURE..... | 17 |
| 4.3 RATED CAPACITY | 17 |
| 4.4 WASHING INDEX | 17 |
| 4.5 WATER CONSUMPTION..... | 17 |
| 4.6 DRYING INDEX | 17 |
| SECTION 5 REQUIREMENTS FOR ACCOMPANYING INFORMATION | |
| 5.1 GENERAL | 18 |
| 5.2 RATED CAPACITY | 18 |
| 5.3 LOADING PATTERN | 18 |
| 5.4 DETERGENT..... | 18 |
| 5.5 RINSE AGENT | 18 |
| 5.6 PROGRAM | 18 |
| 5.7 OTHER..... | 18 |

| | Page |
|--|------|
| APPENDICES | |
| A TEST CONDITIONS, INSTRUMENTATION AND MATERIALS | 20 |
| B PREPARATION OF A DISHWASHER FOR TESTING AND GENERAL TEST PROCEDURES | 33 |
| C PREPARATION AND SOILING OF LOADS | 36 |
| D DETERMINATION OF WASHING PERFORMANCE, ENERGY AND WATER CONSUMPTION AND STANDBY POWER..... | 42 |
| E DETERMINATION OF DRYING PERFORMANCE..... | 48 |
| F EVALUATION AND CALCULATION OF WASHING AND DRYING INDICES | 49 |
| G EXAMPLE CALCULATIONS OF WASHING AND DRYING INDICES AND ENERGY CONSUMPTION..... | 56 |
| H REFERENCE MACHINE DETAILS | 60 |
| I ADJUSTING WATER CONSUMPTION IN THE REFERENCE MACHINE | 62 |
| J CORRECTING FOR VARIATIONS IN ENERGY CONSUMPTION DURING A TEST SERIES | 63 |
| K DISHWASHER TEST REPORT FORMAT..... | 65 |
| L VIEWING CABINET..... | 69 |
| M EXAMPLES OF STANDBY MODES | 70 |

FOREWORD

For comparative testing, the most reliable results will be obtained from the methods of measurement given in this Standard when the measurements are conducted in the same laboratory, at one time, by the same operators. However, compliance with the performance and test requirements of this Standard should ensure that a dishwasher will give satisfactory performance in service.

For determination of the washing and drying indices, the procedure and timing in Appendices D and E is provided to ensure consistent results. For determination of washing performance in accordance with this Standard, it is essential to use a reference machine.

This Standard is broadly based on IEC 60436:1981, *Methods for measuring the performance of electric dishwashers* and more recently has drawn from work undertaken within the IEC SC59A on a revised international dishwasher test method, which was published in IEC 60436, Edition 3, February 2004. The work within IEC has drawn on both European CENELEC Standard EN 50242 and US industry Standard AHAM DW-1. Acknowledgment is made of the assistance received from all of these Standards.

IEC 60436, Edition 3 uses the Universal 65°C as the reference program, but this is used to determine a relative performance index for declaration by the manufacturer (wash and dry performance is included on the EU energy label). The reference program on the reference machine used in this Standard is Gentle 45°C which is used to set a pass/fail for wash performance, rather than a manufacturer declaration of wash performance as is the case in Europe. IEC 60436, Edition 3 also uses the reference machine to assess drying performance whereas it is not used for assessing drying performance in this Standard.

This Standard has differences from and similarities to IEC 60436, Edition 3 in a number of ways, as follows:

- (a) This Standard allows the use of an IEC load (without serving items) or the original AS/NZS load as an alternative. IEC also allow an AHAM (US) load as an alternative to the 'European' load.

NOTE: The AS/NZS load is to be phased out by December 2007.

- (b) There are slight differences in the ambient humidity requirements between AS/NZS (60%) and IEC (55% or 65% dependent on the soil drying method).
- (c) The food items used for soiling the load in this Standard are slightly different to IEC 60436, Edition 3. AS/NZS more closely resembles the soiling from IEC 60436:1981. AS/NZS still uses tomato juice while the IEC 60436, Edition 3 uses milk treated in a microwave as well as minced meat. Some soil items are slightly different (e.g. tinned spinach versus frozen spinach) and the preparation of some items and the allocation of soils to the load itself are also slightly different.
- (d) AS/NZS cold water supply temperature is 20°C while IEC is 15°C.
- (e) AS/NZS water hardness is soft (45 ppm) while IEC specify both soft (≤ 70 ppm) and hard (250 ppm) water alternatives.
- (f) AS/NZS water pressure is 320 kPa while IEC is 240 kPa.
- (g) AS/NZS reference detergent is based on the old IEC type A (phosphate based with chlorine bleach), while IEC specifies type C detergent (phosphate based with oxygen bleach and enzymes). IEC also have new rinse agent formulations (types III and IV).

NOTE: CENELEC still use detergent B and the older rinse aid formulations at the time of publication.

- (h) AS/NZS requires the manufacturer to specify the amount of detergent to be used, whereas IEC specifies a default detergent quantity where an amount is not specified by the manufacturer. AS/NZS and IEC both specify maximum detergent quantities, which may be used for testing.
- (i) In AS/NZS the reference machine water softener is de-activated while in IEC it is allowed to operate normally (noting that most IEC tests will be done with hard water and tests under AS/NZS use soft water). Most dishwashers in Australia and New Zealand do not have a water softener.
- (j) AS/NZS use the reference machine only for assessing the washing performance while IEC use it for assessing washing and drying performance.
- (k) IEC allow the use of either oven drying or air drying of the soiled load prior to washing while AS/NZS only allow air drying.
- (l) AS/NZS and IEC now specify the lighting conditions for washing and drying evaluations. The viewing cabinet previously mandatory in AS/NZS, has been moved to an informative Appendix L.
- (m) AS/NZS and IEC evaluation scoring systems are now aligned.
- (n) AS/NZS requires filter cleaning between test runs while IEC specify that filters are not cleaned between runs. IEC classify filters into 3 main categories and require a minimum of 5 tests (but could be as many as 10 tests) on each dishwasher, depending on variability and performance without filter cleaning.
- (o) AS/NZS now requires standby power measurements on a number of modes.
- (p) IEC requires that the load be pre-conditioned in a dishwasher with IEC rinse aid prior to use in a performance test. AS/NZS does not specify any particular requirements other than the load is clean prior to use.

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard**Performance of household electrical appliances—Dishwashers**

Part 1: Methods for measuring performance, energy and water consumption

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard sets out the method of determining the performance characteristics of electric **dishwashers** intended for household and similar use. This Standard does not specify safety requirements.

In particular this Standard—

- (a) states and defines the principal performance characteristics of electric **dishwashers**, which are—
 - (i) washing performance;
 - (ii) drying performance (irrespective of whether the **dishwasher** has a specific drying **operation** within the selected **program**;
 - (iii) energy and water consumption; and
 - (iv) standby power.
- (b) specifies the standard methods of measuring these characteristics; and
- (c) sets levels of acceptable performance for washing and drying performance.

1.2 OBJECTIVE

The objective of this Standard is to provide test laboratories and others interested in performance testing with test methods and performance requirements so that the performance of **dishwashers** can be measured, compared and evaluated.

1.3 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

| | |
|-------------|--|
| AS | |
| 2700 | Colour Standards for general purposes |
| 2706 | Numerical values—Rounding and interpretation of limiting values |
| AS/NZS | |
| 2007 | Performance of household electrical appliances—Dishwashers |
| 2007.2:2005 | Part 2: Energy efficiency labelling requirements |
| 6400 | Water efficient products—Rating and labelling |
| 62301 | Household electrical appliances—Measurement of standby power |
| IEC | |
| 60436 | Electric dishwashers for household use—Methods for measuring the performance |

| | |
|-------|--|
| ISO | |
| 565 | Test sieves—Metal wire cloth, perforated metal plate and electroformed sheet—Nominal sizes of openings |
| Guide | Guide to the expression of uncertainty in measurement (ISBN 92-67-10188-9) |
| BS | |
| 410 | Specification for test sieves |
| NATA | |
| | Assessment of uncertainties of measurement for calibration and testing laboratories by RR Cook (1999) (ISBN 0-909307-46-6) |

1.4 DEFINITIONS

For the purposes of this Standard the definitions below apply.

NOTE: The following defined terms have been bolded throughout this Standard.

1.4.1 Cycle

The **cycle** is the series of **operations** and other activities that occur within the **cycle time**.

1.4.2 Cycle time

Cycle time is measured from the initiation of the **program** (excluding any user programmed delay) until all activity ceases. Activity is considered to have ceased when the power consumption reverts to a steady state condition that persists indefinitely without user intervention. If there is no activity after the end of the **program**, the **cycle time** is equal to the **program time**.

NOTE: **Cycle time** includes any activity that may occur after the **program** is completed until a steady state condition is reached. This could include fans, any electronic activity or any additional mechanical activity that occurs for a limited period after any end of **program** indicator. Any cyclic event that occurs indefinitely is considered to be steady state. (Refer to Appendix M for examples.)

1.4.3 Delay start mode

Delay start mode is where the model has a user option that is used to delay the commencement of the program. (See also Paragraph D5.)

1.4.4 Dishwasher

A machine which cleans, rinses and dries dishware, glassware, cutlery, and, in some cases, cooking utensils by chemical, mechanical, thermal and/or electric means. A **dishwasher** may or may not have a specific drying **operation** at the end of the **program**.

1.4.5 End of cycle mode

End of cycle mode is the state that the appliance enters at the end of the **cycle**. During **end of cycle mode**, appliance power is in a steady state condition that persists indefinitely. This mode is applicable to all products. (See also Paragraph D4.)

NOTE: In some products this mode may be an equivalent power to **off mode** while in some products **end of cycle mode** will persist until **off mode** is initiated by the user via a power switch.

1.4.6 Off mode

Off mode is present only on those appliances which have a power or off switch which is operated via controls that are intended to be normally accessible to the user. **Off mode** is activated where the appliance remains connected to the mains electricity supply and where the power or off switch is activated to put the appliance into a state where it is not in use and no short duration **operations** are in progress. **Off mode** is a state that persists until the user activates the product via the power or on switch. (See also Paragraph D6.)

Note: In some products, some short term duration operations may be present for a period after **off mode** is initiated. An off or power switch may be present as a separate user operated control or may be integrated into another device operated by the user such as a door.

1.4.7 Operation

Each event that occurs during the **dishwasher cycle**, such as cleaning, rinsing or drying.

1.4.8 Place setting

One **place setting** consists of one each of the following items:

(a) *Crockery*

Items specified in Paragraph A12.2.1 or A12.3.

(b) *Glassware*

Items specified in Paragraph A12.2.2 or A12.3.

(c) *Cutlery*

Items specified in Paragraph A12.2.3 or A12.3.

1.4.9 Program

Series of **operations** which are pre-defined within the **dishwasher**, and which are declared as suitable for specified levels of soil and/or type of load.

1.4.10 Program time

Program time is measured from the initiation of the **program** (excluding any user programmed delay) until the end of **program** is indicated. If the end of **program** is not indicated, the **program time** is equal to the **cycle time**.

NOTE: The end of the **program** is intended to be the earliest point where the consumer would normally be able to access the load, which at this time meets all performance requirements for the program.

1.4.11 Rated capacity

The whole number of **place settings** stated by the manufacturer, which can be cleaned and dried when loaded in accordance with the manufacturer's instructions.

1.4.12 Reference machine

A **dishwasher** of specified repeatable performance against which the performance of **dishwashers** under test is compared. (Refer also to Section 3 and Appendix H).

1.4.13 Reference program

The **reference program** that **shall** be used on the **reference machine** is Gentle 45° (this is also called FEIN 45° or is shown as , depending on the version of the **reference machine**).

1.4.14 Shall

Indicates that a statement is mandatory.

1.4.15 Should

Indicates a recommendation.

1.4.16 Standby mode

Power consumption that may occur while the dishwashers is not performing its main function. The main modes specified in this Standard where standby power occurs are **off mode**, **end of cycle mode** and **delay start mode** (noting that other modes may be present in some machines).

1.4.17 Test program

The **program** to be used in the test, as specified by the client commissioning or requesting the test.

1.5 ROUNDING

Unless otherwise stated, numbers **shall** be rounded and recorded to five significant figures in accordance with AS 2706.

SECTION 2 MEASUREMENTS TO BE PERFORMED AND REQUIREMENTS FOR TESTING

2.1 GENERAL

This Section sets out the requirements for the testing of a **dishwasher** and the reporting of test results. Clauses 2.2 to 2.13 also serve as a key to the intended use of Appendices A to K.

2.2 TEST CONDITIONS, INSTRUMENTATION AND MATERIALS

All tests **shall** be carried out under the conditions specified in Appendix A, and using a test room, instrumentation and associated materials as described in Appendix A.

2.3 PREPARATION OF A DISHWASHER FOR TESTING

Prior to carrying out any test on a **dishwasher**, it **shall** be prepared as set out in Appendix B.

2.4 GENERAL TEST PROCEDURES

All tests **shall** be carried out according to the relevant procedures set out in Appendix B.

2.5 CHECK OF RATED CAPACITY

The **dishwasher shall** be loaded to the **rated capacity** and inspected for compliance with Clause 4.3.

2.6 PREPARATION AND SOILING OF LOADS

The preparation and application of soil to a test load **shall** be as specified in Appendix C.

2.7 DETERMINATION OF WASHING PERFORMANCE

The determination of washing performance **shall** be in accordance with Appendix D.

2.8 DETERMINATION OF ENERGY CONSUMPTION AND STANDBY POWER

The determination of energy consumption and standby power **shall** be in accordance with Appendix D.

2.9 MEASUREMENT OF WATER CONSUMPTION

Measurement of water consumption **shall** be in accordance with Appendix D.

2.10 DETERMINATION OF DRYING PERFORMANCE

The determination of the drying performance **shall** be in accordance with Appendix E.

2.11 EVALUATION AND CALCULATION OF WASHING AND DRYING INDICES

Washing and drying indices **shall** be determined in accordance with Appendix F.

2.12 SAMPLE CALCULATIONS

Examples of the determination of the washing and drying indices are contained in Appendix G.

2.13 REFERENCE MACHINE SPECIFICATION

The specification for the **reference machine**, including calibration parameters, is set out in Appendix H.

SECTION 3 USE OF REFERENCE MACHINE

3.1 GENERAL

The purpose of the **reference machine** is to compensate for unavoidable differences in measurement conditions both between laboratories and within a laboratory over time. Such conditions include water hardness, changes in properties of the soil (variations in the soil itself and in its preparation), ageing of the detergent, and subjective differences in assessment between evaluators.

For this reason, it is essential that the processes within the **reference machine** remain consistent and that the **reference machine** be subjected to the same conditions as those experienced by any **dishwasher** under test to which it will be compared.

It is critical that the load for the **reference machine** and the **dishwasher** under test be soiled at the same time using the same soils and that they be run in parallel. It is possible to run more than one test **dishwasher** in parallel with a **reference machine**. While it is possible for several people to prepare different parts of the soil in parallel, it is critical that one person is responsible for each process for all loads (e.g. one person can prepare the soil and another person can apply the soil, as long as only one person undertakes each part of the process for all relevant **dishwashers**).

The **reference machine** is an integral instrument in the test for wash performance as it is used as an absolute reference; therefore it is vital that it be performing to specification. The **reference machine** design and performance **shall** be as specified in Appendix H.

3.2 PROGRAM

The **program** to be used on the **reference machine shall** be the **reference program**.

3.3 DETERGENT

The detergent dose used in the **reference machine** for the **reference program shall** be 5 g in the pre-wash (placed on the door) and 20 g in the main wash (placed in the detergent dispenser).

3.4 WATER SOFTENER

The **reference machine** has a water softener, which normally uses salt (sodium chloride granules) as a catalyst while softening the water. Under this Standard, all salt is to be removed from the **reference machine** and it **should** be run until none is remaining. This will mean that the 'low salt' light will remain illuminated on the **reference machine**.

3.5 TEST CONDITIONS

For each test run, the test conditions, **dishwasher** preparation and general test procedures for the **reference machine shall** be the same as for the **dishwasher(s)** under test as set out in Appendices A and B, except that the electricity supply **shall** be 230 V $\pm 2\%$ and 50 Hz $\pm 1\%$ for the **reference machine** in all cases. The load for the **reference machine** is always 12 **place settings** irrespective of the number of **place settings** of the **dishwasher (s)** under test and the **reference machine** is always installed as a free standing machine independent of the type of **dishwasher(s)** under test (for example, built-in type). The load in the reference machine shall be laid out as illustrated in Figure 3.1 for every run.

3.6 USE OF REFERENCE MACHINE

The **reference machine shall** be tested in accordance with this Standard concurrently with any **dishwasher(s)** tested for washing performance. (Paragraph B12 sets out the procedures to be observed in relation to the **reference machine**.)

NOTE: It is not required to run the **reference machine** to determine the energy consumption or drying performance of a **dishwasher** under test. However, it is necessary to conduct an energy consumption test that is used for declaration purposes in conjunction with a washing performance test.

3.7 REFERENCE MACHINE LOG

A log **shall** be kept for each **reference machine** and all calibration checks (with the relevant results) plus any changes or repairs to the **reference machine shall** be recorded.

3.8 RESULTS RECORD

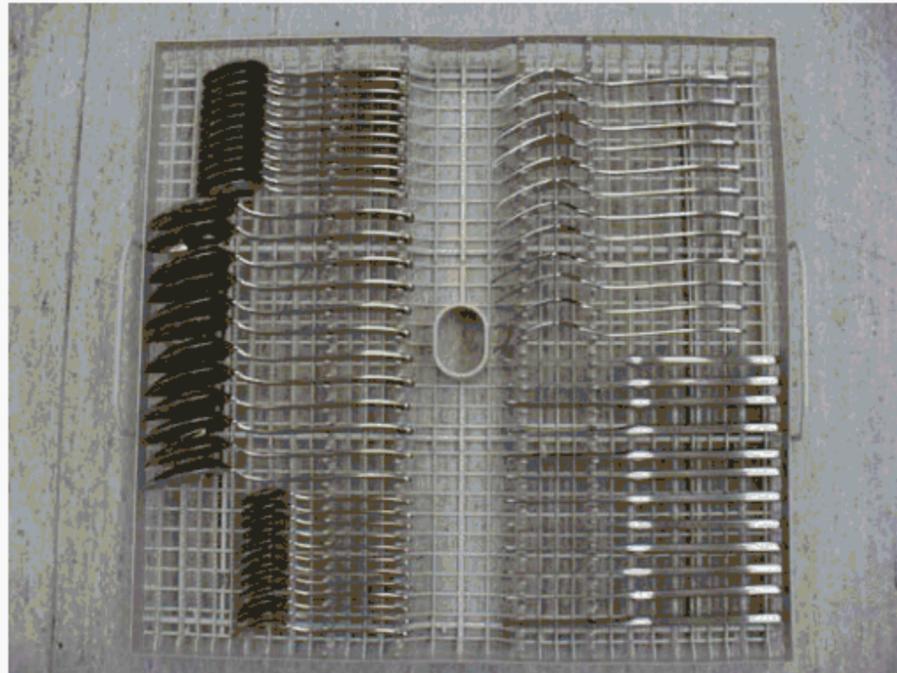
A record **shall** be kept of the wash index test result for every test run performed on the **reference machine**. This record may be associated with the **reference machine** log but **shall** be separable.

