

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Electric dishwashers for household use – Methods for measuring the performance

Lave-vaisselle électriques à usage domestique – Méthodes de mesure de l'aptitude à la fonction



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Electric dishwashers for household use – Methods for measuring the performance

Lave-vaisselle électriques à usage domestique – Méthodes de mesure de l'aptitude à la fonction

INTERNATIONAL
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COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTRIC DISHWASHERS FOR HOUSEHOLD USE –
METHODS FOR MEASURING THE PERFORMANCE**

FOREWORD

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International Standard IEC 60436 has been prepared by subcommittee 59A: Electric dishwashers, of IEC technical committee 59: Performance of household electrical appliances.

This fourth edition cancels and replaces the third edition published in 2004, its Amendment 1 published in 2009 and its Amendment 2 published in 2012.

This edition constitutes a technical revision and includes the following significant technical changes with respect to the previous edition:

- a) Addition of a specification of the reference dishwasher G1222, addition of the microwave oven 752C, inclusion of standby/low power modes and updated cutlery and tableware items.
- b) Combined cleaning and drying: combining the cleaning and drying performance evaluations into one test, along with the energy and water consumption evaluation, prevents an opportunity for circumvention if tests were performed separately. A dishwasher can detect whether soil is present (cleaning evaluation) or not (drying

evaluation) and adjust the cycle to favour performance; combining the tests addresses this.

- c) New dish load items: new dish load items were incorporated which reflect consumer use. New items are: stainless pots, coffee mugs, melamine plastic items, and glass bowl. The new load items provide different shapes which challenge a dishwasher water spray patterns and provide additional surfaces for soil removal assessment.
- d) Detergent: a new detergent "D" is specified which mirrors current tablet formulations available on the market. Detergent type D is phosphate free, with percarbonate instead of perborate bleach and more active enzymes.
- e) Repeatability and reproducibility improvements.
- f) Addition of annexes for the evaluation of soil sensing programmes, rinsing performance, dishwasher filtration and of an annex on the inlet water temperature influence on energy consumption.

The text of this standard is based on the following documents:

FDIS	Report on voting
59A/202/FDIS	59A/203/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The following print type is used in this standard:

- words in **bold** are defined in Clause 3.

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- reconfirmed,
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The contents of the corrigendum of September 2020 have been included in this copy.

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INTRODUCTION

The history of this fourth edition of IEC 60436 is provided as follows:

- Discussion began during the Sydney Australia meeting in September 2008.
- A first working draft was developed and discussed during the Seattle USA meeting in October 2010.
- A questionnaire (59A/149/Q) regarding proposed changes was published January 2011. Responses (59A/153/RQ) were reviewed during a meeting in Bonn Germany April 2011 and published May 2011.
- A Document for Comment (59A/155/DC) was published May 2011. Review of responses (59A/164/INF) began during the Melbourne Australia meeting in October 2011.
- A Committee Draft (59A/168/CD) was published May 2012. Review of responses (59A/170/CC) began during the Oslo Norway meeting in October 2012.
- A second Committee Draft (59A/175/CD) was published May 2013. Review of responses (59A/177/CC) began during the New Delhi India meeting in October 2013.
- Committee Documents for Vote (59A/183/CDV and 59A/184/CDV) were published June 2014. 59A/183/CDV (fragment 1) contained the complete edition 4, except for some Annex U content; 59A/184/CDV (fragment 2) contained additional Annex U content. Review of responses (59A/190b/RVC and 59A/191b/RVC for fragments 1 and 2) began during the Tokyo Japan meeting in October 2014.
- The FDIS document was prepared for publication built upon this history of work.

A Round Robin Test (RRT) has been planned and will be carried out using edition 4. Results from the RRT will be available after the edition 4 is published. Edition 4 updates, if needed, will be incorporated into edition 4 Amendment 1.

ELECTRIC DISHWASHERS FOR HOUSEHOLD USE – METHODS FOR MEASURING THE PERFORMANCE

1 Scope

This International Standard applies to electric **dishwashers** for household and similar use that are supplied with hot and/or cold water.

The object is to state and define the principal performance characteristics of electric **dishwashers** for household and similar use and to describe the standard methods of measuring these characteristics.

This standard is concerned neither with safety nor with minimum performance requirements.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60704-2-3, *Household and similar electrical appliances – Test code for the determination of airborne acoustical noise – Part 2-3: Particular requirements for dishwashers*

IEC 60705, *Household microwave ovens – Methods for measuring performance*

IEC 60734, *Household electrical appliances – Performance – Water for testing*

IEC 62301, *Household electrical appliances – Measurement of standby power*

ISO 607, *Surface active agents and detergents – Methods of sample division*

ISO 80000-1:2009, *Quantities and Units – Part 1: General*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1

dishwasher

machine that cleans, rinses and dries **tableware** by chemical, mechanical, thermal, and electric means

Note 1 to entry: A **dishwasher** can have a specific drying **operation** at the end of the **programme**.

Note 2 to entry: Different **dishwasher** types are designated by manufacturers e.g. **free-standing**, **built-in** or **integrated**.

3.1.2

free-standing dishwasher

dishwasher which is intended to be installed without an enclosing structure



3.1.3**built-in dishwasher**

dishwasher which is intended to be installed inside an enclosing structure such as a kitchen cupboard

3.1.4**integrated dishwasher**

built-in dishwasher which is designed to have a board fitted to the **dishwasher** door

3.1.5**test machine**

dishwasher under test

3.1.6**reference machine**

dishwasher used to standardise cleaning and drying performance measurements

Note 1 to entry: A **reference machine** is specified for use in this standard (see Annex I).

3.1.7**test run**

single **cycle** performance assessment

3.1.8**test series**

set of **test runs** which are collectively used to assess the performance

3.1.9**tableware**

dishware, glassware, cutlery and **serving pieces** used according to this standard to test a **dishwasher**

3.1.10**place setting**

set of **tableware** for the use by one person, not including **serving pieces**

Note 1 to entry: A **place setting** is comprised of different items used for breakfast and lunch (type A); and dessert and dinner (type B).

3.1.11**serving pieces**

set of items for preparation and serving of food which can include pots, serving bowls, serving cutlery and a platter

3.1.12**rated dishwasher capacity**

whole number of **place settings** together with the **serving pieces** which can be cleaned and dried in one **cycle** when loaded in accordance with the manufacturer's instructions

Note 1 to entry: The **rated dishwasher capacity** is declared by the manufacturer and expressed as a number of **place settings**.