3.9 CALIBRATION CHECKS

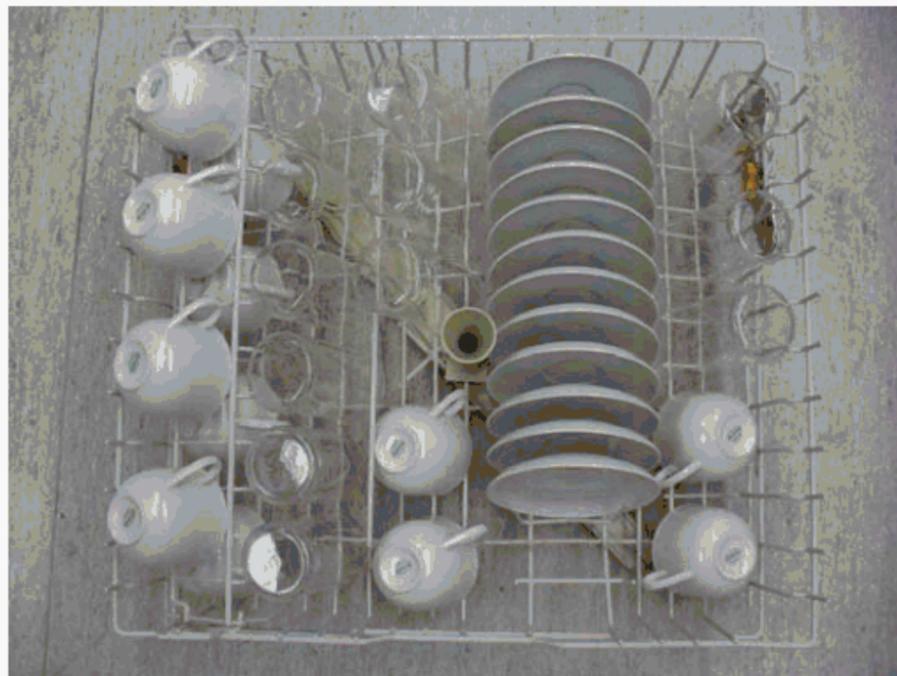
The calibration procedure and actions required when the **reference machine** is determined to be out of calibration **shall** be in accordance with Paragraph H2.

Calibration checks **should** be conducted at intervals, which will maintain confidence in the performance of the **reference machine**. As a guide, calibration checks **should** be conducted at the beginning of each series of tests and after approximately every 10 tests within a test series.

A check of the calibration **shall** also be carried out if the **reference machine** yields a result that is contrary to expectation or if it is observed or otherwise suspected of operating with one or more parameters outside specified limits in Appendix H.



Cutlery tray



Upper basket



Lower basket

FIGURE 3.1 EXAMPLES OF REFERENCE MACHINE LOADING PLAN

SECTION 4 PERFORMANCE REQUIREMENTS

4.1 GENERAL

When tested on the **program** including all associated settings recommended for a normally soiled load equal to the **rated capacity** in the product literature (i.e. operating manual or user instructions), a **dishwasher shall** comply with Clauses 4.3 to 4.6.

NOTE: Requirements regarding energy consumption are given in AS/NZS 2007.2:2005.

4.2 WATER PRESSURE

The test **dishwasher shall** be capable of operating at the maximum and minimum of the water pressure range stated by the manufacturer.

4.3 RATED CAPACITY

When loaded to the **rated capacity** in accordance with the manufacturer's instructions and loading diagram (refer to Clause 5.3 and Figure 5.1), the load items **shall** be supported so that in the case of plates, bowls and saucers, each item has a separate position such that support to the item is provided at a minimum of three points and there is no need for it to rest on any other item or items.

4.4 WASHING INDEX

When tested in accordance with Appendix D at its **rated capacity** with the loading pattern specified in Clause 5.3, the washing index of a **dishwasher shall** be not less than 0.9.

4.5 WATER CONSUMPTION

The claimed water consumption **shall** not be less than the average water consumption of representative **dishwashers** when each is tested in accordance with Appendix D at its **rated capacity** with the loading pattern specified in Clause 5.3. During a verification test, the measured water consumption of a **dishwasher shall** not exceed 110% of the value claimed by the manufacturer for the relevant **program** and settings.

Some **dishwashers** may contain a water softener. Where regeneration of the water softener depends on frequency of use and water hardness, it may only take place from time to time (i.e. not during every **cycle**). Where regeneration does not occur in every **cycle**, any energy, water and time associated with regeneration **shall** be disregarded when verifying the claimed water consumption.

NOTE: In some **dishwashers** the frequency of regenerations is not predictable and depends on the adjustment of the softener and the hardness of the water used.

4.6 DRYING INDEX

When tested in accordance with Appendix E at its **rated capacity** with the loading pattern specified in Clause 5.3, the drying performance index of a **dishwasher shall** be not less than 0.5 (50%).

SECTION 5 REQUIREMENTS FOR ACCOMPANYING INFORMATION

5.1 GENERAL

The information set out in Clauses 5.2 to 5.7 **shall** be marked on the **dishwasher** or stated in the accompanying product literature (i.e. operating manual or user instructions).

5.2 RATED CAPACITY

The supplier **shall** state the **rated capacity** of the **dishwasher** applicable to a normally soiled load.

5.3 LOADING PATTERN

The supplier **shall** provide instructions on the correct method for loading a test load that complies with Appendix A and is equal to the **rated capacity** of the **dishwasher**. This **shall** include one or more photographs or line drawings that clearly illustrate the required loading. Figure 5.1 is an example of an acceptable drawing.

5.4 DETERGENT

The supplier **shall** provide instructions on the amount of detergent to be used to wash a normally soiled load equal to the **rated capacity**, including any separate amount for pre-wash and main wash, but the total amount **shall** not exceed 15 g + 1.25 g per **place setting** when testing for compliance with this Standard. The supplier **should** also recommend detergent amounts for all **programs** where detergent is required. (Refer also Paragraph B7)

5.5 RINSE AGENT

The supplier **shall** provide instructions regarding rinse aid dispenser settings to ensure that the required amount of rinse agent is dispensed when performing a test, which complies with this Standard in accordance with Appendix D.

5.6 PROGRAM

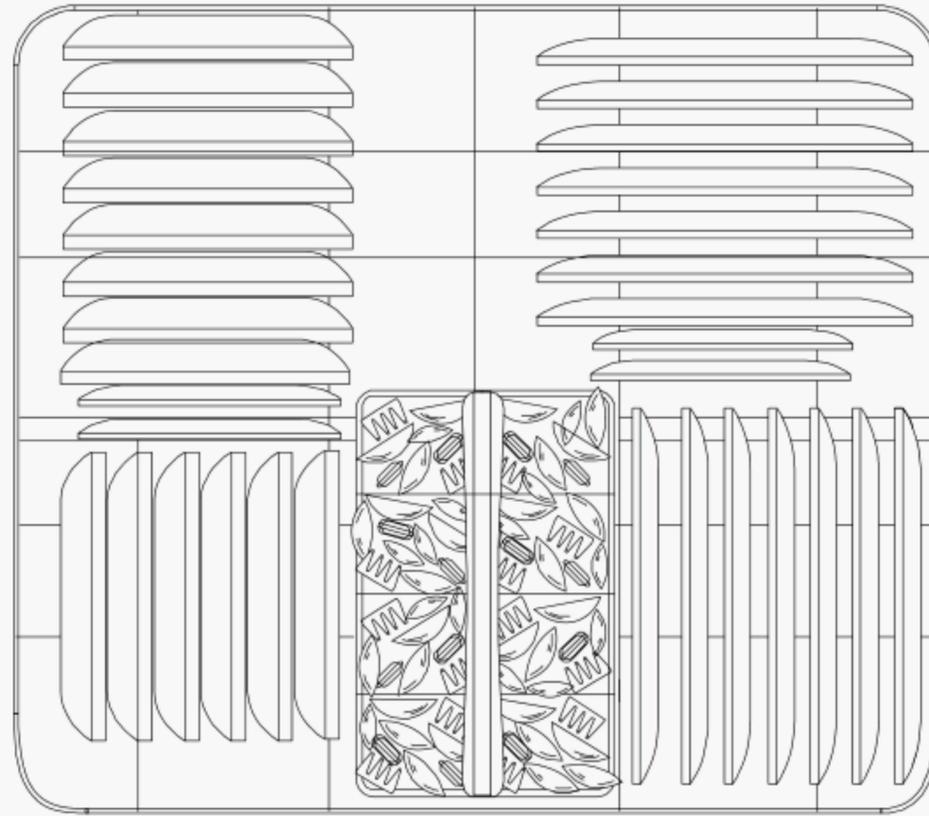
The supplier **shall** state the **program**, including all associated specific settings, that **shall** be used to wash a normally soiled load equal to the **rated capacity** in accordance with this Standard.

Where opening of the door is required at the completion of the **program** for a drying performance test, the position of the door **shall** be specified in the product literature (i.e. operating manual or user instructions).

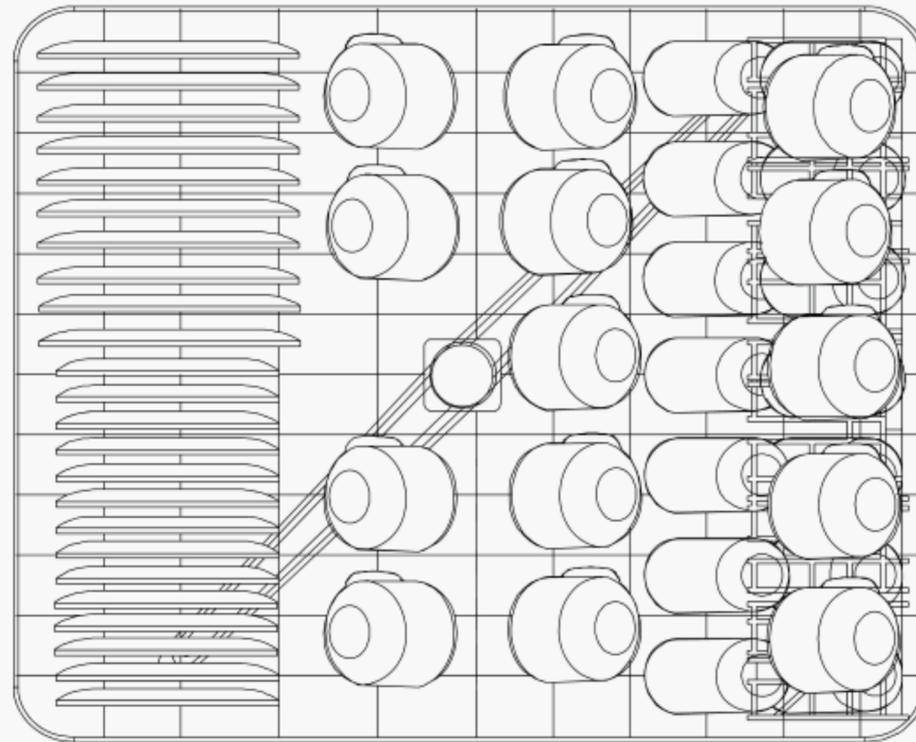
5.7 OTHER

The supplier shall also state—

- (a) installation instructions; and
- (b) minimum and maximum water pressure requirements if applicable.



(a) Lower basket



(b) Upper basket



(c) Cutlery basket

FIGURE 5.1 EXAMPLE OF ACCEPTABLE LOADING DIAGRAM

APPENDIX A
TEST CONDITIONS, INSTRUMENTATION AND MATERIALS
(Normative)

A1 GENERAL

This Appendix specifies the test conditions, instrumentation accuracies, and associated materials required to carry out tests for the determination of the performance of a **dishwasher** in accordance with Appendices B to F.

NOTE: The ISO 'Guide to the Expression of Uncertainty in Measurement' and the NATA book 'Assessment of Uncertainties of Measurement for calibration and testing laboratories' by RR Cook (1999) can provide further details on assessment of uncertainty specified in this Standard.

A2 ACCURACY AND PRECISION OF MEASUREMENTS

The tolerances specified for parameters within this Standard, using the symbol \pm , indicate the allowable limits of variation from the specified parameter outside which the test or results **shall** be invalid. In each case the tolerance has been chosen to allow for factors such as drift of ambient conditions, instrument error, reading error, uncertainty of instrument calibration and other influences.

The statement of tolerance does not permit the deliberate variations of these specified parameters.

While it is required that test parameters remain within the stated tolerance, transient effects do not necessarily render a test invalid.

A3 AMBIENT CONDITIONS

The ambient conditions of the room in which the performance is measured **shall** be maintained throughout all elements of the test process, including soiling, at the following levels:

- (a) Temperature $20^{\circ}\text{C} \pm 2 \text{ K}$.
- (b) Relative humidity $60 \pm 5\%$.

A4 WATER SUPPLY

The water supplied to the **dishwasher** under test **shall** be maintained at the following levels at the **dishwasher** inlet:

- (a) Cold water temperature $20^{\circ}\text{C} \pm 2 \text{ K}$.
- (b) Hot water temperature $60^{\circ}\text{C} \pm 2 \text{ K}$.
- (c) Gauge pressure during water intake (hot and cold) $320 \pm 20 \text{ kPa}$.

If the manufacturer's stated acceptable pressure range does not include 320 kPa, the **dishwasher shall** be tested at the pressure within that range that is nearest to 320 kPa.

A5 WATER HARDNESS

Mains water **shall** be used and its total hardness (CaCO_3 equivalent) **shall** be adjusted (if necessary) to 45 ± 5 ppm by mass, at a temperature of $20^{\circ}\text{C} \pm 2 \text{ K}$.

NOTES:

- 1 For water hardness less than 40 ppm, calcium sulphate and calcium chloride are suitable additives to achieve the specified hardness.
- 2 A total water hardness of ≤ 70 ppm is under consideration.

A6 ELECTRICITY SUPPLY

The electricity supply to the **dishwasher** point of connection during all tests **shall** be maintained within the following limits:

(a) Voltage 230 V $\pm 2\%$.

dishwashers rated for 240 V only **shall** be tested at 240 V $\pm 2\%$.

(b) Frequency 50 Hz $\pm 1\%$ in all cases.

Where the supply is provided from sources other than mains supply in Australia or New Zealand, then the source of the electricity supply **shall** be noted in the test report.

A7 MEASUREMENT ACCURACIES AND INSTRUMENTS

A7.1 Mass

Measurements of mass **shall** be made using instruments having an overall uncertainty of measurement of 2% at the 95% confidence level and a resolution of ± 0.1 g or better. All masses **shall** be recorded to the nearest 0.1 g or better.

A7.2 Temperature

Measurements of both wet and dry bulb temperatures **shall** be made using devices with a resolution of not more than 0.1°C and an overall uncertainty of measurement of better than ± 0.6 K at the 95% confidence level. Temperature measurements **shall** be recorded to the nearest 0.1°C or better.

A7.3 Electrical energy consumption

Measurements of energy consumption to this Standard **shall** be made with an instrument with a resolution of not more than 1 watt-hour and with an overall uncertainty of measurement of better than 2% at the 95% confidence level. Energy measurements **shall** be recorded to the nearest 1 watt-hour or better.

Measurements of **standby power** **shall** be made with instruments in accordance with AS/NZS 62301.

A7.4 Length

Measurements of length **shall** be made using instruments having an accuracy and resolution of ± 1.0 mm or better. All lengths **shall** be recorded to the nearest 1 mm.

A7.5 Time

Measurements of the time shall be made using instruments having a resolution of 1s or better and with an overall uncertainty of measurement of better than 1% at the 95% confidence level. Time measurement shall be recorded to the nearest 1s or better.

A7.6 Water consumption

Water consumption **shall** be measured with instruments with a resolution of 0.1 L or better and an overall uncertainty of measurement of better than 2% at the 95% confidence level. Water consumption measurements **shall** be recorded to the nearest 0.1 L or better.

A8 DETERGENT*

A8.1 AS/NZS detergent†

The standard reference detergent **shall** consist of the following:

| <i>Ingredients</i> | <i>Parts by mass</i> |
|---|----------------------|
| Penta-sodiumtriphosphate (Tripoly) Thermphos NW | 50.00 |
| Sodium metasilicate KO (anhydrous) | 40.00 |
| Sodium sulphate (anhydrous) | 5.75 |
| Sodium dichloroisocyanurate-dihydrate CDB 56C | 2.25 |
| Plurafac RA43 | 2.00 |

The detergent **shall** be supplied in resealable containers of 200 g to 500 g capacity. These **should** be stored in a cool, dry location and **should** be used within three months of the date of manufacture.

Each container shall be marked with the date of manufacture, the chemical composition of the detergent and a statement of compliance with the requirements of this Standard.

A8.2 IEC detergent C (For information only)

The detergent specified in Table A1 is that containing phosphate but no chlorine bleach specified as detergent C in the revised Edition 3 of IEC 60436. This detergent is under consideration for future adoption in this Standard. ‡

* To minimize variations in test results, it is recommended that the detergent and rinse agent used for evaluation machines under test, be obtained from the sources referred to at www.energyrating.gov.au website. For the purpose of check testing appliances the detergent and rinse agent will be obtained from those sources.

† This is the formula specified in IEC 60436:1981, not that of the 1994 Amendment to that document.

‡ In accordance with the policy of adopting IEC/ISO Standards where practical, it is proposed to replace the current AS/NZS detergent and rinse agent with the IEC detergent type C and IEC rinse agent formula IV respectively, by a date yet to be determined.

TABLE A1
CHEMICAL COMPOSITION OF DETERGENT

| Chemical substance | Trade name/supplier | Wt. % |
|---|--|---------------|
| Sodium tripolyphosphate | Thermphos NW / Clariant | 23.0 |
| Tri-sodium citrate dihydrate | N 1560 / Jungbunzlauer | 22.3 |
| Sodium perborate monohydrate | — | 6.0 |
| Tetraacetyl ethylenediamine | TAED / Warwich | 2.0 |
| Sodium disilicate (noncrystalline) | Portil A / Cognis | 5.0 |
| Linear fatty alcohol ethoxylate | Plurafac LF403 /BASF (Nonionic surfactant, low foaming) | 2.0 |
| Maleic acid/acrylic acid copolymer Na salt | Alternative 1: Sokalan CP 5 compound/Henkel 50% active on sodium carbonate | 4.0 |
| | Alternative 2: Norasol WL 4 / Norsohaas 30% active on sodium carbonate | 6.7 |
| Protease | Savinase X.OT / NOVO e.g. Savinase 8.0T: 1.0% | 80 KNPU/Kg X* |
| Amylase | Termamyl xxT / NOVO e.g. Termamyl 60T : 0.7% | 420 KNU/Kg X* |
| Sodium carbonate | Soda, leicht / Mathes and Weber | Add to 100 |

A9 RINSE AGENT[†]

A9.1 AS/NZS rinse agent[‡]

The standard reference rinse agent **shall** consist of the following:

| <i>Ingredients</i> | <i>Parts by volume</i> |
|--|------------------------|
| Low-foaming non-ionic wetting agent (Teric 164 or Triton DF12) | 60 |
| Isopropanol | 20 |
| Water | 20 |

A9.2 IEC rinse agent formula IV (Neutral) (For information only)

The rinse agent specified below is the neutral rinse agent formula IV specified in the revised Edition 3 of IEC 60436. This rinse agent is under consideration for future adoption in this Standard[§]:

| <i>Ingredients</i> | <i>Parts by volume</i> |
|--|------------------------|
| Linear fatty alcohol ethoxylate (Plurafac LF 221/BASF)..... | 15.0 |
| Cumene sulfonate (Stepanate SCS/Stepan, 40% solution in water) | 11.5 |

* X = Activity units

[†] To minimize variations in test results, it is recommended that the detergent and rinse agent used for evaluation machines under test, be obtained from the sources referred to at www.energyrating.gov.au website. For the purpose of check testing appliances the detergent and rinse agent will be obtained from those sources.

[‡] This is the neutral rinse agent specified in IEC 60436:1981 edition.

[§] In accordance with the policy of adopting IEC/ISO Standards where practical, it is proposed to replace the current AS/NZS detergent and rinse agent with the IEC detergent type C and IEC rinse agent formula IV respectively, by a date yet to be determined.

| | |
|-----------------------|------|
| Deionized water..... | 73.5 |
| Viscosity (mPa)..... | 11 |
| pH (1% in water)..... | 6.3 |

A10 SOILING AGENTS

Soiling agents **shall** be used within their use-by date and **shall** consist of the following—

- (a) *Tomato juice* The tomato juice **shall** be of such consistency that 1 g to 3 g of residue remains after the entire inner surface of a glass is wetted and then allowed to drain for 45 s.

Products that might prove suitable include specific ranges produced by both Berri and Heinz and labelled as being without sugar.

- (b) *Egg yolks* Standard top-grade hens' eggs at least 1 week old, weighing 50 to 65 g each, **shall** be used.

- (c) *Tea* Tea complying with the following **shall** be used:

Tea quality—Ceylon

Leaf quality—orange pekoe

Leaf size—broken

Products that might prove suitable include Lipton Royal Ceylon tea, Twinings Ceylon Orange Pekoe tea and Lyons Red Label tea (USA).

- (d) *Reconstituted fortified skim milk* Dried skim milk complying approximately with the following analysis **shall** be used:

| <i>Ingredients</i> | <i>Percent</i> |
|-----------------------|----------------|
| Fat..... maximum..... | 1.5 |
| Protein..... | 36 |
| Lactose..... | 51 |
| Minerals | 8 |
| Water | 4 |

Products that might prove suitable include Diploma instant skim milk powder.

- (e) *Infant cereal* The particular product used **shall** be chosen to approximately comply with the following analysis:

| <i>Ingredients</i> | <i>Percent</i> |
|-----------------------------|----------------|
| Fat..... | 1.6 |
| Protein..... | 13.3 |
| Carbohydrate | |
| Total | 79.2 |
| Sugars | 1.6 |
| Dietary fibre | 3.3 |
| Vitamins and minerals | 1.0 |

Products that might prove suitable include Farex original mixed cereal 6+ months.

- (f) *Spinach* Tinned (not frozen) chopped leaf or pureed spinach **shall** be used*.
- (g) *Margarine* Household margarine with a total fat content of 65% to 85% containing: saturated fat (15% to 43%), polyunsaturated (15% to 43%) and monounsaturated (23% to 43%).

Products that might prove suitable include Meadow Lee canola spread, Olive Grove spread and Golden canola spread.

NOTE: Use of IEC soiling agents is under consideration.

A11 BRUSH TO BE USED WITH INFANT CEREAL

The brush to be used to apply the infant cereal to the soup spoons **shall** be an artist's style, fan-shaped brush, with medium stiff bristles of length 25 ± 5 mm. The bristle fan **shall** be 3 ± 1 mm thick and 25 ± 5 mm at the widest point.

A12 TEST LOAD ITEMS

A12.1 General

All test loads **shall** consist of items from only one load type in accordance with either—

- (a) Paragraph A12.2 (AS/NZS load)[†]; or
- (b) Paragraph A12.3 (IEC European, non-AHAM, load).

The same load type **shall** be used in the **reference machine** and the **dishwasher(s) under test**.

A12.2 AS/NZS load

A12.2.1 Crockery

A12.2.1.1 Specification

The crockery **shall** be white, undecorated, glazed vitrified china of average thickness but not fine bone china. It **shall** be free from cracks or other damage and the glaze **shall** be in good condition. The dimensions **shall** comply with those shown in Figure A1. Table A2 lists examples of acceptable brands.

A12.2.1.2 Items required[‡]

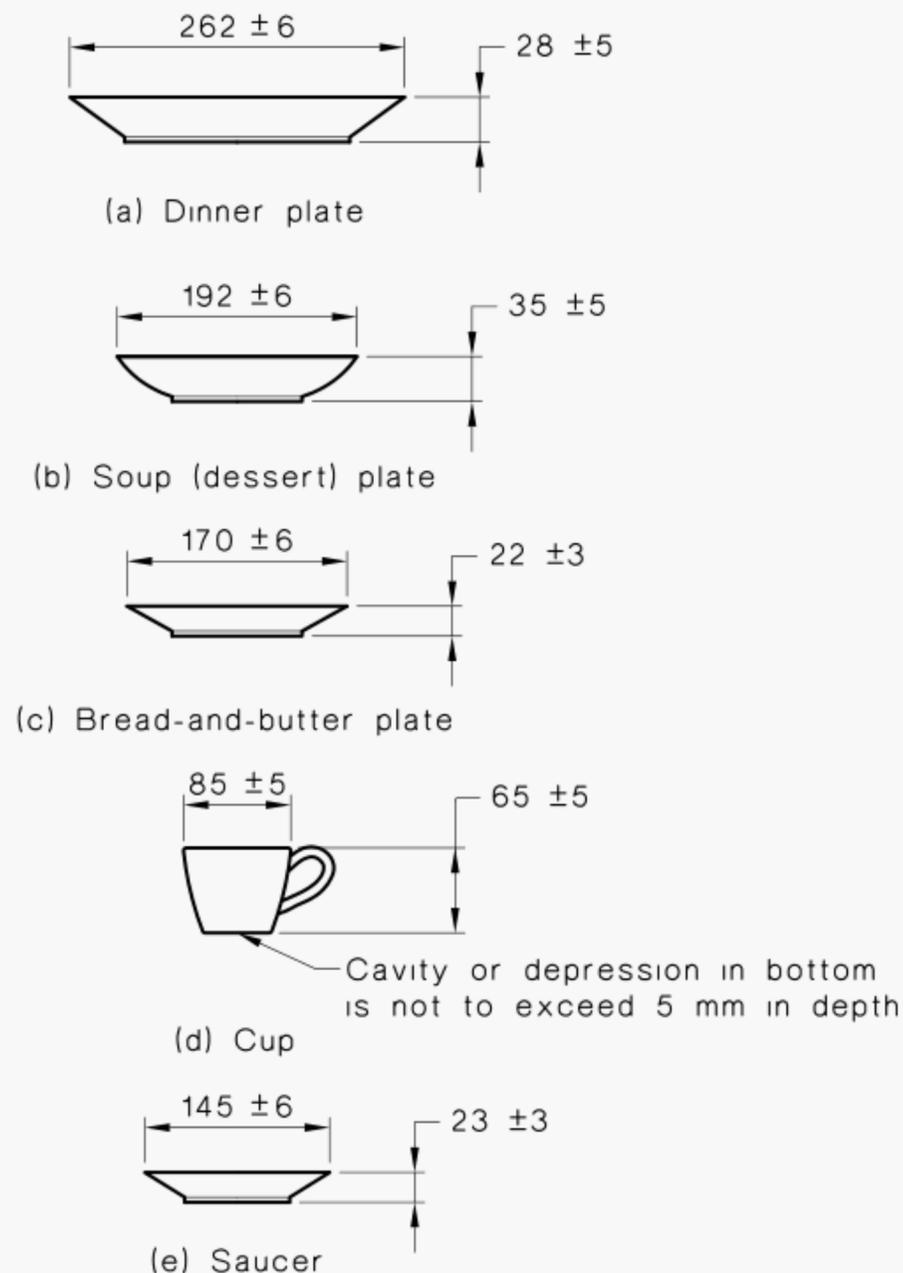
The crockery for one **place setting shall** comprise one each of the following items:

- (a) Dinner plate.
- (b) Soup (dessert) plate.
- (c) Bread-and-butter plate.
- (d) Cup.
- (e) Saucer.

* To minimize variations in test results, it is recommended that the spinach used for evaluating machines under test, be obtained from the source referred to at <http://www.energyrating.gov.au> website. For the purpose of check testing appliances the spinach will be obtained from that source.

[†] It is intended to phase out the AS/NZS test load by December 2007.

[‡] Unlike IEC 60436, no serving utensils or platters are used in the AS/NZS test load.



NOTE: Although the dimensions shown in this Figure are mandatory, the design of each crockery item shown is representative only.

DIMENSIONS IN MILLIMETRES

FIGURE A1 REQUIRED DIMENSIONS OF CROCKERY ITEMS

TABLE A2

ACCEPTABLE BRANDS OF CROCKERY AND CUTLERY

| Item | Brand | Pattern/Style |
|---------------------------|-------------|-------------------------------|
| Cutlery | Paul Wirth | New Look |
| Crockery (excluding cups) | Westminster | Plain white china—coupe style |
| Cups | Westminster | Stackable tea cup |
| Glasses | Duralex | Chopes Unies |

'Paul Wirth', 'Westminster' and 'Duralex' are trademarks. This information is provided for the convenience of users of this Standard and does not constitute an endorsement by the publisher of these trademarks. Items of similar specification may be used if they can be shown to lead to equivalent results.

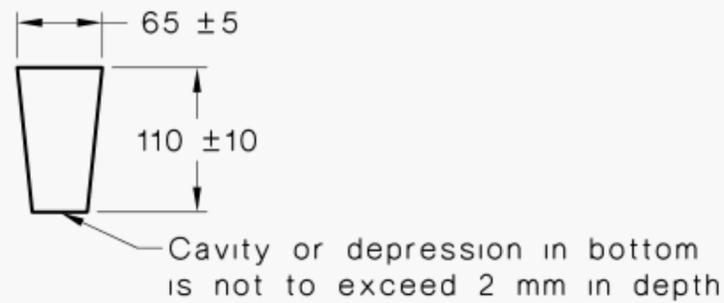
A12.2.2 Glassware

A12.2.2.1 Specification

The glassware **shall** be plain, clear, tapered, straight-sided, undecorated and with unground surfaces. The dimensions **shall** comply with those shown in Figure A2. (Refer to Table A2 for examples of acceptable brands.)

A12.2.2.2 Items required

The glassware required for one **place setting shall** comprise one glass only.



NOTE: Although the dimensions shown in this Figure are mandatory, the design of the glass shown is representative only.

DIMENSIONS IN MILLIMETRES

FIGURE A2 REQUIRED DIMENSIONS OF GLASSWARE

A12.2.3 Cutlery

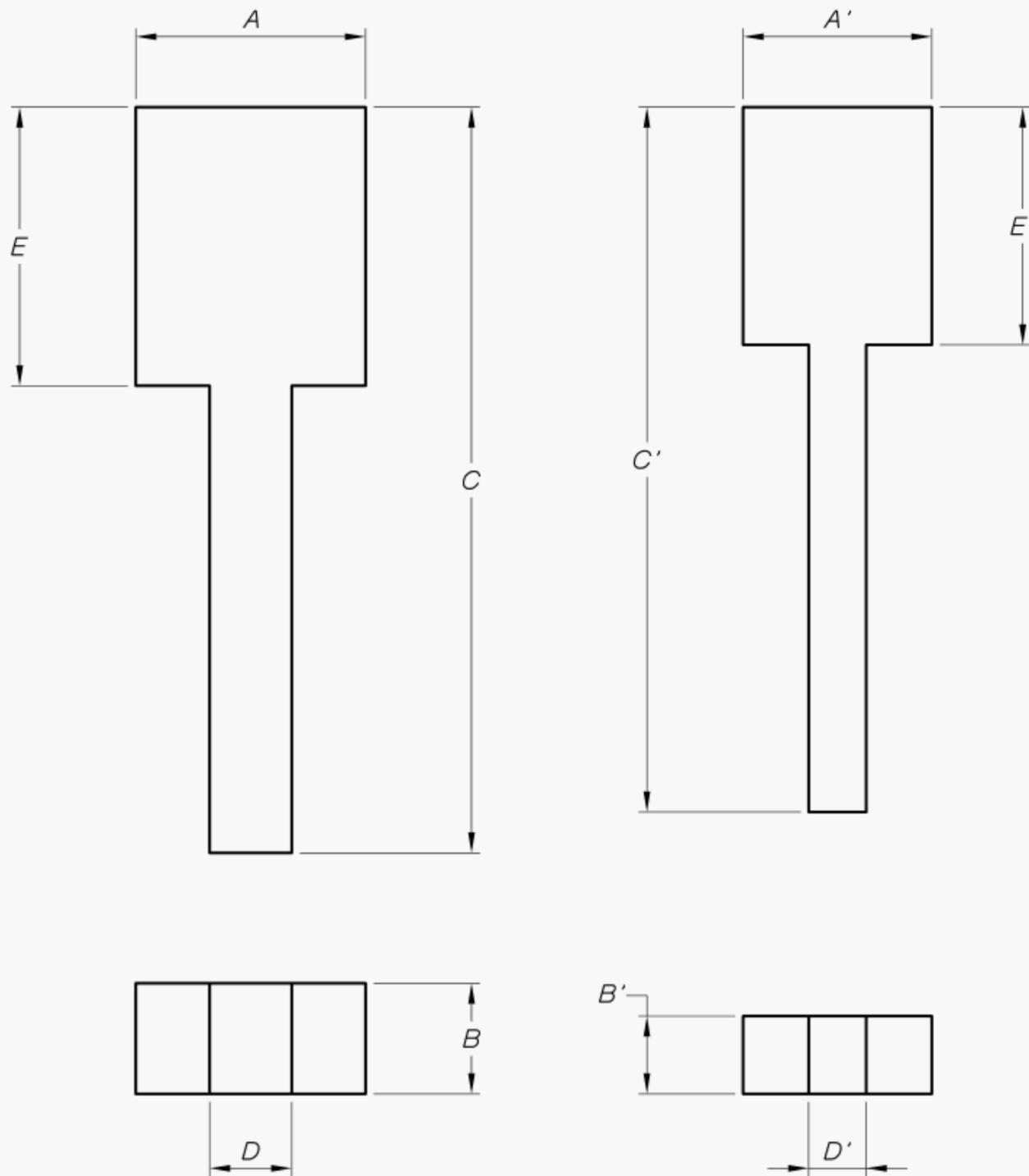
A12.2.3.1 Specification

The cutlery **shall** be as follows:

- (a) Cutlery **shall** be made of 18/10 stainless steel having plain surfaces and no decorative engraving.
- (b) Forks **shall** not have sharp edges.
- (c) The tines of the forks, bowls of the spoons and blades of the knives **shall** be polished (refer Paragraph C1.2), and the handles **shall** have a 'satin' finish (scratch brush).
- (d) Each item **shall** fit completely within the relevant acceptance cavity shown in Figure A3.
- (e) It **shall** be possible to position each item over the relevant rejection cavity shown in Figure A3 so that it at least partially covers every line.

For appropriate gauge dimensions see Figure A3.

Refer to Table A2 for examples of acceptable brands.



(a) Acceptance cavity

(b) Rejection cavity

| Item | A | A' | B | B' | C | C' | D | D' | E | E' |
|---------------|----|----|----|----|-----|-----|----|----|-----|----|
| Fork | 28 | 23 | 22 | 15 | 220 | 185 | 18 | 15 | 80 | 55 |
| Teaspoon | 30 | 25 | 18 | 12 | 145 | 135 | 15 | 8 | 50 | 40 |
| Dessert spoon | 40 | 35 | 25 | 15 | 195 | 165 | 15 | 10 | 65 | 55 |
| Soup spoon | 50 | 40 | 30 | 16 | 190 | 158 | 15 | 10 | 60 | 35 |
| Knife | 3 | 1 | 20 | 15 | 230 | 200 | 11 | 5 | 110 | 95 |

Note: For the knife, *A* is the thickness of the blade and *D* is the thickness of the handle.

DIMENSIONS IN MILLIMETRES

FIGURE A3 ACCEPTABLE DIMENSIONS OF CUTLERY ITEMS

A12.2.3.2 *Items required*

The cutlery required for one **place setting shall** comprise one each of the following items:

- (a) Fork.
- (b) Teaspoon.
- (c) Dessertspoon.

- (d) Soupspoon.
 (e) Knife.

A12.3 IEC load (non-AHAM)*

A12.3.1 Specification

All pieces **shall** be free from cracks or other damage. The glaze of the china **shall** be in good condition. The glasses **shall** be clear and free from cloudiness. Forks **shall** not have sharp edges. The prongs of forks, bowls of spoons, and blades of the knives **shall** be polished (refer Paragraph C1.2), and the handles **shall** have a 'satin' finish.