3.1.13**operation**

each event that occurs during the **dishwasher programme** such as cleaning, rinsing or drying

3.1.14**programme**

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 and together form a complete **cycle**

3.1.15

cycle

complete cleaning, rinsing, and drying process, as defined by the **programme** selected, consisting of a series of **operations** until all activity ceases

3.1.16

cycle time

length of time beginning with the initiation of the **cycle** (of the selected **programme**), excluding any user programmed delay, until all activity ceases (i.e. the end of the **cycle**)

3.1.17

programme time

length of time beginning with the initiation of the **cycle** (of the selected **programme**), excluding any user programmed delay, until an end of **programme** indicator is activated and the user has access to the load

Note 1 to entry: If there is no end of **programme** indicator, the **programme time** is equal to the **cycle time**.

3.1.18

automatic dispenser

device activated automatically which injects or dispenses **detergent** or **rinse aid**, one or more times into the **dishwasher** at predetermined points in the **dishwasher cycle**

3.1.19

non-automatic dispenser

device, usually a fixed cup or cavity on the **dishwasher** door, cover, or **rack**, which deposits a previously measured amount of **detergent** or **rinse aid**, into the **dishwasher**

3.1.20

water softener

device which reduces the hardness of water

3.1.21

regeneration

process by which softening capacity is restored to a **water softener**

3.1.22

rack

support for holding dishware, cutlery, and/or glassware in the **dishwasher**

3.1.23

detergent

cleaning agent for use in **dishwashers** to aid in the removal of food soils by chemical means

Note 1 to entry: A reference **detergent** in powder form is specified for use in this standard (see 5.7).

3.1.24

rinse aid

chemical agent added to the water in the last rinsing **operation** to improve the drying effect and reduce water marks

Note 1 to entry: A reference **rinse aid** is specified for use in this standard (see 5.8).

3.1.25

end of cycle mode

mode that occurs after the completion of the **cycle**, without any further intervention of the user

Note 1 to entry: This mode can persist or may be of limited duration where a **power management system** is present.

3.1.26

left on mode

mode that occurs after the completion of the **cycle**, with the door opened and unlatched, without any further intervention of the user

Note 1 to entry: In some products this mode can be equivalent to **off mode**.

Note 2 to entry: This mode can persist or can be of limited duration where a **power management system** is present.

3.1.27

off mode

mode where the product is switched off using appliance controls or switches that are accessible and intended for operation by the user during normal use to attain the lowest power consumption

Note 1 to entry: If an appliance is equipped with a **power management system**, the lowest power consumption that can persist will be reached automatically.

Note 2 to entry: This mode can persist while connected to a mains power source.

3.1.28

delay start mode

mode where the user has selected a specified delay to the commencement of the **cycle** (of the selected **programme**)

Note 1 to entry: This mode is only applicable to **dishwashers** that provide a delay start function for the user.

3.1.29

end of cycle mode duration

time for the **dishwasher** to revert automatically to **off mode** after the end of the **cycle** without any further intervention of the operator

Note 1 to entry: End of **cycle** is reached when all activities cease (according to 3.1.15 and 3.1.16).

Note 2 to entry: This mode applies if the **test machine** is equipped with a **power management system**.

3.1.30

left on mode duration

time for the **dishwasher** to revert automatically to **off mode** after the end of the **cycle** with the door unlatched and opened

Note 1 to entry: The **left on mode duration** is declared by the manufacturer.

Note 2 to entry: End of **cycle** is reached when all activities cease (according to 3.1.15 and 3.1.16).

Note 3 to entry: This mode applies if the **test machine** is equipped with a **power management system**.

3.1.31

power management system

system within the **dishwasher** which allows it to revert automatically to **off mode** after the completion of the **cycle**

3.1.32

refrigerated

storage of foods at a temperature of $(4 \pm 3) ^\circ\text{C}$

3.1.33

freeze

storage of foods at a temperature of $(-18 \pm 3) ^\circ\text{C}$

3.1.34

automatic or self-cleaning filter

filter system which does not require frequent cleaning by the user

3.1.35

manual filter

filter system which requires frequent cleaning by the user

3.2 Symbols

3.2.1 Symbols related to the application of egg (6.4.5.3)

A_t the total amount of soil to be applied to all the items to be soiled for each item type t ;

N_t the number of items of type t to be soiled with egg;

M_t the average mass of egg to be applied to each item of type t

3.2.2 Symbols related to the calculation of the drying index (7.2.3)

N the total number of scores for all items;

n the number of combined cleaning and drying **test runs**;

s_z the total number of scores per item number;

$D_{R,z}$ the sum of drying scores of the **reference machine**;

$D_{T,z}$ the sum of drying scores of the **test machine**;

$D_{R,i}$ the average drying score for one **test run** of the **reference machine**;

$D_{T,i}$ the average drying score for one **test run** of the **test machine**;

$\ln P_{D,i}$ the logarithm of the drying performance index for one **test run** of the **test machine**;

$\ln P_D$ the arithmetical average of $\ln P_{D,i}$;

$\ln S_D$ the drying standard deviation of the $\ln P_{D,i}$;

$\ln W_D$ the half range of the logarithmic drying confidence interval;

$t_{f,1-\alpha/2}$ a numerical factor, depending on the number $f = n - 1$ degrees of freedom for the chosen confidence level $1 - \alpha = 0,95$ with two-sided demarcation (see Table 5);

P_D the drying performance index for the **test series**.

3.2.3 Symbols related to the calculation of the cleaning index (7.3.2)

N the total number of scores for all items;

n the number of combined cleaning and drying **test runs**;

s_z the total number of scores per item number;

$C_{R,z}$ the sum of cleaning scores of the **reference machine**;

$C_{T,z}$ the sum of cleaning scores of the **test machine**;

$C_{R,i}$ the average cleaning score for one **test run** of the **reference machine**;

$C_{T,i}$ the average cleaning score for one **test run** of the **test machine**;

$\ln P_{C,i}$ the logarithm of the cleaning performance index for one **test run** of the **test machine**;

$\ln P_C$ the arithmetical average of $\ln P_{C,i}$;

$\ln S_C$ the cleaning standard deviation of the $\ln P_{C,i}$;

$\ln W_C$ the half range of the logarithmic cleaning confidence interval;

$t_{f,1-\alpha/2}$ a numerical factor, depending on the number $f = n - 1$ degrees of freedom for the chosen confidence level $1 - \alpha = 0,95$ with two-sided demarcation (see Table 5);

P_C the cleaning performance index for the **test series**.

3.2.4 Symbols related to the measurements (Clause 8 and Annex U)

E_e	the electrical energy;
E_h	the hot water energy;
E_c	the cold water correction energy;
t_h	the volume-weighted average inlet temperature of all hot water;
t_{hi}	the temperature of each increment of hot water supplied to the test machine ;
Q_{hi}	the volume of each increment of hot water supplied to the test machine;
Q_h	the volume of hot water supplied to the test machine ;
Q_t	the total water volume;
t_c	the volume-weighted average inlet temperature;
t_{ci}	the temperature of each increment of water supplied to the test machine which is subsequently heated by the internal heater of the machine;
Q_{ci}	the volume of each increment of water supplied to the test machine which is subsequently heated by the internal heater of the machine;
Q_c	the volume of the cold water supplied to the test machine .
$E_{\text{Regional-e}}$	the estimated energy consumption for the dishwasher for a cold water supply temperature of t_{nr} ;
$E_{\text{IEC15 } ^\circ\text{C-m}}$	the measured energy for the dishwasher in accordance with 8.2.2 with a cold water supply temperature of 15 °C;
t_{nr}	the nominal non-standard cold water temperature for the region;
Q_a	the cold water volume of all cold fills that occur in heated operations ;
Q_b	the cold water volume of all cold fills for non-heated operations , excluding any cold fills that occur after the last heated operation;
$E_{\text{IEC15 } ^\circ\text{C-e}}$	the estimated energy for the dishwasher with a cold water supply temperature of 15 °C;
$E_{\text{Regional-m}}$	the measured energy consumption for the dishwasher for a cold water supply temperature of t_{nr} but otherwise in accordance with 8.2.2.

3.2.5 Symbols related to the microwave calibration (Annex F)

$t_{u,1}$	the required cooking time in min at the nominal output power P_1 ;
P_1	the nominal output power of 780 W;
t_1	the nominal cooking time at the nominal output power P_1 of 4 min;
$P_{u,1}$	the measured power output in W at the nominal output power P_1 ;
t_c	the time correction in min depending on the cleaning performance of the milk glasses;
$t_{u,2}$	the required cooking time in min at the nominal output power P_2 ;
P_2	the nominal output power of 150 W;
t_2	the nominal cooking time at the nominal output power P_2 of 10 min;
$P_{u,2}$	the measured power output in W at the nominal output power P_2 .

4 List of measurements

The standard methods of measuring the performance characteristics are determined as follows:

- combined cleaning and drying performance according to Clause 6 and 7;
- energy consumption, water consumption, **cycle time** and **programme time** according to Clause 8;
- airborne acoustical noise according to Clause 9;

- additional aspects of energy consumption of **dishwashers** (low power modes) according to Annex K.

5 General conditions for measurements

5.1 General

5.1.1 General information

The **dishwasher** manufacturer's instructions regarding installation and use of the **dishwasher** shall be followed, except where there is a conflict with this standard, in which case this standard shall prevail.

Manufacturers should provide sufficient information on relevant test conditions for the **test machine**, including installation instructions, **detergent** amounts, **rinse aid** settings, **water softener** settings (if applicable), filter type, and loading schemes.

Performance tests according to this standard are generally carried out on a new machine, with a **reference machine** running parallel with the **test machine(s)**, i.e. at the same time under the same conditions using soil prepared at the same time from the same batch. The **reference machine** shall be in accordance with the description given in Annex I.

The **reference machine** shall always be installed as a **free-standing** machine independent of the type of **test machine**.

Before commencing a **test series**, the **reference** and **test machines** shall be checked to ensure that they are operating properly.

All tests shall be started with the appliances at the ambient temperature according to 5.5.

NOTE An appliance which has been stored for 12 h at ambient conditions is considered to be at ambient temperature.

The tolerances specified for parameters within this document, using the symbol " $\pm$ ", indicate the allowable limits of variation from the specified parameter outside which the test or results shall be invalid. The statement of tolerance does not permit the deliberate variation of these specified parameters.

Rounding shall not be applied to the results of intermediate calculations. If numbers have to be rounded, they shall be rounded to the nearest number according to ISO 80000-1:2009, Annex B, Clause B.3, Rule B. If the digit to be rounded is five or more, it shall be rounded up. If the rounding takes place to the right of the comma, the omitted places shall not be filled with zeros.

Requirements for measurements and instrumentation and their accuracy are described in Table T.1.

5.1.2 Free standing dishwashers

Dishwashers shall be tested as **free-standing** except where they are designated as **built-in** or **integrated** (refer to 5.1.3). **Dishwashers** that can be installed as either **free-standing** or **built-in/integrated** shall be tested as **free-standing**.

5.1.3 Built-in and integrated dishwashers

Dishwashers that can only be installed as **built-in** or **integrated**, shall be installed in an enclosure according to Annex N. The enclosure is illustrated in Figure N.1.

5.2 Sequence of test procedures and conditioning of the test machine

Before conducting performance tests on a new **dishwasher**, it shall be operated for at least three **cycles**, using a **programme** suitable for normally or heavily soiled **tableware**, with reference **detergent** (specified in 5.7) and with reference **rinse aid** (specified in 5.8), to remove manufacturing residue; a clean load or no load may be used.

NOTE Any **cycles** or **operations** performed on the appliance during the manufacture of the product are ignored.

If noise measurements should be done, they shall be carried out before any performance measurements and in accordance with Clause 9. For noise tests the conditions of the respective standard should be fulfilled. No additional **cycles** shall be carried out on the **test machine** between the sequential steps specified in the following procedure.

The assessment of the cleaning and/or drying performance shall be performed using a soiled load (Clause 6). Drying and cleaning performance may be both assessed consecutively on a single **test run** or on separate **test runs**. The determination of energy consumption, water consumption, **cycle time** and **programme time** (Clause 8) shall be done concurrently with the combined cleaning and drying performance test (Clause 6 and 7).

Manufacturers or suppliers may have information on the design and **operation** of their **dishwashers** which would allow an equivalent determination of the drying performance using an alternate method, for example, with unsoiled **tableware** and in a separate test. For declaration and verification purposes according to this standard, the method specified in the previous paragraph using a soiled load takes precedence over any other determination. The method used shall be reported.

Between two **test series** the **reference** and **test machines** shall be cleaned by operating for at least two **cycles** in the test programme with reference **detergent** (specified in 5.7). Prior to starting a new **test series**, ensure that the filters and all visible areas of the machine, and areas that can be cleaned according to the manufacturer's instructions to the user, are clean. When checking for soil residue in the **dishwasher**, particular attention should be paid to accumulations in locations such as filters, sump, spray arms, door seals and **rack** rails

If recommended by the manufacturer, adjust the **water softener** and add salt as per 5.9.