A12.3.2 Items required

One **place setting shall** comprise one each of the following items as listed in Table A3.

TABLE A3
PLACE SETTING

| No. | Item description | Diameter/volume/ length | Shape/ style | Name | Colour |
|-----|-----------------------|----------------------------|----------------------------------|--------------|--------|
| 1 | Crockery—Dinner plate | 26 cm | Arzberg 8500 | City | White |
| 2 | Crockery—Soup plate | 23 cm | Arzberg 1382 | 1382 | White |
| 3 | Crockery—Dessert dish | 19 cm | Arzberg 8500 | City | White |
| 4 | Crockery—Cup | 0.21 L | Arzberg 1382 | 1382 | White |
| 5 | Crockery—Saucer | 14 cm | Arzberg 1382 | 1382 | White |
| 6 | Glassware—Glass | 250 ml 60 mm | Beaker/Tall Form/Without rain | Schott Duran | |
| 7 | Cutlery—Fork | 184 mm | WMF 'Berlin' | | |
| 8 | Cutlery—Soup spoon | 195 mm | WMF 'Berlin' | | |
| 9 | Cutlery—Knife | 203 mm | WMF 'Berlin' | | |
| 10 | Cutlery—Teaspoon | 126 mm | WMF 'Berlin' | | |
| 11 | Cutlery—Dessert spoon | 156 mm | WMF 'Berlin' | | |

The mass of one **place setting shall** be—

Crockery + glass: 1580 g ±35 g;
 Cutlery: 195 g ±10 g.

NOTE: 'Arzberg', 'Schott' and 'WMF' are trademarks. This information is provided for the convenience of users of this Standard and does not constitute an endorsement by the publisher of this trademark. Items of similar specification may be used if they can be shown to lead to equivalent results.

* To minimize variations in test results, it is recommended that the items from the IEC test load used for evaluating machines under test, be obtained from the source referred to at www.energyrating.gov.au website. For the purpose of check testing appliances the IEC load items will be obtained from that source. IEC serving pieces are not included in this load and their use is under consideration.

A13 SIEVES

The sieve to be used in the preparation of the spinach **shall** be a 200 mm diameter, stainless steel, full depth wire mesh (i.e. 'metal wire cloth') laboratory sieve of aperture size 2.00 mm, complying with ISO 565 or with BS 410.

The sieve to be used in the preparation of the egg yolk **shall** be stainless steel, dished, of aperture size 1.0 to 2.0 mm.

A14 BLOCK INSERT

The block to be inserted into the door opening following a washing performance test **shall** be of moisture resistant construction, have at least two flat parallel faces 50 ± 2 mm apart, be not wider than 150 mm, and **shall** be of appropriate weight and length such that it can hold the door ajar when inserted in accordance with Paragraph D4(g).

Suitable objects may include nominal 100 mm × 50 mm rectangular guttering products or a lightweight 50 mm × 50 mm × 200 mm painted wooden block.

A15 WHITE COTTON GLOVES

Bleached, brushed drill cotton gloves may be used for handling load items during the evaluation of washing and drying performance (refer Paragraph F2.1).

A16 BUILT-IN DISHWASHER TEST ENCLOSURE

A16.1 General

Where the manufacturer's instructions require that a **dishwasher** be installed under a bench or in a similarly enclosed position for correct operation, then all tests **shall** be carried out with the **dishwasher** installed in an enclosure complying with Paragraphs A16.2 to A16.4.

A16.2 Materials

The enclosure **shall** be constructed either of 22 mm \pm 5 mm thick water resistant grade particleboard or medium density fibreboard, neither painted nor veneered, or with untreated plywood. The material **shall** have a density between 600 kg/m³ and 700 kg/m³.

A16.3 Dimensions

The minimum internal dimensions of the test enclosure **shall** comply with the manufacturer's instructions where so documented.

If the dimensions are not provided, the inner dimensions of the test enclosure **shall** be as follows:

- (a) The inner depth **shall** exceed the outer depth of the **dishwasher** by not less than 100 mm.
- (b) The inner width **shall** exceed the outer width of the **dishwasher** by not more than 20 mm.
- (c) The inner height of the test enclosure **shall** exceed the outer height of the **dishwasher** by not more than 10 mm.

In the rear corner of the left or the right side wall of the test enclosure, an opening of height 100 mm and of width 75 mm **shall** be provided for water supply, drainage, pipe work, and electric supply cord. This opening **shall** not be sealed after installation of the **dishwasher**.

A16.4 Construction

The enclosure **shall** consist of a top, back and sides as illustrated in Figure A4.

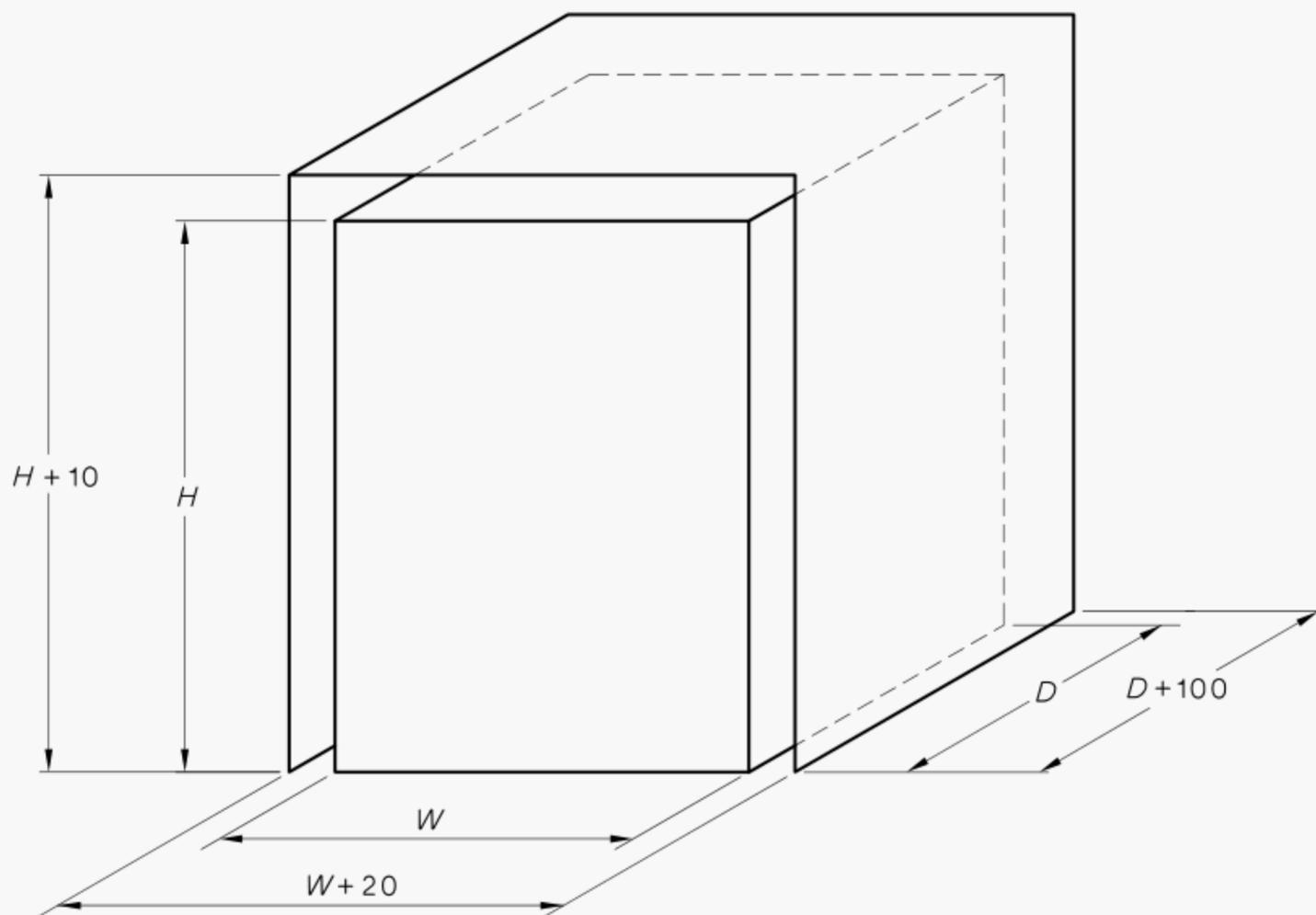
All joints, including that between the sides and the floor that the enclosure is placed on, **shall** be close-fitting, with gaps a maximum of 1 mm wide. To achieve this condition, any appropriate fasteners such as screws, nails, clamps or adhesives may be used.

The enclosure **shall** be weighed down with one or more masses, totalling a minimum 12 kg, placed on top of the enclosure and located in such a way that approximately equal force is applied to the sides and back, and the top undergoes a maximum 5 mm deflection.

Where specified, the test enclosure **shall** be provided with ventilating openings in accordance with manufacturer's instructions.

The **dishwasher shall** be built in or placed in the test enclosure in accordance with manufacturer's instructions.

Solid or resilient material provided for closing the gap between the contours of the **dishwasher** and the cabinet may be used where supplied with the **dishwasher**. Where such materials are not provided, the gaps between the test enclosure and the **dishwasher shall** be left open.



NOTE: The dimensions $H + 10$, $W + 20$, $D + 100$ are the inside dimensions of the enclosure.

DIMENSIONS IN MILLIMETRES

FIGURE A4 TEST ENCLOSURE FOR BUILT-IN-TYPE APPLIANCES

A17 LIGHTING CONDITIONS FOR LOAD EVALUATION

The lighting conditions measured at the position of evaluating load items for a washing or drying performance test, **shall** be diffused lighting maintained within the following limits:

- (a) A colour temperature of 3500 – 4500 K.
- (b) A luminance level of 1000 – 1500 lux.

The lighting **shall** be installed in order to avoid any direct glare, shadows or effects from extraneous light sources.

The colour of the bench top where the load items are to be evaluated **shall** be a neutral grey colour, equivalent to light grey N35 as specified in AS 2700.

A matt black board, similar to that described in Appendix L, **shall** also be provided on the bench top for the evaluation of transparent items.

NOTE: This does not preclude the use of a viewing cabinet to aid in evaluation, an example of which is given in Appendix L.

APPENDIX B

PREPARATION OF A DISHWASHER FOR TESTING AND GENERAL TEST PROCEDURES

(Normative)

B1 SCOPE

This Appendix specifies requirements for preparing a **dishwasher** for testing, and the test conditions to be complied with when determining its performance in accordance with Appendices C, D, E and F.

B2 CONDITION AND INSTALLATION OF MACHINE

The **dishwasher** under test **shall** be installed and used in accordance with the manufacturer's instructions except where specified otherwise by this Standard. Before measurements are commenced the **dishwasher shall** be checked to ensure that it has no defects that may affect the operation of the unit.

B3 FILTERS

All filters **shall** be thoroughly cleaned before each test run.

B4 TEST PROGRAM

The **test program** to be used, including all associated specific settings, **shall** be the one stated by the manufacturer for the test. The details of this **program**, including all associated settings, **shall** be recorded on the test report.

B5 INITIAL TEMPERATURE OF MACHINE

The **dishwasher shall** be at laboratory ambient temperature at the beginning of each test run. It **shall** be accepted that this requirement has been met if the internal surface temperature of the **dishwasher** is within 2 K of the ambient air temperature, or if the **dishwasher** has been left open and standing at the stable laboratory ambient temperature for not less than 2 hours.

B6 TEST ENCLOSURE

If the manufacturer's instructions require that a **dishwasher** be installed under a bench or in a similarly enclosed position for correct operation, all tests **shall** be carried out with the **dishwasher** under test installed in an enclosure complying with Paragraph A16.

B7 DETERGENT QUANTITY

The quantity of detergent to be used **shall** be as specified by the manufacturer for the **test program** in the accompanying product literature (i.e. operating manual or user instructions). (Refer also to Clause 5.4 regarding limits and Paragraph A8.1 for the type of detergent). The quantity of detergent to be used in the **reference machine** is specified in Clause 3.3.

The quantity of detergent used **shall** be recorded on the test report.

B8 RINSE AGENT QUANTITIES

B8.1 Dishwashers with automatic dispenser

The quantity of rinse agent to be used **shall** be as specified by the manufacturer for the **test program**. (Refer to Clause 5.5.)

For **dishwashers** with an adjustable automatic dispenser, the quantity used or the setting **shall** be as recommended by the manufacturer.

B8.2 Dishwashers without automatic dispenser

For **dishwashers** without an automatic dispenser, the specified amount of rinse agent **shall** be added manually in accordance with the manufacturer's instructions.

B9 WATER SOFTENING

If a water-softening device is fitted to the **dishwasher**, it **shall** be treated as follows:

- (a) If specific instructions are provided by the manufacturer, follow the instructions applicable to 45 ppm incoming water hardness.
- (b) If no such specific instructions are given, deactivate the device and remove any salt as necessary so that no additional water softening is occurring.

Note in the test report whether or not a softening device was fitted and any consequent action taken.

B10 PRECONDITIONING RUN

Before conducting the washing performance measurements on a **dishwasher** for the first time, the **dishwasher shall** be operated for at least two complete **programs** using a clean test load and with detergent and rinse agent added as specified in Paragraphs B7 and B8 respectively.

NOTE: If a noise measurement is required, three runs may be performed without rinse aid prior to the above preconditioning runs.

An additional preconditioning run **shall** also be conducted if the **dishwasher** has not been run for ≥ 10 days.

B11 TEST LOAD

The test load **shall** consist of the number of complete **place settings** claimed by the manufacturer as the **rated capacity** of the **dishwasher** for the **test program**. The number of **place settings shall** be recorded.

NOTE: The **reference machine** is always tested with 12 **place settings**, irrespective of the **rated capacity** of the **dishwasher under test**.

The test load **shall** be at ambient temperature immediately prior to starting a test run.

B12 SOILING

The loads for the **reference machine** and each **dishwasher** under test **shall** be soiled using soils that have been prepared, mixed and applied in the same session. In the case of the spinach, milk, infant cereal, margarine and tomato juice, the soils for both loads **shall** come from the same manufacturer's package except that it may come from different packages if the relevant soil from both sources is combined and thoroughly mixed prior to being divided for application to both loads.

Each soil **shall** be applied to the **reference machine** load and all relevant loads for **dishwashers** under test by the same person. For a large number of test loads, it may be necessary to have more than one person preparing soils, but each soil type for all loads **shall** be prepared by one person. Similarly, each soil type for all loads **shall** be applied by one person (the person preparing soils can be different to the person applying soils).

NOTE: This does not preclude more than one person from applying the soils.

At the completion of the required drying time (refer to Paragraph C2.8), the **reference machine** and each **dishwasher** being tested concurrently with it **shall** be loaded (cutlery first) and the door left open with the racks pulled out to the load/unload position. This **shall** be completed within 30 min of the end of the drying period. Once the **reference machine** and all **dishwashers** under test are loaded, all **shall** be closed and started within 2 min.

B13 EVALUATION

The evaluation of the washed loads for both the **reference machine** and each **dishwasher** under test **shall** be carried out by the same judge or pair of judges.

NOTE: This does not preclude the testing of more than one **dishwasher** at a time in association with the **reference machine**, but judge(s) must evaluate the **reference machine** and any **dishwashers** under test for wash performance.

B14 POST-TEST REMOVAL OF STAINS

Following evaluation, all soil deposits, stains and water marks **should** be washed from the load items before they dry and harden further.

NOTE: This will assist in preventing unnecessary damage to load items such as discolouration of stainless steel and surface damage caused by harsh abrasives.

APPENDIX C
PREPARATION AND SOILING OF LOADS
(Normative)

C1 PREPARATION OF LOAD ITEMS

C1.1 General

Prior to soiling, all items **shall** be thoroughly clean and dry so that they could achieve a score of 5 (see Table F1). Any evaluation of load items prior to soiling **shall** be done in accordance with Paragraph F2. Any soil, stains or moisture **shall** be removed. Any items with imperfections likely to affect the evaluation, or with chips, **shall** be removed from the test load and replaced.

NOTE: As well as carrying out a visual inspection for cleanness, it has been found useful to periodically check for starch residues using iodine.

Any detergent used to clean the load items, including any hand washing, need not comply with Paragraph A8, but **shall** be a dishwashing detergent. The load **shall** be thoroughly rinsed to remove any detergent residue.

All load items **shall** be thoroughly clean, dry and at laboratory ambient temperature prior to soiling.

C1.2 Knives

Before each test run, each knife **shall** be inspected for leakage of adhesive from the handle, any associated discolouration, or any corrosion. Any such stains **shall** be removed.

If metal polish is used care **should** be taken to choose a polish containing only fine abrasives, as any scratching or roughening of the metal surface may adversely affect the performance of the **dishwasher** being tested.

After polishing, all residues **shall** be removed by washing and thoroughly rinsing, then drying each item.

C1.3 Forks and soup spoons

Before each test run, the bowls of all soup spoons and the tines of each fork **shall** be polished on both sides using a dry cloth or, if necessary, metal polish as described in Paragraph C1.2. If polish is used, the items **shall** be washed, rinsed and dried as described in Paragraph C1.2.

C2 PREPARATION AND APPLICATION OF SOILING AGENTS

C2.1 General

Preparation and application of soiling agents **shall** be in accordance with Paragraphs C2.2 to C2.4.

Refer to Paragraph B12 for requirements regarding the soiling of the load for the **reference machine**. Refer to Figure C1 for a proposed schedule for soil preparation and application. Refer to Paragraph A10 for soiling agents.

All food products at the time that they are used for preparation of soil in accordance with this Standard **shall** be within the use-by date stated on the product. The remains of newly opened packets of tea, infant cereal or powdered milk may be used for subsequent tests for a period of up to 60 days after opening where the contents are stored in an airtight container. Specific directions are provided for storage and re-use of tomato juice and spinach after opening (refer to Paragraphs C2.2.3 and C2.6.3 respectively).

Soils may be prepared in a room that does not comply with the ambient temperature and humidity requirements specified in Paragraph A3. However, application of soils and subsequent drying prior to washing **shall** be in a room that complies with Paragraph A3.

C2.2 Tomato juice

C2.2.1 Preparation

Tomato juice at laboratory ambient temperature or taken directly from the refrigerator **shall** be used. The tomato juice **shall** be shaken in the container or well stirred before use.

NOTE: A quantity of 200 ml of tomato juice will typically soil 14 glasses with approximately 150 ml of residue.