5.3 Electricity supply for machines

5.3.1 Electricity supply for test machine

5.3.1.1 Voltage

The test voltage shall be set at the rated voltage of the **test machine** and maintained within the range of ± 2 % throughout the test. If a voltage range is indicated, then the test voltage shall be set at the nominal voltage of the country in which the appliance is intended to be used. The measured voltage shall be reported.

5.3.1.2 Frequency

The supply frequency shall be set at the rated frequency of the **test machine** and maintained within the range ± 1 % throughout the test. If a frequency range is indicated, then the testing shall be carried out at the nominal frequency of the country in which the appliance is intended to be used. The measured frequency shall be reported.

5.3.2 Electricity supply for the reference machine

5.3.2.1 Voltage

The supply voltage shall be set at 230 V a.c. and maintained within ± 2 % throughout the test. The measured voltage shall be reported.

5.3.2.2 Frequency

The supply frequency shall be set at 50 Hz and maintained within ± 1 % throughout the test. The measured frequency shall be reported.

5.4 Test programme

The **programme** to be tested for noise and performance measurements is typically the one recommended by the manufacturer for a normally soiled load.

Additional programmes may then be tested.

NOTE In some countries the manufacturer has to declare the **programme** to be used for the purpose of energy labelling (which may not be for a normally soiled load). In some countries the programme is legislated and the rules for compliance have to be followed.

The same **programme** shall be used for measuring the combined cleaning and drying performance according to Clause 6 and 7; the energy consumption, water consumption, **cycle time** and **programme time** according to Clause 8; and the noise according to Clause 9, if tested.

The name of the **programme** tested shall be reported.

5.5 Ambient conditions

The following ambient conditions shall be maintained throughout the soiling, drying and measurement process. The conditions shall be reported.

- Ambient temperature of the room: $(23 \pm 2) ^\circ\text{C}$
- Relative humidity: $(55 \pm 10) \%$

5.6 Water

5.6.1 General

Subclause 5.6 describes the characteristics of the water supply to be connected to the **dishwasher** while it is being prepared for testing and throughout the testing process. It also includes a specification for water to be used in the preparation of soil (e.g. tea according to 6.4.3, minced meat according to 6.4.4 and oat flakes according to 6.4.6).

The actual water conditions (temperature, hardness, and pressure) maintained during the tests shall be reported.

5.6.2 Water temperature

The temperature of the supply water shall be:

- cold water feed temperature:
 - $(15 \pm 2) ^\circ\text{C}$.
- hot water feed temperature:
 - temperature indicated by the manufacturer $\pm 2 ^\circ\text{C}$, or
 - where a range is specified by the manufacturer which does include $60 ^\circ\text{C}$, $(60 \pm 2) ^\circ\text{C}$, or
 - where a range is specified by the manufacturer which does not include $60 ^\circ\text{C}$, the value nearest to $(60 \pm 2) ^\circ\text{C}$, or
 - $(60 \pm 2) ^\circ\text{C}$, if instructions are not given.

NOTE Some countries specify a hot water temperature for regulatory purposes, in which case this water temperature should be used for testing.

For **dishwashers** that include a water supply line (i.e. the water inlet hose is supplied by the manufacturer), the volume of the water pipe between the measurement device for temperature and the connection point to the water inlet hose of the test **dishwasher** shall not exceed 250 ml. For **dishwashers** that do not include a water supply line (i.e. the water inlet hose is not supplied by the manufacturer), the volume of the water pipe between the measurement device for temperature and the connection point to the water inlet supply valve of the test **dishwasher** shall not exceed 400 ml. If a bypass to ensure water supply temperature is installed, at each connection to the water inlet hose(s), or water inlet supply valve, of the **dishwasher**, the bypass shall be opened before starting tests until the water inlet temperature is in the required range. If the temperature is measured in the circulation loop the volume of the spur taking the water from the circulation loop shall not exceed 250 ml for **dishwashers** that include a water supply line, or shall not exceed 400 ml for **dishwashers** that do not include a water supply line.

5.6.3 Water hardness

If hard water is used it shall have a total water hardness of $(2,5 \pm 0,5)$ mmol/l. If soft water is used it shall have a total water hardness of $\leq 0,85$ mmol/l. If water hardness needs to be adjusted to meet these specifications, it shall be prepared according to IEC 60734 – Methods B, C1, C2 or C3. The measured water hardness shall be reported. The water hardness used in the test shall be the one most applicable to the country of intended use.

5.6.4 Water pressure

The pressure of the water supply at each water inlet shall be set at 240 kPa and shall be maintained within the range ± 20 kPa during all fills. The measured water pressure shall be reported. Where the manufacturer specifies a range of water pressure that does not include (240 ± 20) kPa, the water pressure shall be set at the end of the pressure range closest to (240 ± 20) kPa.

5.7 Detergent

The reference **detergent** D, as described in Annex E, shall be used in the **reference** and **test machines**. The quantity for one **test run** shall be as recommended by the manufacturer, but not more than

8 g + 1 g per **place setting** loaded.

The maximum amount stated above shall be used if no recommendation is given by the manufacturer.

The quantity of **detergent** used during the tests shall be reported.

Refer to I.1.2 for the amount of **detergent** used in the **reference machine**.

The **detergent** shall be placed in the **dishwasher** immediately prior to starting the **programme** in the locations specified by the manufacturer. If a **dispenser** is fitted, some or all of the **detergent** dose shall be placed in it according to the manufacturer's instructions. The **dispenser** shall be clean and dry prior to the placement of **detergent**. In the absence of manufacturer's recommendations, the **detergent** shall be placed in the main compartment of the **dispenser**.

Detergent from the same batch shall be used for the **reference** and **test machines**.

Before use the **detergent** shall be homogenized in accordance with ISO 607 (refer to Annex L for suitable equipment).

The **detergent** shall be stored in a waterproof container in quantities of no more than 1 kg in a cool and dry atmosphere. It shall be used within six months after production.

5.8 Rinse aid

The **rinse aid** Formula “III”, as described in Annex E, shall be used.

For **dishwashers** with an adjustable **automatic dispenser**, the setting shall be as recommended by the manufacturer. In the absence of such an indication, the setting shall be used which gives the lowest quantity of **rinse aid**.

Any requirement or recommendation to experiment with the setting by the laboratory shall be ignored.

For machines without **automatic dispensers**, the **rinse aid** shall be added manually, if so recommended by the manufacturer and in accordance with their instructions.

5.9 Salt

If the **dishwasher** is equipped with a **water softener** that requires salt, fill the salt reservoir in accordance with the manufacturer's instructions. For specification of the salt, see Annex E.

For **dishwashers** with an adjustable **water softener**, the setting shall be as recommended by the manufacturer for the water hardness used for the test. Where there is no recommendation, use the lowest setting.

6 Combined cleaning and drying performance tests

6.1 General and purpose

The purpose of this test is to measure how well the appliance cleans and dries normally soiled **place settings** and **serving pieces**.

The tests are carried out in parallel with the **reference machine** specified in Annex I; under conditions described in Clause 5. The **reference** and **test machines** shall be prepared according to Clause 5 using a load as specified in 6.2 and soiled according to 6.4 with soils specified in 6.3. The **tableware** shall be dried (using either the air drying or oven drying method) according to 6.5 and placed into the machines according to 6.6. The test results shall be evaluated according to Clause 7.

The sequence of the test procedure as specified in 5.2 shall be followed.

Soiling of the test loads for the **reference** and **test machines** shall be prepared in parallel.

For a large number of test loads, it may be necessary to have more than one person preparing soils, but one person shall prepare each soil type for all loads. Similarly, one person shall apply each soil type for all loads (the person preparing soils may be different to the person applying soils).

6.2 Load

6.2.1 Composition of the test load

The test load shall comprise specific numbers of each **tableware** item according to the rated capacity of the **test machine** as described in Annex A. The physical condition of the **tableware** items shall meet the description in Annex A.

6.2.2 Requirements for pre-conditioning of new tableware

New **tableware** items shall be pre-conditioned by washing them for three **cycles** using **detergent** (specified in 5.7) and **rinse aid** (specified in 5.8). Use a **dishwasher**, other than the **test machine** or the **reference machine**, with a **programme** suitable for normally or heavily soiled **tableware**.

6.2.3 Requirements for conditioning of tableware

All **tableware** items shall be clean, dry and conditioned prior to the **test run**. In this case 'clean' means that an item would score 5 if assessed according to Clause 7 and 'dry' means that an item would score 2 if assessed according to Clause 7.

Special attention should be paid to soup plates (specified in A.2) soiled with oat flakes (specified in 6.4.6.1) to verify they are free of starch residue from previous tests. This can be checked by applying Lugols solution after each cleaning performance test. Lugols solution can be obtained from supplier mentioned in L.1.15.

The **tableware** items shall be conditioned in a **dishwasher** using **detergent**; the type of **detergent** specified in 5.7 is recommended but not required. The **dishwasher** shall dispense **rinse aid** (specified in 5.8) in the final **operation** prior to the next test. Use a **dishwasher**, other than the **test machine** or the **reference machine**, with a **programme** which has a cleaning performance equal to or better than that of the **reference machine**.

6.2.4 Requirements for re-conditioning tableware

A film or scale may accumulate on the surface of the **tableware** with use. If this happens and the accumulation cannot be removed by the procedure given in 6.2.3, apply the following procedure:

- Place the **tableware** in a **dishwasher** other than the **test machine** or the **reference machine**.
- Run a **cycle** in which the **detergent** is substituted with 30 g anhydrous citric acid (for the supplier see L.1.15) and **rinse aid** specified in 5.8 is dispensed as normal. Use a **programme** which has a cleaning performance equal to or better than that of the **reference machine**.
- Inspect and condition the **tableware** according to 6.2.3.

6.3 Soiling agents and preparation equipment

The following soiling agents are required:

- milk;
- tea;
- minced meat;
- egg;
- oat flakes;
- spinach;
- margarine.

All food products, by the time they are used for the preparation of soiling agents to this standard, shall be within the "use-by" date or before their expiry date stated on the product and shall be stored according to the supplier's instructions unless this standard provides additional information. For milk (6.4.2) and eggs (6.4.5) specific additional information is provided.

Each soiling agent used for the **reference** and for **test machines**, for one **test series**, shall be from the same production batch.

NOTE Details of a supplier of suitable soils from the same batch can be found in L.1.11.

If the specified product is not available, the use of a similar product which provides equivalent results is permitted. Equivalency shall be proven through testing. Refer to L.2 for guidance on equivalency.

6.4 Preparation and application of soiling agents

6.4.1 General

Subclause 6.4 describes how the soiling agents are prepared and applied to the test load items.

Unless specifically stated otherwise, all soiling agents shall be freshly prepared for each test.

The final preparation and application of the soils to the **tableware** items shall be done within 12 consecutive hours, with prepared soils **refrigerated** in air tight containers prior to usage except where specified otherwise.

Based on the number of **place settings**, calculate the total weight of soil that will be needed (grams/item × number of **tableware** items) to soil all the machines being run in parallel.

Start by pre-heating the microwave oven for the milk soiling. During this time prepare the tea soiling and begin preparation and application of the remainder of other soiling agents. During the pre-drying period for the tea (1 h), complete the preparation and application of the remaining soiling agents.

For all soiling agents except milk and tea, apply the specified mass of soil to the specified load items using the specified application tool. Specific procedures for applying milk and tea are described in 6.4.2 and 6.4.3.

NOTE The correct amount of soil can be applied either by placing the item to be soiled on a balance, zeroing the balance, and adding soil until the specified mass has been applied; or by weighing slightly more than is required into a container along with the application tool, and applying soil to the load item from this container until the mass of soil missing from the container along with the application tool is equal to the specified amount to be applied to the item.

Soils shall be evenly distributed. Soil can be added or removed to ensure the exact amount until drying of soil (by appearance) begins.

Refer to Table C.1 to Table C.4 for an illustration of soil application and quantities.

For guidance, Annex D contains pictures showing how soiled **tableware** should look.

6.4.2 Milk

6.4.2.1 General

U.H.T. milk with 1,5 % to 2 % fat content shall be used. U.H.T. milk shall not be used within 30 days of its expiry date. U.H.T. milk shall be kept **refrigerated** after opening and used within 2 days of opening.

Alternatively, fresh 1,5 % to 2 % fat content homogenized milk may be used and shall be kept **refrigerated** after opening and used within 2 days of opening.

UHT milk shall be used unless unavailable, then fresh milk may be used.

6.4.2.2 Items required for preparation

- Microwave ovens with a glass turntable as specified in Annex F;
- Glasses (specified in Annex A);
- Pipette (10 ml; specified in L.1.14).

6.4.2.3 Pre-heating the microwave oven

Before cooking the milk in the glasses, heat up the microwave oven as follows:

- Place six glasses each filled with 50 ml of water at a temperature of $(23 \pm 2) ^\circ\text{C}$, in the microwave oven; use glasses which do not belong to the test load.
- Place the glasses evenly-spaced in a circle with a radius of 160 mm (centre of the circle = centre of the glass turntable). See Figure 1.
- As described in Annex F, operate the microwave oven for $t_{u,1}$ min depending on the oven type at a nominal power setting of 780 W ($P_{u,1}$) and then for $t_{u,2}$ min at a nominal power setting of 150 W ($P_{u,2}$).