C2.2.2 Application

The tomato juice **shall** be applied as follows:

- (a) Pour sufficient juice to fill the first clean glass, then pour this into the second glass, then into the third glass and so on until the interiors of all glasses are coated. Pour off the juice contained in the last glass.
- (b) Allow to stand for 30 min.
- (c) Empty each glass by turning it upside down for 5 s, then turn it upright and place it on a clean surface prior to loading.

C2.2.3 Storage and reuse

Unused tomato juice, including that poured off from the last glass, may be kept for reuse if stored in an airtight container and refrigerated for not more than 5 days.

C2.3 Tea

C2.3.1 Water hardness

The water used to make the tea **shall** have a hardness in accordance with Paragraph A5.

C2.3.2 Preparation

The tea **shall** be prepared as follows:

- (a) Place a quantity of tea in a suitable container and add boiling water in the proportion of 1 L of water to 20 g of tea.
- (b) Allow to stand for 5 min.

NOTE: A quantity of 1.75 L of water and 35 g of tea will typically soil 14 teacups.

C2.3.3 Application

The tea **shall** be applied as follows:

- (a) Pour the tea through a strainer, of sufficiently small mesh size to remove all tea leaves, into the cups, so as to half fill each cup.
- (b) Allow to stand for 30 min, then empty each cup by turning upside down for 5 s.

C2.4 Egg yolk

C2.4.1 Preparation

The eggs **shall** be allowed to stand at laboratory ambient temperature for not less than 6 hours before use.

NOTE: A quantity of four eggs **should** soil 14 dinner, bread and butter and soup plates with approximately 50 g of residue.

The egg yolk **shall** be prepared using the following equipment:

- (a) 1 small bowl.
- (b) 2 large bowls.
- (c) Medium-sized saucepan.
- (d) Egg separator.
- (e) Slotted spoon.
- (f) Sieve—fine meshed (to retain yolk skins). (Refer to Paragraph A13.)
- (g) Timing device.

The method of egg yolk preparation **shall** be as follows:

- (i) Fill saucepan with water nearly to the top, and boil.
- (ii) Fill large bowl with cold water.
- (iii) Place sieve over other large bowl.
- (iv) Separate the eggs using an egg separator and place the yolks gently in the sieve taking care not to break them.
- (v) Place the sieve with the yolks into the boiling water and poach for 30 s. Ensure that the yolks are completely covered with water and that the yolks are not stacked.
- (vi) Remove the sieve and eggs from the saucepan and place in large bowl of cold water for 30 s. (Refer to Item (ii).)
- (vii) Allow the excess water to drain from the sieve.
- (viii) Puncture the yolks while in the sieve and allow the fluid to strain through the mesh into the small bowl.
- (ix) Wait until as much yolk as possible has drained into the bowl (gentle agitation of the yolks hastens the process).
- (x) Scrape the underside of the sieve to recover as much of the yolk as possible.

C2.4.2 *Application*

The egg yolk **shall** be applied as follows:

- (a) Ensure that the total amount of egg yolk used is 3 times the number of **place settings** expressed in grams, ± 1 g.
- (b) Measure the weight of the container with the egg yolk together with the pastry brush. Apply approximately 1 g of egg yolk to the sunken portion of each dinner plate so that approximately one third is soiled as shown in Figure D1. Reweigh the container and pastry brush and repeat this process for the bread and butter plates and soup bowls.
- (c) Reweigh the container and pastry brush. Apply approximately 0.1 g of the egg yolk remaining to both sides of the head of each table fork, leaving the handles unsoiled. Place each fork face up on the rim of a plate, with the base of the handle resting on the table and no two forks touching.
- (d) Leave the forks on the plates (see Paragraph C2.8).

C2.5 Infant cereal

C2.5.1 Preparation

The infant cereal **shall** be prepared as follows:

- (a) Place 15 g of skim milk powder in a dry container (saucepan or bowl).
- (b) Place 20 g of infant cereal into the same container.
- (c) Slowly add 200 ml of cold water, stirring continuously until smooth.
- (d) Apply direct heat to the container until the mixture is boiling.
- (e) Place, uncovered, on a gently boiling water bath for 20 min, stirring occasionally.
- (f) Remove from heat. The mixture is then ready for immediate application.

C2.5.2 Application

The cereal **shall** be applied as follows:

- (a) Ensure that the total amount of cereal used **shall** be 3 times the number of **place settings**, expressed in grams, ± 1 g.
- (b) Measure the weight of the container with the cereal together with the brush. Apply approximately 1 g of cereal to the sunken portion of each dinner plate so that approximately one third is soiled as shown in Figure D1. Reweigh the container and brush and repeat this process for the bread and butter plates and soup bowls.
- (c) Reweigh the container and brush. With the cereal remaining, apply approximately 0.1 g per **place setting** to both sides of the head of each soup spoon leaving the handles unsoiled. The soil **shall** be applied using two strokes only per spoon, i.e. one for each side. Place each spoon face up on the rim of a plate with the base of the handle resting on the table and no two spoons touching.
- (d) Leave the spoons on the plates (see Paragraph C2.8).

C2.6 Spinach

C2.6.1 Preparation

The contents of a new can **shall** be stirred until homogeneous. A sieve that conforms to the requirements of Paragraph A13 **shall** be used to prepare the spinach. The contents of a full tin of spinach **shall** be placed gently onto the sieve, spread evenly across the mesh, and allowed to stand on a horizontal surface and drain for 5 min. The drained liquid **shall** be discarded. All of the spinach **shall** be rubbed through the sieve into a clean bowl. The sieved spinach **shall** be mixed until homogeneous. Spinach previously prepared may be used directly from the refrigerator.

NOTE: A plastic or rubber squeegee or broad spatula is recommended for pushing the spinach through the sieve.

C2.6.2 Application

The spinach **shall** be applied as follows:

- (a) Ensure that the total amount of spinach used is 3 times the number of **place settings** expressed in grams, ± 1 g. At frequent intervals during the following application process, stir the remaining spinach and liquid in the bowl so that the mixture remains homogeneous.
- (b) Measure the weight of the container with the spinach together with the pastry brush. Apply approximately 1 g of spinach to the sunken portion of each dinner plate so that approximately one third is soiled as shown in Figure D1. Reweigh the container and pastry brush and repeat this process for the bread and butter plates and soup bowls.

C2.6.3 *Storage of opened sieved spinach*

Once prepared in accordance with Paragraph C2.6.1 spinach may be stored, refrigerated in an airtight container, for a maximum of 5 days. The temperature of the refrigerator **shall** remain between 0.5°C and 4°C while the spinach is in storage.

C2.7 **Margarine**

C2.7.1 *Preparation*

Margarine may be used when taken directly from the refrigerator.

C2.7.2 *Application*

The total amount of margarine used **shall** be equal to the number of **place settings** times 1.5, expressed in grams, ± 1 g. For each saucer approximately 1.5 g of margarine **shall** be spread uniformly over the top surface using a knife or spatula.

C2.8 **Time for application and drying of soiling agents**

All soiling **shall** be completed within 90 mins of the beginning of soiling. All load items **shall** be dried in ambient conditions that comply with Paragraph A3. After soiling, the cups and saucers **shall** be placed on a level surface in their serving orientation to dry. All other load items **shall** be left to dry in their serving orientation to allow the soils to set, generally one to two hours is sufficient. The total dry time after the completion of soiling of all load items **shall** be 15 to 18 hours* and **shall** be in accordance with one of the following options: Load items, excluding the cups and saucers, **shall** be—

- (a) loaded into the **dishwasher** racks with the racks still in the **dishwasher**—in this case, the **dishwasher** door **shall** be open and the racks pulled out; or
- (b) loaded into the **dishwasher** racks which have been placed on a bench—in this case, a tray **shall** be placed under the racks and any soil that falls into the tray **shall** be placed in the **dishwasher** before the wash **program** is commenced; or
- (c) placed on a level surface (usually where soiling was undertaken)—in this case, care is necessary to ensure that any loose soil particles fall into the **dishwasher** during loading.

* A shorter drying procedure is under investigation.

| Time | 0 min | 5 min | 10 min | 15 min | 20 min | 25 min | 30 min | 35 min | 40 min | |
|---------------|-------|--------|----------|--------|--------|-----------|------------------|--------|--------|-------|
| Infant cereal | Mix | Boil | Simmer | | | | | | | Apply |
| Tea | | Infuse | Pour | Stand | | | | | | Drain |
| Tomato juice | | Pour | Stand | | | | | | | Drain |
| Eggs | | | Separate | Poach | Apply | No action | | | | |
| Margarine | | | Apply | | | Action | | | | |
| Spinach | | | Apply | | | Apply | Supervision only | | | |

NOTES:

- 1 Preparation prior to soiling **should** include the temperature equalization of the eggs (for 6 hours) and boiling of the water required for the tea, eggs and infant cereal.
- 2 Margarine can be applied whenever there are a few minutes to spare. The same applies to spinach, except that there is less chance of contaminating the other soils with spinach if it is applied last.
- 3 If numerous loads are being prepared at the same time, the application stages of the soiling procedure may take longer than has been allocated in this Figure. In this case, the margarine **should** be applied at a different time, allowing 2 extra minutes for egg yolk application, and the spinach **should** be applied after draining of the tomato juice and the tea, leaving 5 extra minutes for the application of infant cereal. (Refer to Paragraph B12)

FIGURE C1 PROPOSED SCHEDULE OF SOIL PREPARATION AND APPLICATION

APPENDIX D

DETERMINATION OF WASHING PERFORMANCE,
ENERGY AND WATER CONSUMPTION AND STANDBY POWER

(Normative)

D1 SCOPE

This Appendix specifies the methods for measuring the washing performance and consumption of energy and water of a **dishwasher**. It also specifies the determination of standby power consumption, **program time** and **cycle time**.

D2 TEST CONDITIONS

The relevant conditions as specified in Appendices A, B and C **shall** apply.

D3 PRINCIPLE

Cold water and/or hot water, as applicable, are metered directly into the **dishwasher** for water consumption. Electric energy to the **dishwasher** is metered in kilowatt-hours. Heat energy embodied in the water input to the **dishwasher** is calculated relative to a cold water temperature of 20°C. The electrical and water energy components are summed to give the tested energy consumption. At the completion of the **program**, the wash score for each load item is evaluated and recorded. It is not necessary to evaluate the load if only the energy consumption is to be measured, but a soiled load is still used in this case.

- (a) Water consumption, **program** energy and **program time**: These are determined from a standard performance run with a soiled load. Refer Paragraph D4.
- (b) **Cycle time**, post **program** energy and **end of cycle mode power**: These can usually also be determined from a standard performance run (Paragraph D4). The **dishwasher** is allowed to continue past the end of the **program** until the end of the **cycle** without any user intervention. **End of cycle mode** may be determined once the power level is stable. In some cases it may be necessary or desired to perform a separate run with a soiled load to determine post program energy and time and the power in **end of cycle mode**. In these cases a standard performance run (Paragraph D4) shall be used.
- (c) **Tested energy consumption (E_t)**: The **program** energy (including electrical and water energy components during the **program**) and the post program energy are summed to give the **tested energy consumption**. Refer Paragraph D8.
- (d) Other **standby power** modes: **Delay start mode** power (where applicable) and **off mode** power are determined from separate measurements. Refer Paragraph D5 and D6.

D4 TEST PROCEDURE – PERFORMANCE MEASUREMENTS

The following procedure **shall** be applied to the **reference machine** and each **dishwasher** under test that is run in parallel:

- (a) Load the **dishwasher** with the soiled test load and detergent specified in Paragraph A8.1, according to the manufacturer's instructions. The orientation of the soils on each plate **shall** be as shown in Figure D1. Any breakage during loading, and its cause, **shall** be noted on the test report. If an item is broken or significantly damaged while loading, it **shall** be replaced with a clean item and evaluated as normal. If an item is chipped only, it **shall** be washed as normal but any soiling on the chipped surface **shall** not be counted. (See also Paragraph F2.5.)

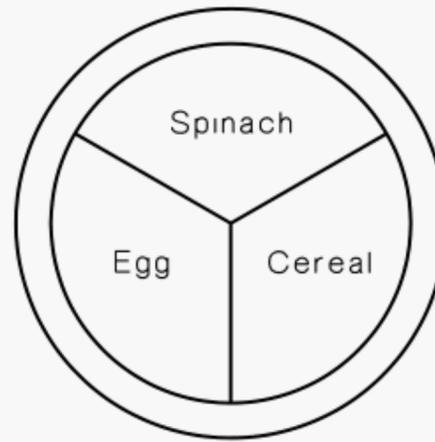


FIGURE D1 ORIENTATION OF SOILED PLATE IN DISHWASHER

- (b) Operate the **dishwasher** through the chosen **program**.
- (c) Record the following data for each **operation** within the **program**:
- (i) The measured temperature of the cold water supply (t_c) for each **operation** which draws cold water and which either—
 - (A) draws hot water; and/or
 - (B) where an internal water heater operates, in degrees Celsius.
 - (ii) The quantity of cold water input to the machine (Q_{cw}) for each **operation** which draws cold water, in litres.
 - (iii) The temperature of the hot water supply (t_h) as measured for each **operation** which draws hot water or where an internal water heater operates, in degrees Celsius.
 - (iv) The quantity of hot water input to the machine (Q_h) for each **operation** which draws hot water, in litres.
 - (v) The electrical energy (E_e) supplied to the machine for the test **program**, in kilowatt hours.
 - (vi) The time from the commencement of the **program** until the **program** is completed. Record details of how the end of **program** is indicated. Also record the **cycle time** if this occurs within 5 min of the end of the **program**. Recording time for each operation is recommended.
- NOTE: Any period between the end of the **program** and the end of the **cycle** is treated as a separate **operation** for the purpose of measurement of energy. It may be useful to record the time for each **operation**.
- (d) Ensure that the following conditions remain relevant at the end of the **program**:
- (i) No adverse warning indicators are present.
 - (ii) Door/drawer remains closed.
 - (iii) Water supply is left on at the specified pressure.
 - (iv) All external communication remains disconnected and switched off (as far as possible).

- (e) At the completion of the **program**, leave the **dishwasher** to continue operating until the end of the **cycle** without any user intervention. Continue to record time, electrical energy consumption and any water consumption until the end of the **cycle**.

NOTE: Where wash performance is being measured and where the end of the **cycle** does not occur within 1 hour of the end of the **program** (or where the end of the **cycle** is unclear), it may be more convenient to undertake a separate run to measure post **program** energy, post **program** time and **end of cycle mode** power and proceed directly to the wash performance evaluation at this point.

- (f) At the completion of the **cycle** (where the dishwasher has reverted to a steady state condition), leave the **dishwasher** to continue operating for a further hour without any user intervention for the determination of **end of cycle mode** power. Energy consumption measurement of average power for this period shall be in accordance with AS/NZS 62301. This step may be skipped if a determination of **end of cycle mode** power is not required for this run.

- (g) If washing performance is being measured, continue as follows:

- (i) Within 10 min of the completion of (e) or (f) above (as applicable), prop the **dishwasher** door or cover ajar using a block in accordance with Paragraph A14 to assist air drying before evaluating the test load for soil.

NOTE: Air drying the test load before a washing evaluation is intended to improve the repeatability of the test.

The block **shall** be inserted so as to provide a gap of approximately 50 mm width between the edge of the door opposite the hinge and the **dishwasher** lining. If the 'door' of the **dishwasher** opens as a sliding drawer front, the block **shall** be inserted between the upper horizontal edge of the front and the **dishwasher**.

If the **dishwasher** has more than one 'door' (e.g. two drawers) a block **shall** be inserted between each of the lower 'doors' and the 'door' above.

NOTE: Washing performance, energy and water consumption are determined over a **cycle**.

- (ii) Following a waiting time not less than 60 min and not more than 18 h from the insertion of the block, conduct an evaluation of the load and record the score for each load item. (Refer to Paragraph F2).

The intent is to have the load reasonably dry for the evaluation of soiling.

- (iii) Calculate the washing index. (Refer to Paragraph F3).

- (h) Check that all of the appropriate information has been recorded on the test report form.

D5 TEST PROCEDURE—DELAY START MODE

This procedure **shall** be used to determine **delay start mode** power for a machine with this feature.

Manufacturers or suppliers may have information on the design and operation of their machines which would allow an accurate determination of these parameters through methods other than the testing schedule specified. For the purposes of declaration, a manufacturer or supplier may use any method which gives an equivalent value to the method specified below. For verification purposes, the method specified below has precedence over any other determination.

- (a) Load the machine at **rated capacity** with a clean load.
- (b) Select the test **program** and set the delay start time to be a value greater than 3 hours where possible (otherwise the longest time possible).

- (c) Ensure that the following conditions remain relevant during the delay start period:
- (i) No adverse warning indicators are present.
 - (ii) Door/drawer remains closed.
 - (iii) Water supply is left on at the specified pressure.
 - (iv) All external communication is disconnected and switched off (as far as possible).
- (d) If the conditions in (c) above are met, determine energy consumption (or average power) for a period of 3 hours from the commencement of the delay start (or until the **program** is activated if the maximum delay start period is less than 3 hours). Energy consumption measurement or average power for this period shall be in accordance with AS/NZS 62301.
- The initial power consumption at the start of this mode may be higher, so a true average over a 3 hour period is required for this mode.
- (e) From the measurements in (d) determine the average **delay start mode** power.

D6 TEST PROCEDURE—OFF MODE

This procedure **shall** be used for the determination of **off mode** power consumption where the product has a power or off switch.

Manufacturers or suppliers may have information on the design and operation of their machines which would allow an accurate determination of these parameters through methods other than the testing schedule specified. For the purposes of declaration, a manufacturer or supplier may use any method which gives an equivalent value to the method specified below. For verification purposes, the method specified below has precedence over any other determination.

- (a) The machine shall be empty with mains power connected to the machine. Switch the machine to the off state and allow it to reach a steady state power before measurements commence.
- (b) Ensure that the following conditions remain relevant during the measurement of **off mode**:
- (i) No adverse warning indicators are present.
 - (ii) Door/drawer remains closed.
 - (iii) Water supply is left on at the specified pressure.
 - (iv) All external communication is disconnected and switched off (as far as possible).
- (c) If the conditions in (b) above are met, determine the energy consumption or average power for a period of not less than 1 hour. Energy consumption measurement for this period shall be in accordance with AS/NZS 62301.
- (d) From the measurements in (c) determine the average **off mode** power.

D7 DETERMINATION OF WATER CONSUMPTION

Hot and cold water consumed during each **operation** occurring during the **cycle shall** be separately reported and summed to give total hot water (Q_h) and total cold water (Q_c) consumption. Hot and cold water consumption (as applicable) **shall** be reported separately, and **shall** be summed together to give total water consumption (Q_t). Any water consumption that occurs between the end of the **program** and the end of the **cycle** (refer Paragraph D4) shall be included in this value.