After pre-heating, take the water-filled glasses out of the microwave oven.

6.4.2.4 Application

- Items to be soiled:
The type A glasses shall be soiled with milk.
- Quantity of soil:
Use 10 ml of milk to soil each glass.
- Method of soiling the glasses:
Upon removal from the refrigerator, shake the milk well for approximately 30 s before each application. Immediately after shaking add 10 ml of milk to each glass using a pipette and immediately carry out the cooking process.

NOTE Details for a suitable pipette are given in L.1.14.

Any remaining milk shall be **refrigerated** again, without delay.

6.4.2.5 Cooking process

Immediately after the pre-heating has been completed, place 6 glasses with milk in the microwave oven and cook the glasses continuously at 780 W and then at 150 W for the cooking times calculated according to Clause F.2.

During each cooking **operation** there shall always be 6 glasses, with milk, in the microwave oven. The glasses shall be placed on the turntable as shown in Figure 1 and the base of each glass shall lie flat on the turntable.

For guidance, Table J.1 contains an informative reference to a shade chart. After the cooking period in the microwave oven, the colour of the cooked milk may be compared with the colour chart referred to in Annex J as an indication of correct preparation. 90% of the whole surface of the milk should have a colour shade between numbers 4 and 6 and 10% should be between colour shade numbers 7 and 12. If differences are recognized, see Clause F.2. For colour comparing only original colour sheets should be used. They can be obtained from the supplier mentioned in L.1.7.

NOTE If more than 6 glasses are required for testing, an additional 6 can be cooked immediately after the first set of 6 glasses, without repeating the pre-heating process.

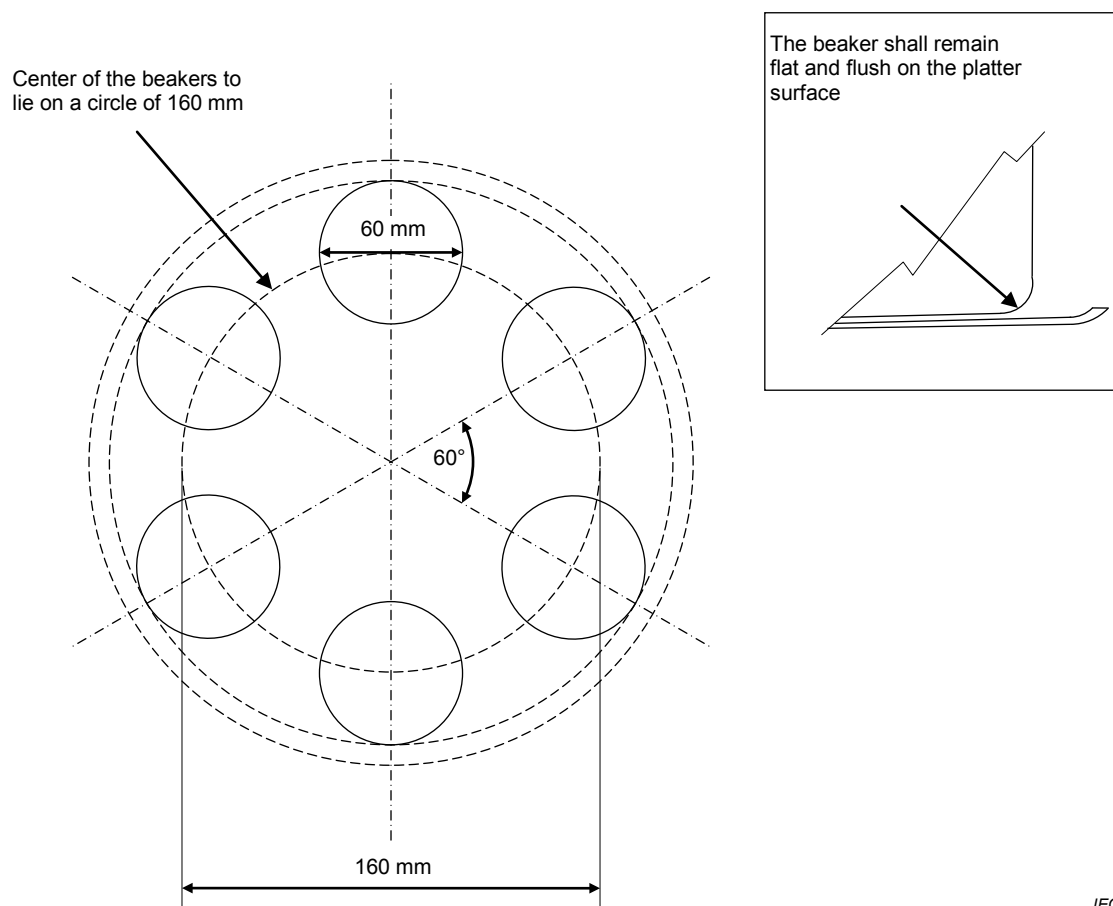


Figure 1 – Position of the glasses on the microwave turntable

6.4.3 Tea

6.4.3.1 General

Use tea with the following characteristics:

- tea type: black
- tea quality: ceylon
- leaf quality: orange pekoe
- leaf size: broken

NOTE Details of a supplier of suitable tea are given in Annex L.

The remains of newly opened packets of tea may be used for subsequent tests for a period of up to 60 days after opening, provided the contents are stored in a sealed container.

6.4.3.2 Preparation

Pour the calculated amount of boiling water (see 5.6 for specification) over the tea (ratio: 1 l water to 6 g of tea) and allow to stand in a covered container, for a period of 5 min. Afterwards, pour the tea through a sieve (mesh aperture 1 mm) into a second container.

6.4.3.3 Application

Start the application immediately after completion of the preparation by filling approximately 120 ml of tea into each mug, 80 ml into each cup and 40 ml onto each saucer.

distribution over mugs, cups and saucers can be ensured by using a proportioning pump with 40 ml dosage. Foam and particles are to be avoided.

NOTE 1 Details for a suitable dosing pump are given in L.1.16.

NOTE 2 Foam can be avoided if a proportioning pump is used with slow pumping.

Immediately after completion of application, proceed with pre-drying using either the oven drying method (6.4.3.4) or the air drying method (6.4.3.5).