D8 DETERMINATION OF TESTED ENERGY CONSUMPTION

D8.1 General

Measurements from Paragraph D4 shall be used to determine the tested energy consumption (E_t) for a selected **cycle** which **shall** be calculated using the following equation:

$$E_t = E_{c\ pr} + E_{c\ pp} + E_{c\ tw} + E_{h\ tw} \text{ (kWh)} \quad \dots \text{ D(1)}$$

where

- $E_{c\ pr}$ = sum of electrical energy consumed during each **operation** during the test **program** (Refer to Paragraph D4)
- $E_{c\ pp}$ = post program electrical energy consumed from the completion of the **program** until the completion of the **cycle** in kilowatt-hours (Refer to Paragraph D4)
- $E_{c\ tw}$ = total cold water correction energy for the whole test, being the sum of the cold water correction energies (E_c) for each relevant **operation** (Refer to Paragraph D8.2.)
- $E_{h\ tw}$ = hot water supply energy for the whole test, being the sum of the hot water supply energies (E_h) for each relevant **operation**. (Refer to Paragraph D8.3.)

D8.2 Cold water correction energy (E_c)

Cold water energy correction **shall** be carried out for each **operation** where the cold water supply temperature is not 20°C and either the internal heater operates or external hot water is also used. The cold water correction energy for each relevant **operation shall** be calculated using the following equation:

$$E_c = \frac{Q_c (t_c - 20)}{860} \text{ (kWh)} \quad \dots \text{ D(2)}$$

where

- Q_c = the volume of cold water used for the relevant **operation**, in litres.
- t_c = the average measured inlet temperature of the cold water during the relevant **operation** in degrees Celsius.

NOTES:

- 1 As t_c may vary between 22°C and 18°C (refer to Paragraph A4), E_c may be positive or negative.
- 2 The value of 860 is derived from 3.6 MJ per kWh and 4.186 joules per calorie. As 1 calorie of energy is defined as a temperature rise of 1 K for 1 cm³ (equal to 1 ml) of water, the energy embodied per litre per degree K is 4186 joules; 3 600 000 divided by 4186 equals 860.
- 3 To determine E_c it is preferable to integrate the energy by measuring the temperature for each unit volume of water measured and summing these for the whole draw off. However, where the **dishwasher** draws water at a reasonably constant flow rate and/or where the temperature remains reasonably constant during the draw off, a temperature average during each draw off (based on a continuous sampling period of say 5 s or less) could provide an acceptable result.

D8.3 Hot water supply energy (E_h)

Calculation of the hot water supply energy **shall** be carried out for each **operation** in which the **dishwasher** uses any hot water from an external source. It **shall** be calculated as the energy contained in the externally supplied hot water relative to the nominal cold water temperature of 20°C by the following equation:

$$E_h = \frac{Q_h (t_h - 20)}{860} \quad (\text{kWh}) \quad \dots \text{D(3)}$$

where

Q_h = the volume of external hot water used for the relevant **operation**, in litres.

T_h = the average measured inlet temperature of the hot water during the relevant **operation** in degrees Celsius.

NOTES:

- 1 The hot water energy so calculated includes only the energy embodied in the hot water relative to the nominal cold water temperature. It does not take into account any losses associated with the conversion and distribution of hot water that occur in different households or different countries.
- 2 To determine E_h it is preferable to integrate the energy by measuring the temperature for each unit volume of water measured and summing these for the whole draw off. However, where the **dishwasher** draws water at a reasonably constant flow rate and/or where the temperature remains reasonably constant during the draw off, a temperature average during each draw off (based on a continuous sampling period of say 5 s or less) could provide an acceptable result.

D9 DETERMINATION OF STANDBY POWER

Measurements of standby power in accordance with the procedures and instruments specified in AS/NZS 62301 **shall** be determined for the following modes (as applicable) on the **dishwasher**.

NOTE: Factory default settings as supplied **should** be tested. Any setting or condition that may affect power consumption in these modes **should** be reported

Power in each applicable mode **shall** be reported in Watts to the nearest 0.1 W or better.

- (a) **Off mode shall** be determined where the appliance has a power or off switch. **Off mode** can only be activated via controls that are normally accessible to the user while power is connected to the appliance. Refer to Paragraph D6 for determination.

NOTE: Many appliances use some power in **off mode** to supply electronic controls.

- (b) **End of cycle mode** occurs at the completion of the **cycle**. During **end of cycle mode**, appliance power is in a steady state that persists for an indefinite period. This mode is applicable to all appliances. Refer to Paragraph D4 for determination.

- (c) **Delay start mode should** be determined where the appliance has a user option that is used to delay the commencement of the **program**. Refer to Paragraph D5 for determination.

NOTES:

- 1 Refer to Appendix M for examples of standby power modes
- 2 AS/NZS 2007.2:2005 provides details of how standby power is incorporated into the energy efficiency labelling requirements.

D10 PROGRAM TIME AND CYCLE TIME

Program time and **cycle time shall** be determined and reported for each **program** tested to this Standard.

APPENDIX E
DETERMINATION OF DRYING PERFORMANCE
(Normative)

E1 SCOPE

This Appendix specifies the method for measuring the drying performance of a **dishwasher**.

NOTE: IEC use the **reference machine** for assessing drying performance, whereas this is not required in this Standard. The determination of energy consumption, water consumption, **standby power** or time is not permitted using a clean load specified in this Appendix.

E2 TEST CONDITIONS

The relevant conditions specified in Appendices A, B and C **shall** apply.

E3 TEST PROCEDURE

The procedure **shall** be as follows:

- (a) Load the **dishwasher** in accordance with Paragraph D4(a), except that the load items **shall** be unsoiled.
- (b) Operate the **dishwasher** through the **test program**.
- (c) On completion of the **program**, leave the **dishwasher** door or cover closed and latched unless the manufacturer recommends otherwise in the product literature (i.e. operating manual or user instructions), in which case the door position **shall** be noted in the report (refer Clause 5.6).
- (d) Following a waiting time of not less than 30 min and not more than 40 min after the end of the **program**, commence a drying evaluation of the load and record a dry score for each load item in accordance with Paragraph F4. Refer to Paragraph F4.2 regarding time allowed for evaluation of each load item and the total load.
- (e) Calculate the drying index in accordance with Paragraph F5.
- (f) Check that all of the appropriate information has been recorded in the test report.

APPENDIX F
EVALUATION AND CALCULATION OF WASHING AND
DRYING INDICES

(Normative)

F1 SCOPE

This Appendix specifies the methods for evaluating and calculating the washing and drying indices.

F2 EVALUATION OF WASHING PERFORMANCE

NOTE: Refer to Paragraph B13, for requirements regarding the evaluation of the load washed concurrently by the **reference machine**.

F2.1 Conditions

One or two judges **shall** be used. If two judges are used, there **shall** be no communication regarding the evaluation between the two judges except that the first judge may inform the second of the accidental removal of soil, the disturbance of water, or similar. Instances of the accidental removal of a soil particle include removal due to handling, removal due to confirmation of the particle by touch, or removal by residual water in a depression.

Judges **shall** exercise extreme care when handling each item so as not to unduly disturb soil.

When two judges are used, each judge **shall** not be able to see the scores of the other.

The judges **shall** have clean, dry hands or wear clean cotton gloves to avoid applying finger smears to the items (see Paragraph A15). Hands/gloves **shall** be checked frequently for soil particles, which are to be removed immediately. Gloves **shall** be replaced or hands rewashed if necessary.

During evaluation, when two judges are used, they **shall** wear uniform white attire, a white smock-type apron, or other suitable overgarment with a white front.

The examination **shall** be performed in lighting conditions specified in Paragraph A17. Alternatively a suitably positioned viewing cabinet as described in Appendix L may be used.

F2.2 Removal and examination of load items

The first judge **shall** remove each piece from the **dishwasher** and immediately carry out the first evaluation. If applicable, the second judge **shall** then receive the piece by hand and carry out the second evaluation.

One item at a time **shall** be carefully removed and all surfaces **shall** be visually examined for any soil. Items **shall** not be stacked or handled between evaluations in such a manner as may transfer or remove any soil residue.

The observation time for each piece **shall** be a maximum of 10 s per judge except that additional time may be spent confirming a blemish, but not looking for additional soiling.

Transparent items **shall** be examined against both the matt black surface and the normal grey surface used for evaluation (refer to Paragraph A17).

Each item **shall** be judged and allocated a wash score in accordance with Paragraph F2.3.

F2.3 Allocation of wash score

Each load item **shall** be awarded a wash score from Table F1 according to the category of soil area or number of discrete particles that is applicable to the soil on the item. (Refer to Figures F1 and F2 for examples of soil sample areas).

Unglazed base rings of ceramic plates and cups **shall** not be assessed for soil.

If the requirements for more than one score are met, the lowest applicable score **shall** be awarded.

All load items in the **dishwasher shall** be evaluated, not only those items that were soiled.

TABLE F1
WASH SCORE

| Number of discrete particles (<i>n</i>) | Soil area (<i>A</i>) mm ² | Wash score |
|--|---|------------|
| $n = 0$ | $A = 0$ | 5 |
| $0 < n \leq 4$ | $0 < A \leq 4$ | 4 |
| $4 < n \leq 10$ | $4 < A \leq 20$ | 3 |
| $10 < n$ | $20 < A \leq 50$ | 2 |
| N/A | $50 < A \leq 200$ | 1 |
| N/A | $200 < A$ | 0 |

F2.4 Assessment of marks and stains

F2.4.1 *Finger marks*

Marks created by handling during the evaluation process **shall** be ignored for the purposes of the washing evaluation.

F2.4.2 *Detergent*

Undissolved, redeposited detergent **shall** be considered soil for the purposes of a washing evaluation.

F2.4.3 *Wet stains*

A wet mark **shall** be ignored if it is transparent or cloudy white in colour. If it is any other colour (typically green or pinkish) the coloured area **shall** be considered soil and assessed by size accordingly. If the coloured area encloses a non-coloured or cloudy white area, this area **shall** be considered part of the coloured area when assessing the soil.

F2.4.4 *Dry stains*

If a dry stain contains any coloured portion (other than cloudy white) that portion **shall** be considered to be soil and assessed as in Paragraph F2.4.3.

If any portion of a dry stain is colourless or cloudy white, the examiner **shall** lightly draw the pad of one finger from a clean section of the item onto the stain. If the stain is discernible as a raised area according to this method, then the whole stain **shall** be considered to be soil and assessed as in Paragraph F2.4.3.

If the stain feels rough, but is not revealed as a raised area on the surface, then it **shall** be ignored.

If any stain feels sticky to the touch, then the sticky portion **shall** be considered soil and assessed as in Paragraph F2.4.3.

F2.4.5 *Infant cereal stains*

If infant cereal remains on the soup spoons as a pattern of fine pale lines (i.e. brush marks) the total area covered by the lines and all of the spaces between the lines **shall** be considered to be soil and assessed by size accordingly.

F2.4.6 *Stains surrounding particles*

If particles or other specks of matter are surrounded by a clear or cloudy white stain (either wet or dry) the sum of the areas of the individual specks only **shall** be estimated and this area assessed as a soiled area.

NOTE: This process may be accomplished by mentally compressing the specks into a single, continuous stain and comparing the resulting area to the sample areas. (Refer to Figures F1 and F2 for examples of soil sample areas.)

F2.5 Evaluation of damaged items

Items that have been damaged during the test **shall** be treated as follows:

- (a) *If the dishwasher breaks an item* Score zero for that item.
- (b) *If a judge breaks an item after the wash* Discount and do not include this item when calculating the washing index.
- (c) *If there is more than one breakage in any load for any reason* Reject the test and repeat. (See also Item (d).)
- (d) *If there is a breakage of a soiled item before washing* Deal with it in accordance with Paragraph D4(a), but count as a breakage for the purposes of Paragraph F2.5(c).

F3 DETERMINATION OF WASHING INDEX

NOTE: Refer to Appendix G for example calculations.

F3.1 Total wash score

After all items in a load (including those to which soil was not applied) have been scored by a judge, the wash scores of all the load items **shall** be summed and recorded as the total wash score W . The total number of load items **shall** be recorded as N . Total wash score (W) and total number of load items (N) **shall** be recorded for the **reference machine** and each **dishwasher** under test that has been run in parallel.

F3.2 Washing index

Having calculated the total wash score for the **reference machine** (W_r) and each **dishwasher** under test (W_{ti}) that has been run in parallel with the **reference machine**, the washing index for each **dishwasher** under test **shall** be calculated using the following equation:

$$\text{Washing index for dishwasher } i = \frac{W_{ti} \times N_r}{W_r \times N_{ti}} \quad \dots \text{ F(1)}$$

where

W_r is the total wash score for the **reference machine**

W_{ti} is the total wash score for the i th **dishwasher** under test run in parallel

N_r is the total number of load items in the **reference machine**

N_{ti} is the total number of load items in the i th **dishwasher** under test run in parallel

For each **dishwasher** where a washing index is calculated, the total wash scores in Equation F(1) **shall** be from the same judge, or an average score from two judges as set out in Paragraph F3.3.

F3.3 Combined scores for two judges

F3.3.1 Average scores

Where a test load and **reference machine** load has been scored by two judges, the total wash score for each judge **shall** be calculated, then the average total wash score of the two judges scores **shall** be determined for both the **dishwasher** under test and the **reference machine** and used in Paragraph F3.2.

F3.3.2 Validity check

If the total wash scores of the two judges differ by more than N/2 for the same **dishwasher**, the test **shall** not be considered valid in accordance with this Standard.

NOTE: This is equivalent to 10 percentage points difference.

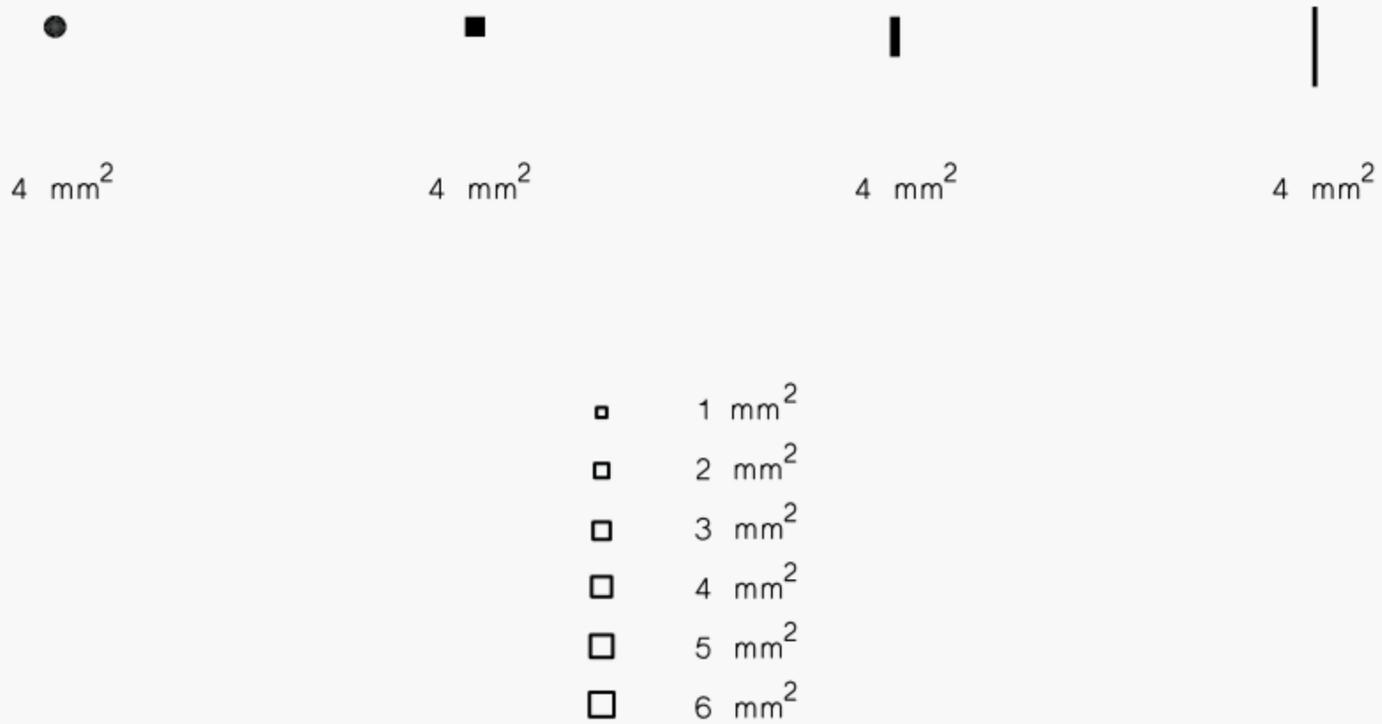


FIGURE F1 SAMPLE AREA COMPARISON CHART FOR SOIL EVALUATION

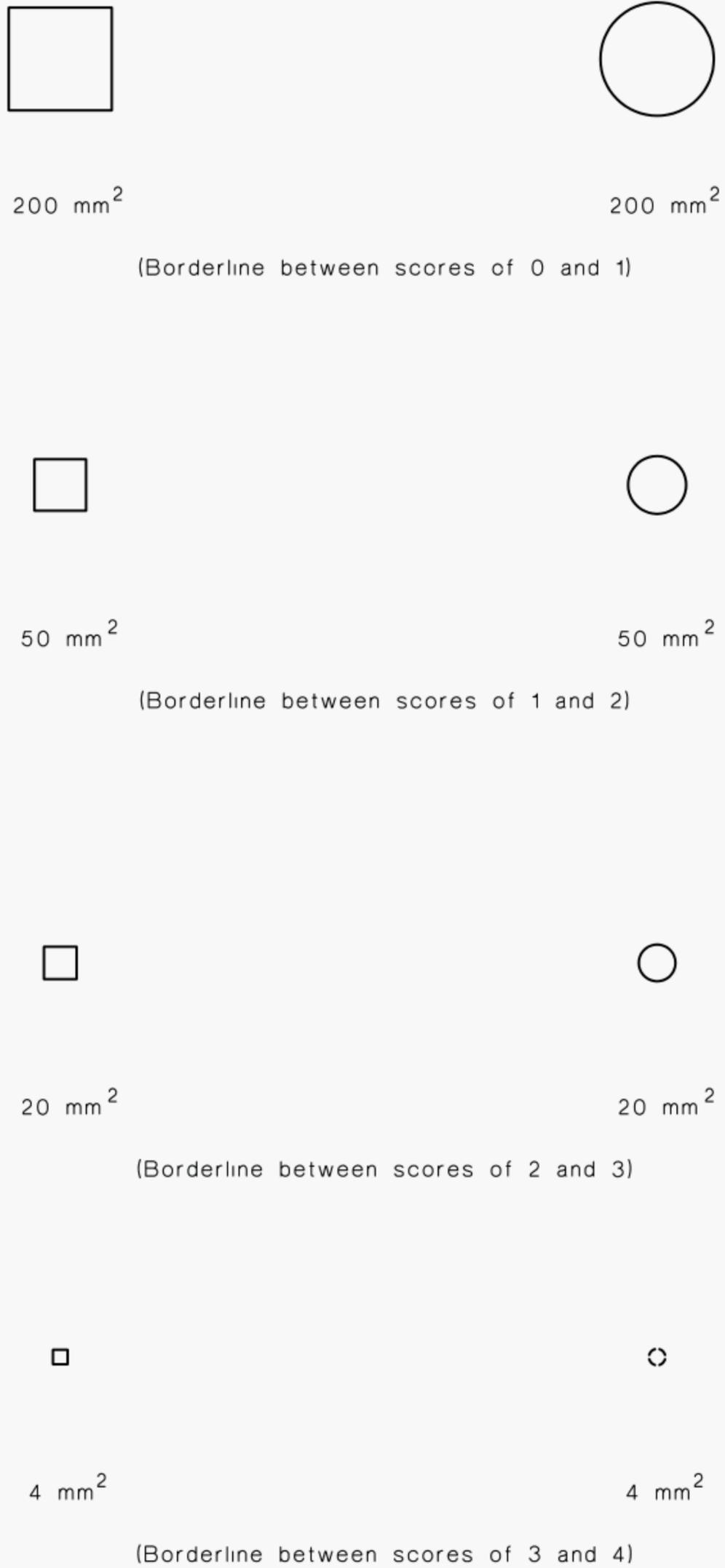


FIGURE F2 SAMPLE BORDERLINE AREA CHART FOR SOIL EVALUATION

F4 EVALUATION OF DRYING PERFORMANCE

F4.1 Conditions

Conditions for evaluating drying performance **shall** be in accordance with Paragraph F2.1.