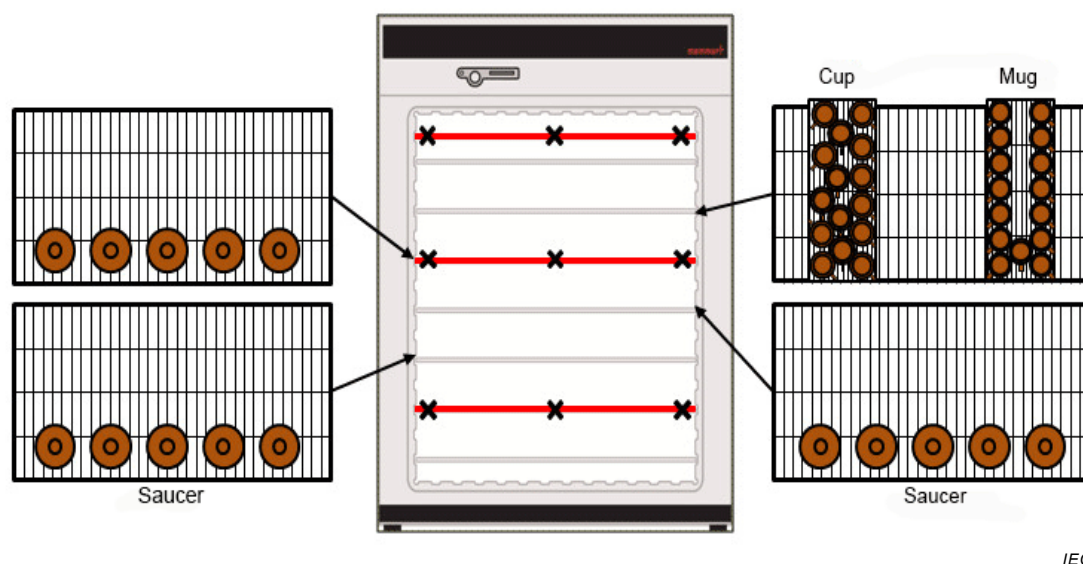
6.4.3.4 Pre-drying for oven drying method

All items soiled with tea shall be pre-dried in a thermal cabinet (specified in Annex G) prior to the oven drying method described in 6.5.2. The thermal cabinet shall be pre-heated to 80 °C by the time the tea application takes place. After completion of the tea application, the following procedure shall be carried out:

- Switch off the power and open the doors of the thermal cabinet.
- Load the **tableware** items into the thermal cabinet. Refer to Figure 2 for loading **tableware** items.
- Close the doors and switch on the power of the thermal cabinet.
- This procedure shall be completed in 3 min.

The **tableware** items shall remain in the thermal cabinet for a period of 1 h after the power of the thermal cabinet is switched back on. After this pre-drying period proceed as described in 6.5.2.

In order to facilitate unloading of dishes soiled with tea after pre-drying phase and the loading of all dishes for the two hour drying phase, within 10 min, it is recommended to do so with two persons.



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Figure 2 – The thermal cabinet for pre-drying of soiled cups, mugs and saucers

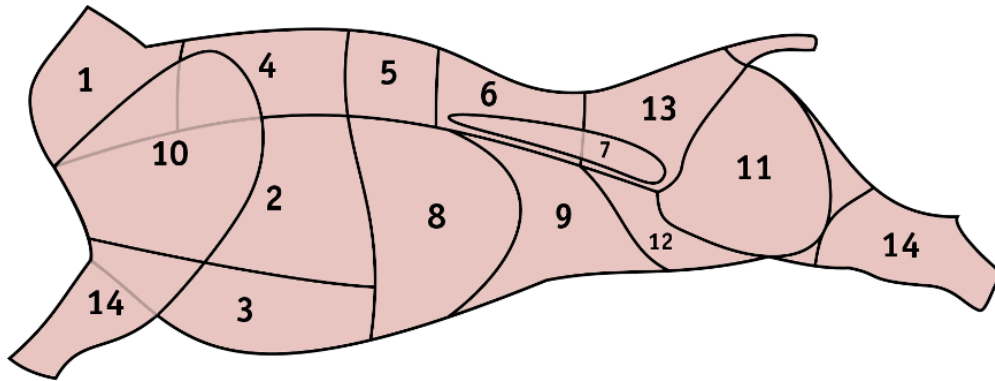
6.4.3.5 Pre-drying for air drying method

After completion of tea application items shall remain at ambient conditions for a period of 1 h. After the pre-drying period carefully remove 100 ml from each mug, 60 ml from each cup, and 20 ml from each saucer using a syringe. Discard the removed tea.

6.4.4 Minced meat

6.4.4.1 General

The cuts of the beef used to prepare the minced meat should be taken from parts 11 or 13 (Figure 3) and, depending on country, can be called round, silverside, topside, thick flank, etc.



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Figure 3 – Schematic view of the different beef pieces

Prepare a sufficiently large amount of minced beef to ensure a homogeneous mix. Remove all fat and sinew from the meat before mincing. Use an electric meat grinder, with a perforated disc, with between 45 and 55 holes of 4,5 mm diameter.

NOTE 1 Details for a suitable grinder and accessories are given in L.1.17. The no-load speed for the grinder is approximately 180 r/min.

NOTE 2 Choose a setting which produces approximately 700 g minced meat per minute.

6.4.4.2 Preparation and Storage

Mix 50 g of whisked whole egg (see 6.4.5) to every 150 g minced meat (see 6.4.4). Mix well and divide into 60 g portions. Store the portions in water-tight containers and **freeze**. Before use, allow the meat to defrost to ambient temperature and mix with water (see 5.6 for specification) at a ratio of 30 g of minced meat to 8 g of water, until homogeneous.

6.4.4.3 Application

- Items to be soiled:
Soil the oval platter, the glass bowl and the oven pot with minced meat.
- Quantity of soil:
8 g of minced meat for the oval platter, 8 g for the glass bowl and 6 g for the oven pot.
- Method of soiling:
Refer to 6.4.1 and use a plastic fork as an application tool.
 - Oval platter:
Apply the minced meat evenly to the upper surface of the platter and ensure that a space of 20 mm around the edge is left clean.
 - Glass bowl:
Apply the minced meat to the bottom and inner sides and ensure that a space of 40 mm around the edge is left clean.

- Oven pot:

Apply the minced meat on the bottom and the inner sides of the oven pot and ensure that a space of 10 mm around the edge is left clean.

6.4.5 Egg

6.4.5.1 General

Use good quality hen's eggs weighing 50 g to 65 g each. Eggs shall be at least 7 days old. Eggs shall be **refrigerated** until required. Eggs shall be at ambient temperature prior to use.