NOTE: IEC use the **reference machine** for assessing drying performance, whereas this is not required in this Standard.

F4.2 Removal and examination of load items

Except where specified otherwise, the conditions of Paragraph F2.2 **shall** apply. Starting with the lower basket if possible/where applicable, one item at a time **shall** be carefully removed and all surfaces **shall** be visually examined for residual water. Each item **shall** be examined only while in the lighting conditions specified in Paragraph A17, not when in the **dishwasher** or in transit.

NOTE: The lower basket is evaluated first as some water from the upper basket may fall while items are being lifted out of the **dishwasher**. The **dishwasher should** not be moved from the commencement of the **program** until after the evaluation has been completed.

Each item **shall** be judged 'dry', 'intermediate', or 'wet' (see Paragraph F4.3).

The examination of each item is limited to 3 s per judge. The total elapsed time from the commencement of the drying evaluation **shall** not exceed the number of items times 8, in seconds.

F4.3 Allocation of dry score

F4.3.1 *General*

A surface particle of water that has a maximum dimension of 6 mm across **shall** be termed a 'drop'. Surface water with any dimension longer than 6 mm across **shall** be treated as a 'streak'. (Refer to Figure F3.)

F4.3.2 *Dry*

An item that is completely free of moisture **shall** be termed 'dry'. A dry item **shall** be given a score of 2.

F4.3.3 *Intermediate*

An item having one or two drops of water, or one wet streak (run) **shall** be termed 'intermediate'. An intermediate item **shall** be given a dry score of 1.

F4.3.4 *Wet*

An item having more than two drops of water, or one drop and one streak, or two streaks **shall** be termed 'wet'. An item with a pool of water that is greater in volume than 3 drops **shall** be treated as wet. A wet item **shall** be given a dry score of 0.

F4.4 Water marks

Deposits of dissolved solids that remain after evaporation of water drops or streaks (water marks) **shall** be ignored for the purposes of a drying evaluation.

F5 DETERMINATION OF DRYING INDEX

NOTE: Refer to Appendix G for example calculations.

F5.1 Total dry score

After all items in a load have been scored by a judge, the dry scores of all the load items **shall** be summed and recorded as the total dry score D . The total number of load items **shall** be recorded as N .

F5.2 Drying index

The drying index of the load **shall** be calculated using the following equation:

$$\text{Drying index} = \frac{D}{N \times 2} \quad \dots \text{F(2)}$$

where:

D is the total dry score for the **dishwasher** under test

N is the total number of load items in the **dishwasher** under test

The drying index **shall** be expressed as a decimal (maximum value 1.000) or as a percentage.

For all **dishwashers** where a drying index is calculated, the total dry scores in Equation F(2) **shall** be from one judge, or an average score from two judges as set out in Paragraph F5.3.

F5.3 Combined scores for two judges

F5.3.1 Average scores

Where a test load has been scored by two judges, the total dry score for each judge **shall** be calculated, then the average total dry score of the two judges scores **shall** be determined and used in Paragraph F5.2.

F5.3.2 Validity check

If the total dry scores of the two judges differ by more than $N/5$ for the same **dishwasher**, the test **shall** not be considered valid in accordance with this Standard.

NOTE: This is equivalent to 10 percentage points difference.



FIGURE F3 REPRESENTATIVE MAXIMUM SIZED WATER DROP
(6 mm DIAMETER)

APPENDIX G

EXAMPLE CALCULATIONS OF WASHING AND DRYING INDICES AND ENERGY CONSUMPTION

(Informative)

G1 WASHING INDEX

The example given in this Paragraph of the calculation of washing index is for a **dishwasher** with 12 **place settings**, evaluated by one judge. Raw wash scores are shown in Table G1.

TABLE G1
TABULATION OF RESULTS

| Load item category | Possible scores | No. of items corresponding to each score | Totals |
|-----------------------------------|-----------------|--|-------------------------|
| Crocery | 5 | 15 | 75 |
| | 4 | 24 | 96 |
| | 3 | 13 | 39 |
| | 2 | 5 | 10 |
| | 1 | 2 | 2 |
| | 0 | 1 | 0 |
| Glassware | 5 | 3 | 15 |
| | 4 | 4 | 16 |
| | 3 | 3 | 9 |
| | 2 | 1 | 2 |
| | 1 | 0 | 0 |
| | 0 | 1 | 0 |
| Cutlery | 5 | 12 | 60 |
| | 4 | 15 | 60 |
| | 3 | 14 | 42 |
| | 2 | 7 | 14 |
| | 1 | 6 | 6 |
| | 0 | 6 | 0 |
| Total number of load items N: 132 | | | Total wash score W: 446 |

The total number of load items is 132 (12 **place settings** times 11 load items). The parallel test run on the **reference machine** gave a total wash score of 420. The **reference machine** always has 12 **place settings** and a total number of load items of 132.

The washing index for the **dishwasher** under test is given using Equation F(1).

$$\begin{aligned} \text{Washing index} &= \frac{446 \times 12}{420 \times 12} \\ &= 1.0619 \end{aligned}$$

As $1.0619 > 0.9$, the **dishwasher** under test meets the requirements of Clause 4.4.

G2 DRYING INDEX

The example in this Paragraph of the calculation of the drying index is for the same load as in Paragraph G1. Load item dry scores are as shown in Table G2.

TABLE G2
TABULATION OF RESULTS

| Load item category | Possible scores | No. of items corresponding to each score | Totals |
|-----------------------------------|-----------------|--|------------------------|
| Crockery | 2 | 35 | 70 |
| | 1 | 15 | 15 |
| | 0 | 10 | 0 |
| Glassware | 2 | 6 | 12 |
| | 1 | 4 | 4 |
| | 0 | 2 | 0 |
| Cutlery | 2 | 21 | 42 |
| | 1 | 29 | 29 |
| | 0 | 10 | 0 |
| Total number of load items N: 132 | | | Total dry score D: 172 |

The drying index for the dishwasher under test is given using Equation F(2).

$$\begin{aligned} \text{Drying index} &= \frac{172}{132 \times 2} \\ &= 0.65152 \end{aligned}$$

As $0.65152 > 0.5$, the **dishwasher** under test meets the requirements of Clause 4.6.

G3 ENERGY CONSUMPTION

The following example of the calculation of the energy consumption is for a hypothetical **dishwasher** that takes in external hot water for the main wash and heats cold water internally for the final rinse (this is unlikely in practice):

TABLE G3
TABULATION OF RESULTS

| Operation | Cold water volume (Q_c) L | Average cold water temperature (t_c) °C | Cold water correction energy (E_c) kWh | Hot water volume (Q_h) L | Average hot water temperature (t_h) °C | Hot water supply energy (E_h) kWh | Total water volume (Q_t) L | Electrical energy (E_e) kWh | Heater operates? (Y/N) | Maximum water bath temperature* °C |
|-----------|----------------------------------|--|---|---------------------------------|---|--|-----------------------------------|------------------------------------|------------------------|---------------------------------------|
| Pre-wash | 5.32 | 19.6 | | | | | 5.32 | 0.096 | N | |
| Wash | | | | 5.56 | 61.1 | 0.266 | 5.56 | 0.098 | N | |
| Rinse 1 | 5.43 | 20.1 | | | | | 5.43 | 0.105 | N | |
| Rinse 2 | 5.45 | 19.7 | | | | | 5.45 | 0.098 | N | |
| Rinse 3 | 5.28 | 19.6 | -0.002 | | | | 5.28 | 0.352 | Y | |
| Total | 21.48 | | -0.002 | 5.56 | | 0.266 | 27.04 | 0.749 | | |

* Option for **dishwashers** under test, mandatory for the **reference machine**.

NOTE: Recording time for each operation is not mandatory but may be useful.

The energy consumption for the dishwasher under test is given using Equation D(1).

$$\begin{aligned}\text{Tested energy consumption } E_t &= 0.749 - 0.002 + 0.266 \\ &= 1.012 \text{ kWh}\end{aligned}$$

No cold water energy correction is undertaken for the pre-wash or rinses 1 and 2 as the internal heater does not operate nor is external hot water consumed (see Paragraph D7).

APPENDIX H
REFERENCE MACHINE DETAILS
(Normative)

H1 MACHINE DESIGNATION

The **reference machine shall** be a Miele, Model No. G590 or G595 REF, manufactured by—

Miele and Cie KG
Carl-Miele-Strasse 29
33332 Guetersloh
Germany

A service viewing window and associated key **shall** be purchased with the **reference machine** to facilitate the performance of calibration checks (measurement of spray arm rotations).

H2 CALIBRATION PROCEDURE

To perform a calibration check on the **reference machine** the appropriate measurements or observations **shall** be made and compared with the values and requirements given in Paragraph H3. If the **reference machine** does not comply with the specified requirements, the test conditions, equipment and procedure **shall** be checked and the measurements repeated as appropriate.

If the **reference machine** still fails to comply, Miele **shall** be contacted to undertake remedial action. In Australia or New Zealand, this enquiry **should** be directed to—

The Technical Manager
Miele Australia Pty Ltd
1 Gilbert Park Drive
KNOXFIELD VIC. 3180
Ph: +61 3 9764 7120
Fax: +61 3 9764 7129

NOTE: Miele G590 and Miele G595 are the trade names of products supplied by Miele. This information is provided for the convenience of users of this Standard and does not constitute an endorsement by the publisher of this trade mark. Items of similar specification may be used if they can be shown to lead to equivalent results.

H3 MACHINE PARAMETERS

The electricity supply for calibration checks **shall** be 230 V $\pm 2\%$ and 50 Hz $\pm 1\%$.

The hoses and pipes **shall** not be kinked. The height of the drain hose (measured from the bottom of the **reference machine** to the highest point of the hose) **shall** be 600 ± 100 mm.

Rinse aid dosage (setting: 2): 1.8 to 2.8 ml.

The dosage **shall** be measured using the device supplied with the **reference machine**.

Spray arm rotation per min with a clean load installed **shall** be within the following limits:

| | |
|---------|------------|
| Top: | 45 ± 4 |
| Middle: | 23 ± 4 |
| Below: | 35 ± 6 |

If the above spray arm requirements are not met, remedial action **shall** be taken. The test **shall** be considered valid if the spray arm rotations remain within the specified tolerance plus or minus 2 rpm from the tolerance values stated above.

NOTE: The spray arm rotations may be measured on any **program / cycle** where the circulating pump is activated.

When the **reference machine** is run on the **reference program** ('Gentle' 45°C or 'FEIN' 45°C' or may be shown as ) in accordance with Appendices B and D, except with a clean load at room temperature and no detergent, the following values **shall** be achieved:

Energy consumption (kWh): 1.25 ± 0.2

Water consumption (L): 27.8 ± 1.5

The total water consumption **should** be adjusted to achieve a value that is as close as possible to the target value above. This **shall** be done by adjusting the pressure-reducing valve on the water inlet that is provided with the **reference machine**. Background and guidance on adjustment of water volume for the **reference machine** is provided in Appendix I. Note that the actual water volume will have some influence on the energy consumption.

Water level (mm) left in sump: 20 ± 5

The water level left in the sump is used as an indicator of the drain pump performance. The water level **shall** be measured at the completion of the **cycle** by removing the sieve and measuring the height of the water level from the lowest point of the sump. There is no adjustment for this parameter—a **reference machine** that operates outside the specified range will require servicing.

Time for the **cycle** (min): 79.0 ± 4

This time is from the start of the **program** until the end of the cycle (i.e. when the operation of the fan at the end of the **cycle** stops). The end of **program** indicator (the off or 'ende' indicator on the fascia panel) is reached approximately 9 min prior to the fan stopping (this time interval needs to be established accurately for the particular **reference machine**, but each **reference machine should** behave consistently). If required, the off or 'ende' indicator can be used as a proxy for checking the **cycle time** (taking into account the fan time).

NOTE: An allowable range for a raw wash performance result (as is included in the IEC Standard) for the **reference machine** is under consideration for the Gentle 45°C **program**.

Maximum water temperatures (°C):

Washing **operation**: $45 \pm 2^\circ\text{C}$

2nd rinsing **operation**: $55 \pm 2^\circ\text{C}$

The water temperature **shall** be measured using a temperature sensor immersed in the water of the sump for all test runs.

APPENDIX I

ADJUSTING WATER CONSUMPTION IN THE REFERENCE MACHINE

(Informative)

I1 PURPOSE

This Appendix provides guidance on how to adjust the water consumption of the **reference machine** in order to achieve the target water consumption of 27.8 L.

I2 BACKGROUND

In order to get repeatable and reproducible performance from the **reference machine**, it is important that the water consumption be carefully monitored and adjusted periodically so that its average total water consumption during the Gentle 45°C **program** (FEIN 45°C) and the Universal **program** is as close as possible to the target water consumption of 27.8 L (this includes the water consumed in the regeneration **operation** at the start of each **program**).

Although the **reference machine** uses a pressure switch to stop overfilling, each fill is controlled primarily by a timer. Therefore the flow rate of the water into the **dishwasher** (and hence the fill volume) is affected by the water pressure at the **dishwasher** inlet. Each **reference machine** is supplied with a pressure control valve which must be installed and which **should** be used to adjust the inlet pressure so that the fill volume is as close as possible to the target volume. If the laboratory supply pressure varies from day to day, it may be necessary to also adjust the inlet pressure reduction valve on the **reference machine** to compensate. This aspect of the **reference machine** performance needs ongoing monitoring.

I3 TARGET VALUES

Experience has shown that to achieve the target volume of 27.8 L in the **reference machine** on a 4 fill **program** (e.g. Gentle, Universal), the fill volumes will be approximately as follows:

- (a) regeneration: 3.15 L
- (b) pre-wash, main wash, rinse 1, rinse 2: Four fills of 6.16 L each

Measurements on a number of **reference machines** suggest that the regeneration **operation** is generally around 11.1% to 11.3% of the total water consumption volume for 4 fill **programs**. However, this can be slightly higher or lower, depending on the **reference machine** under test and the particular run. Each fill volume typically varies by less than 50 ml when inlet pressure conditions are stable (again this depends on the **reference machine** to some degree). Fill volume variations (in ml) for the regeneration **operation** are similar to other **operations**, so this appears slightly more variable (in relative terms) than other **operations**.

Initial adjustment can be made by allowing the **dishwasher** to progress through a regeneration and a single fill **operation** (pre-wash) on the selected **program**. The total water volume can be estimated by adding the regeneration volume to 4 times the pre-wash fill volume. If this is higher than 27.8 L, the pressure reduction valve **should** be closed down and another trial conducted (and vice versa if the volume is too low). When it is estimated that the **dishwasher** is close to the target, the total volume **should** be confirmed with a full **cycle** on the selected **program** (using a load with no detergent as specified in Appendix H). The fill volume **should** be largely unaffected by the presence of soil or detergent in the load.

APPENDIX J

CORRECTING FOR VARIATIONS IN ENERGY CONSUMPTION DURING A TEST SERIES

(Informative)

J1 Purpose

This Appendix is intended to give guidance when assessing the repeatability and reproducibility of the performance of the **dishwasher** used in a series of comparative tests.

J2 Background

When a series of tests are performed for the purpose of energy consumption, the result is partly dependent on the performance of the **dishwasher(s)** selected for testing (and its variability) and partly on the conditions in the test lab during the test. Even though the test conditions in the lab may comply with the requirements of this Standard, some allowable variations within the Standard can have a significant influence on the energy consumption of a **dishwasher**. The main variables of interest within this Standard are the hot water supply temperature, the fill volume and the thermostat operating temperature within the **dishwasher** itself (noting that energy corrections for variations in cold water supply temperature are already included in the Standard as part of E_t).

Within this Standard, hot water is supplied at $60^{\circ}\text{C} \pm 2^{\circ}\text{C}$ (primarily used in supplementary connection mode). Therefore two complying tests on the same **dishwasher** could theoretically have delivery temperatures as different as 4°C . In the case where there were 3 **operations** that used 5 L of hot water each (e.g. main wash and two rinses), this could amount to an energy discrepancy of around 0.07 kWh/cycle between tests (which could amount to 5% of total energy) where there is no top up energy from the internal heater.

Similarly, where the thermostat cut-out temperature varies between tests on the same **dishwasher**, this can have an impact on the measured electric energy consumption (noting that the test laboratory has no control over this variable). Laboratory test experience suggests that this variation can be significant in some **dishwashers**; of the same order as variations in hot water supply temperature. Variations in fill volume can also be significant in some **dishwashers**.

J3 Corrections

During a series of tests, where sufficient data is available, it is possible to compare the test conditions and performance and partially correct the energy consumption. Analysis of this additional data, where available, will assist in the assessment of the validity of the laboratory energy measurements and will allow differences due to allowable variations and **dishwasher** performance to be partly corrected out for comparison purposes. This is particularly useful when a **dishwasher** is being tested at different labs in a round robin. To quantify these impacts it is necessary to have hot water inlet temperature data, water fill volume and bath temperature measurements for each relevant **operation** for each test.

The tested energy consumption E_t of a **dishwasher** over a series of tests can be more fairly compared with the following adjustment factor:

$$E_{t1 \text{ est}} = E_{t2} + E_{\text{adj}} \quad \dots \text{J}(1)$$

where:

$E_{t1 \text{ est}}$ is the estimated tested energy consumption for test 1, based on test 2 data but corrected for test 1 conditions

E_{t2} is the tested energy consumption for test 2 in accordance with equation D(1)

E_{adj} is the adjustment factor given in equation J(2) below.

$$E_{adj} = \frac{\sum [Q_{1hi} \times (t_{1hi} - 20) - Q_{2hi} \times (t_{2hi} - 20)] + [Q_{1i} \times (t_{1i} - 20) - Q_{2i} \times (t_{2i} - 20)]}{860} \dots J(2)$$

where:

- i is the i th relevant **operation** (e.g. rinse, wash etc) in the **program**
- 1 is the relevant variable for test 1
- 2 is the relevant variable for test 2
- Q_{hi} is the hot water fill volume for each relevant **operation** where hot water is used
- Q_i is the total fill volume for each relevant **operation** where the internal heater operates
- t_{hi} is the average hot water temperature for each relevant **operation** where hot water is used
- t_i is the average bath temperature for each relevant **operation** where the internal heater operates

While there are other factors that can affect energy consumption differences in **dishwashers** (e.g. thermal mass of the **dishwasher** itself, insulation levels), calculation of the adjustment factor above **should** provide a more equitable basis for comparison of energy performance for subsequent runs on the same **dishwasher**.

Calculation of the above adjustment factor is useful in tracking and correcting for changes in the performance of a single **dishwasher** during a round robin or in a series of tests within a lab, for example. The approach could also be used in principle to more accurately track the performance of manufacturer production (assuming that there are no fundamental design changes such as fill volume or cut-out temperatures).

Using this approach is not valid when assessing manufacturer claims, even if all the relevant data is available. One issue is that verification tests can rarely be done on the **dishwashers** upon which the manufacturer claim is based. Verification tests are typically done on production **dishwashers** and there is no guarantee that there has been no design change that would affect the actual energy performance of the **dishwasher** e.g. changes in the fill volume control or changes in the thermostat cut-out temperature. The only variable for which it would be valid to make energy adjustments in a verification test when compared to a manufacturer claim would be for variations in the hot water supply temperature for those **operations** where the internal heater does not operate, assuming comparable water volumes are used.

NOTE: Energy efficiency labelling values under AS/NZS 2007.2:2005 are normally measured using cold water connection only (primary water connection mode).

APPENDIX K
DISHWASHER TEST REPORT FORMAT
(Normative)

K1 SCOPE

This Appendix specifies the minimum information to be provided and the required order of presentation of that information in any complying test report.

The requirements of this Appendix do not preclude the use of computer-generated test reports.

K2 WASHING PERFORMANCE

A picture or drawing, clearly illustrating the standard test load as arranged for the test, **shall** be included with the test results. (Refer to Clause 5.3 and Figure 5.1.)

This drawing **shall** be accompanied by the following completed standard information block:

| | | |
|--|---------------------------------------|-------------------------|
| This dishwasher complies with AS/NZS 2007.1, <i>Performance of household electrical appliances—Dishwashers, Part 1: Energy consumption and performance</i> , when tested as follows: | | |
| Brand | _____ | |
| Model | _____ | |
| Program used | _____ | |
| Amount of detergent | Pre-wash _____ (grams) | Main wash _____ (grams) |
| Amount of rinse aid | _____ (ml) or Dispenser setting _____ | |
| Number of place settings | _____ | |

K3 FORM FOR TEST DATA

All of the information shown below **shall** be provided, and **shall** be presented in the order shown. The format given is recommended for compliance with the requirements of this Appendix.

DISHWASHER DETAILS

- Brand:
- Model name and number:.....
- Serial number of dishwasher under test:
- Date of manufacture:
- Country of manufacture:
- Rated capacity, place settings:
- Water connection (hot/cold/dual):.....
- Claimed water consumption:
- Energy label CEC, in kilowatt-hours:
- (If verification test)
- Star rating:.....
- (If verification test)
- Other relevant information and markings:.....
- Water softener fitted?(Y/N) If yes, what action was taken?.....

LABORATORY DETAILS

Laboratory name:
 Address:
 Test officer:

TEST DETAILS

Number and date of relevant Standard:
 Dates of testing:
 Name of test program and program settings:
 Type of test:
 Water connection mode selected (hot/cold/dual):
 Supply voltage:..... V(r.m.s.) Cold water pressure:..... kPa
 Supply frequency:..... Hz Hot water pressure: kPa
 Ambient air temperature:..... °C Water hardness: ppm
 Relative humidity:%

If the source of electricity is not mains in Australia or New Zealand, provide details:

Load type used: (indicate load used)
 AS/NZS load (Paragraph A12.2) IEC non-AHAM load (Paragraph A12.3)

SUMMARY OF RESULTS

Does the rated capacity comply with the requirements of Clause 4.3? (Y/N)
 Dishwasher under test total wash score (W_t):.....
 Reference machine total wash score (W_r):.....
 Dishwasher under test place settings (N_t):
 Reference machine place settings (N_r):..... 12
 Washing index:
 Does the washing index comply with the requirements of Clause 4.4? (Y/N)
 Total drying score (D):.....
 Drying index:
 Does the drying index comply with the requirements of Clause 4.6: (Y/N)
 Does the water consumption comply with the requirements of Clause 4.5?..... (Y/N)

Provide the following data for the dishwasher under test:

Test program energy consumption (E):.....
 Cold water correction energy ($E_{c,pr}$):
 Hot water supply energy ($E_{h,pr}$):
 Cold water volume ($Q_{c,pr}$):
 Hot water volume ($Q_{h,pr}$):
 Total water volume (Q_{tot}):
 Cycle time:.....
 Program time:

If there was a time difference between the end of program and end of cycle, provide details of test procedure during this time and also record time and energy below:

.....
 Time between end of program and end of cycle (min):.....
 Energy between end of program and end of cycle (Wh):.....

Standby power: off mode (*W*) (if applicable):.....

Standby power: delay start mode (*W*) (if measured):

Standby power: end of cycle mode (*W*):.....

Where the manufacturer recommends an alternative configuration or set up which results in a lower power consumption than off mode while the appliance is still connected to the mains, this power level and a description of the mode should be recorded.

Provide the following data tabulated according to Table K1 for each operation for the dishwasher under test and the reference machine:

**TABLE K1
TABULATION OF RESULTS**

| Operation | Cold water volume (Q_c) L | Average cold water temperature (t_c) °C | Cold water correction energy (E_c) kWh | Hot water volume (Q_h) L | Average hot water temperature (t_h) °C | Hot water supply energy (E_h) kWh | Total water volume (Q_t) L | Electrical energy (E_e) kWh | Heater operates? (Y/N) | Maximum* water bath temperature °C |
|-----------|----------------------------------|--|---|---------------------------------|---|--|-----------------------------------|------------------------------------|------------------------|---------------------------------------|
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Total | $Q_{c\ pr} =$ | | $E_{c\ pr} =$ | $Q_{h\ pr} =$ | | $E_{h\ pr} =$ | $Q_{t\ pr} =$ | $E_{e\ pr} =$ | | |

* Optional for dishwashers under test, mandatory for the reference machine. Recording time for each operation is not mandatory but may be useful.

APPENDIX L
VIEWING CABINET
(Informative)

A cabinet as specified in this Appendix may be provided for the evaluation of load items for a wash or dry test (refer to Figure L1).

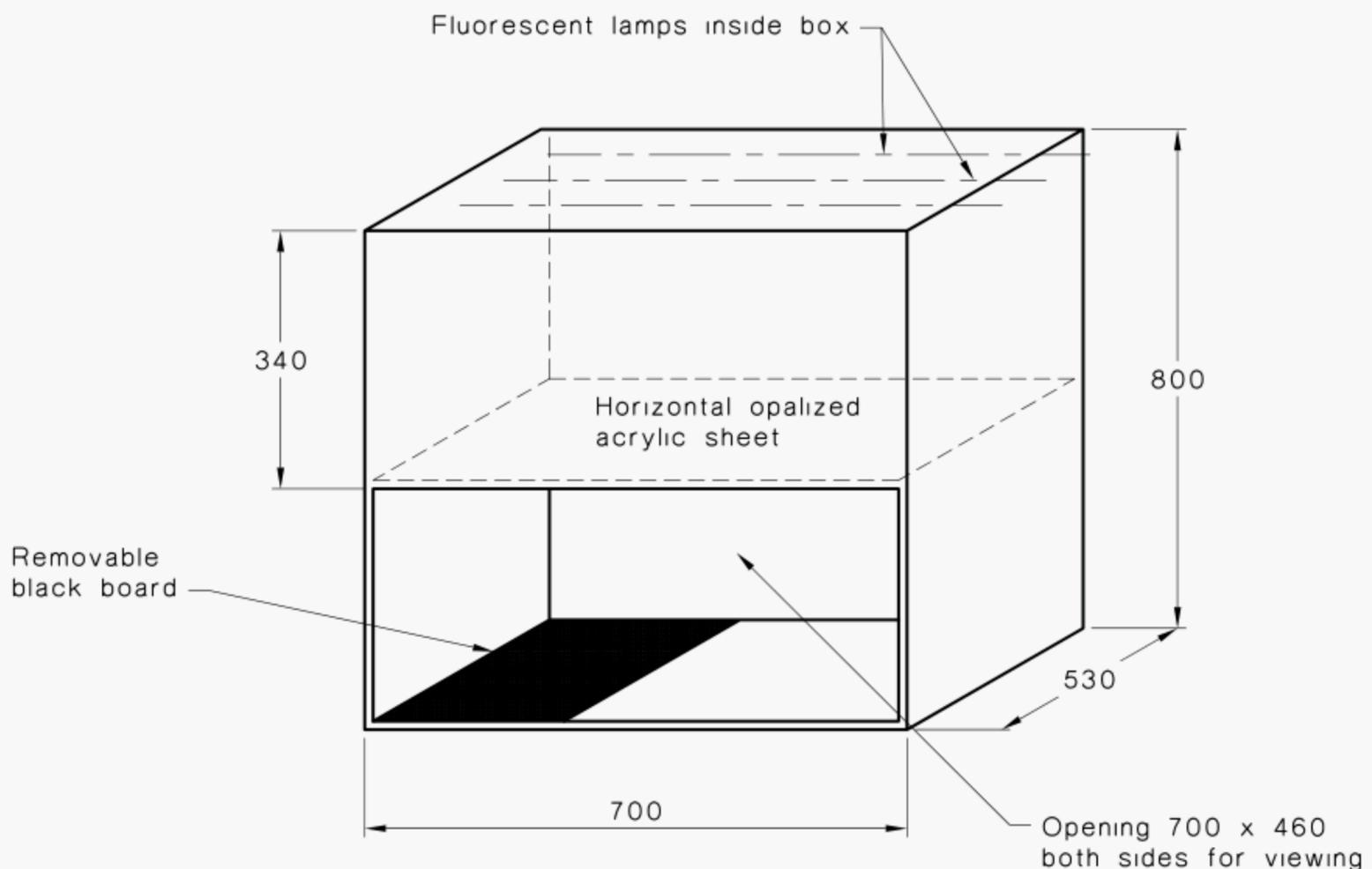
The viewing cabinet **shall** be a box approximately 700 mm wide by 530 mm deep by 800 mm high, either painted internally with a neutral grey paint or constructed from or lined with a pre-finished board. The colour **shall** be equal to light grey N35 as specified in AS 2700. Both the 700 mm sides **shall** be open to facilitate viewing by judges on opposite sides.

The lighting conditions, measured at the position of evaluating load items for a washing or drying performance test, **shall** be diffused lighting maintained within the following limits:

- (a) A colour temperature of 3500 – 4500 K.
- (b) A luminance level of 1000 – 1500 lux.

To achieve the above conditions, three 18 W linear fluorescent lamps (nominally 600 mm long) may be installed in the top of the box, the tubes being screened from view by partitions extending 340 mm down from the top of the box. The light source **shall** be diffused through an opalized acrylic sheet fixed 200 mm below the lamps.

A removable board approximately 250 mm wide by 530 mm deep by approximately 6 mm thick, painted matt black on the upper surface, **shall** be provided for the evaluation of transparent articles (see Figure L1).



DIMENSIONS IN MILLIMETRES

FIGURE L1 TYPICAL VIEWING CABINET

APPENDIX M
EXAMPLES OF STANDBY MODES
(Informative)

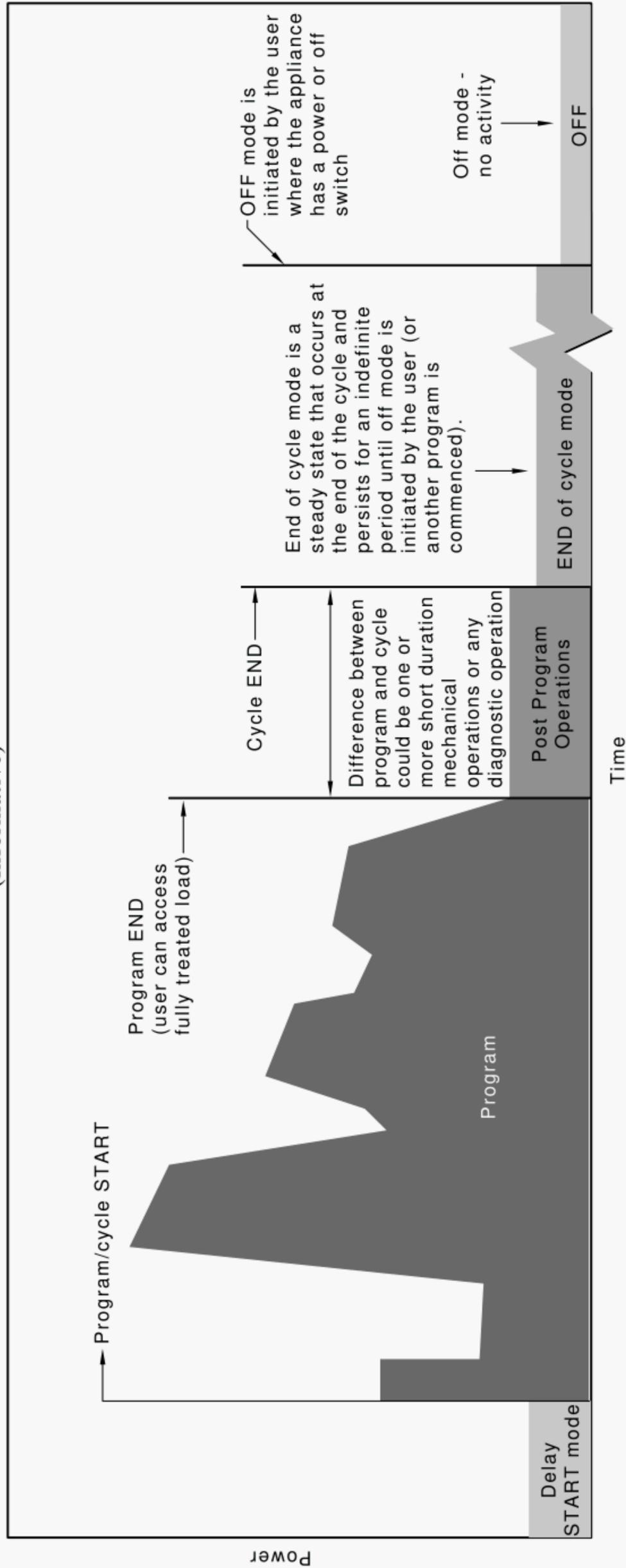


FIGURE M1 SCHEMATIC REPRESENTATION OF STANDBY MODES

NOTES

NOTES

Standards Australia

Standards Australia is an independent company, limited by guarantee, which prepares and publishes most of the voluntary technical and commercial standards used in Australia. These standards are developed through an open process of consultation and consensus, in which all interested parties are invited to participate. Through a Memorandum of Understanding with the Commonwealth government, Standards Australia is recognized as Australia's peak national standards body.

Standards New Zealand

The first national Standards organization was created in New Zealand in 1932. The Standards Council of New Zealand is the national authority responsible for the production of Standards. Standards New Zealand is the trading arm of the Standards Council established under the Standards Act 1988.

Australian/New Zealand Standards

Under a Memorandum of Understanding between Standards Australia and Standards New Zealand, Australian/New Zealand Standards are prepared by committees of experts from industry, governments, consumers and other sectors. The requirements or recommendations contained in published Standards are a consensus of the views of representative interests and also take account of comments received from other sources. They reflect the latest scientific and industry experience. Australian/New Zealand Standards are kept under continuous review after publication and are updated regularly to take account of changing technology.

International Involvement

Standards Australia and Standards New Zealand are responsible for ensuring that the Australian and New Zealand viewpoints are considered in the formulation of international Standards and that the latest international experience is incorporated in national and Joint Standards. This role is vital in assisting local industry to compete in international markets. Both organizations are the national members of ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission).

Visit our web sites

www.standards.org.au

www.standards.co.nz

www.standards.com.au



GPO Box 476 Sydney NSW 2001

Administration

Phone (02) 8206 6000

Fax (02) 8206 6001

Email mail@standards.com.au

Customer Service

Phone 1300 65 46 46

Fax 1300 65 49 49

Email sales@standards.com.au

Internet www.standards.org.au



Level 10 Radio New Zealand House

155 The Terrace Wellington 6001

(Private Bag 2439 Wellington 6020)

Phone (04) 498 5990

Fax (04) 498 5994

Customer Services (04) 498 5991

Information Service (04) 498 5992

Email snz@standards.co.nz

Internet www.standards.co.nz

This page has been left intentionally blank.