NOTE Tests have shown that very fresh eggs change in their consistency over the first few days after laying; a minimum of 7 days after laying ensures stability.

6.4.5.2 Preparation

Use at least three eggs and separate the egg white from the egg yolk. Discard the yolk sack, and mix egg yolks with a fork in a bowl.

6.4.5.3 Application

- Items to be soiled:
Soil the melamine dessert plates, the dinner plates and the forks with egg yolk.
- Quantity of soil:
Calculate the total amount of soil to be applied to all the items to be soiled for each item type
 A_t as follows:

$$A_t = N_t \times M_t \quad (1)$$

where

N_t is the number of items of type t to be soiled with egg

M_t is the average mass of egg to be applied to each item of type t

For forks, $M_t = 0,16$ g

For melamine dessert plates, $M_t = 1,5$ g

For dinner plates, $M_t = 2,16$ g

When applying the egg, distribute the total amount A_t as equally as is reasonably practical between all the items of type t . The total quantity applied shall be A_t .

- Method of soiling:
Refer to 6.4.1 and use a pastry brush with a width of approximately 25 mm as an application tool.
 - Forks:
Apply a thin, even layer of egg soil to both sides of the head of each fork. Place the forks on an extra plate, not belonging to the test load, prong down. Allow to dry in this position.
 - Melamine dessert plates:
Apply the egg soil evenly to the upper surface of each plate ensuring that a space of 20 mm around the edge is left clean.
 - Dinner plate:
Apply the egg soil evenly to the upper surface of each plate, ensuring that a space of 20 mm around the edge is left clean.

6.4.6 Oat flakes

6.4.6.1 General

Use uncooked chopped, rolled oat flakes.

NOTE Details of a supplier of suitable oat flakes are given in Annex L.

The remains of newly opened packets of oat flakes may be used for subsequent tests for a period of up to 60 days after opening, provided the contents are stored in a sealed container.

6.4.6.2 Preparation

Thoroughly mix 50 g of oat flakes with 750 ml of cold water (see 5.6 for specification) and 250 ml of milk (see 6.4.2 for specification). Prepare porridge by bringing the mixture to the boiling point and allow to simmer for 10 min, stirring continuously from the very beginning of heating, using a wooden spoon. Apply the porridge immediately after preparation.

NOTE The immediate application of hot porridge guarantees that the amount of water is not reduced due to evaporation and the porridge has a defined consistency.

6.4.6.3 Application

- Items to be soiled:
Soil the soup plates, the small dessert bowls and the type B soup spoons with porridge.
- Quantity of soil:
Dip the soup spoons in the prepared soil.
Apply 3 g of porridge on each soup plate and on each dessert bowl.
- Method of soiling:
 - Soup spoons:
Dip the bowl part of the soup spoons into the freshly made hot porridge and place on an extra plate, not belonging to the test load, with the back of the spoon bowl facing upwards. Allow to dry in this position.
 - Soup plates and dessert bowls:
Refer to 6.4.1 and use a pastry brush with a width of approximately 25 mm as an application tool.
Apply the porridge soil evenly to the upper surface of each soup plate and ensure that the higher rim with a space of 25 mm is left clean.
Apply the porridge soil evenly to the upper surface of each dessert bowl and ensure that a rim with a space of 5 mm is left clean.

Alternate load item: The soup plates in the **test machine** may be replaced by dinner plates. Use the same application method for the dinner plates as is used for the soup plates. Apply the porridge soil evenly to the upper surface of each dinner plate and ensure that a rim with a space of 20 mm is left clean.

6.4.7 Spinach

6.4.7.1 General

Use frozen young spinach, finely minced and with no other additives or ingredients.

NOTE Details of suppliers of suitable spinach are given in Annex L.

6.4.7.2 Preparation and storage

Allow the spinach to defrost at ambient temperature. Afterwards, place the spinach in a sieve with a mesh size of 2 mm and allow to drip for 5 min. Pass the spinach completely through a

grinder (use same grinder described in 6.4.4.1) having a perforated disc with between 150 and 220 holes with 2 mm diameter.

NOTE 1 Choose a setting which produces 200 g to 250 g of spinach per minute. The no-load speed for the grinder is approximately 180 r/min.

Divide the spinach into convenient portions and **refrigerate** in water-tight containers until use. Once prepared, the spinach must be used within 3 days. Stir the spinach before use.

NOTE 2 A comparison with the pictures in Annex D can be helpful to evaluate if the prepared and applied spinach has the same particle size and can be distributed in a similar way to that depicted on the load items in the pictures.

6.4.7.3 Application

- Items to be soiled:
Soil the dessert plates and the small pot with spinach.
- Quantity of soil:
Soil each dessert plate with 5 g of spinach. Soil the small pot with a mixture of 1 g of margarine (see 6.4.8.1 for specifications) and 6 g of spinach.
- Method of soiling dessert plates:
Refer to 6.4.1 and use a pastry brush with a width of approximately 25 mm as an application tool. Apply the spinach soil evenly to the upper surface of each plate and ensure that a space of 20 mm around the edge is left clean.
- Method of soiling the small pot:
Place spinach and margarine (ratio: 6 g of spinach to 1 g of margarine) into a container and mix with a plastic fork until homogeneous. The margarine shall be at ambient temperature. Apply 7 g of this mixture on the small pot with a clean plastic fork or a rubber spatula. Apply the spinach-margarine mixture to the bottom and inner sides of the small pot and ensure that a space of 40 mm around the edge is left clean.

6.4.8 Margarine

6.4.8.1 General

Household margarine with a total fat content of 60 % to 85 %, that has the following proportion of fatty acids, shall be used:

- saturated fatty acids (33 ± 11) %
- polyunsaturated fatty acids (33 ± 20) %
- monounsaturated fatty acids (33 ± 20) %

NOTE Unsaturated fats include trans fats.

6.4.8.2 Preparation and storage

The margarine shall be **refrigerated** prior to applying it to the bowls. The margarine for the spinach-margarine mixture (see 6.4.7.3) shall be at ambient temperature.

6.4.8.3 Application

- Items to be soiled:
Soil the small pot and the melamine bowls with margarine.
- Quantity of soil:
Use 1 g of margarine for the small pot and 5,5 g per melamine bowl.
- Method of soiling the small pot:
Apply the spinach-margarine mixture as described in 6.4.7.3.
- Method of soiling the melamine bowls:

Refer to 6.4.1 and use a scraper or rubber spatula as an application tool. Leave a 10 mm unsoiled rim.

Apply the margarine shortly before the start of the **test run** (6.6.1) and then place the melamine bowls into the machine.

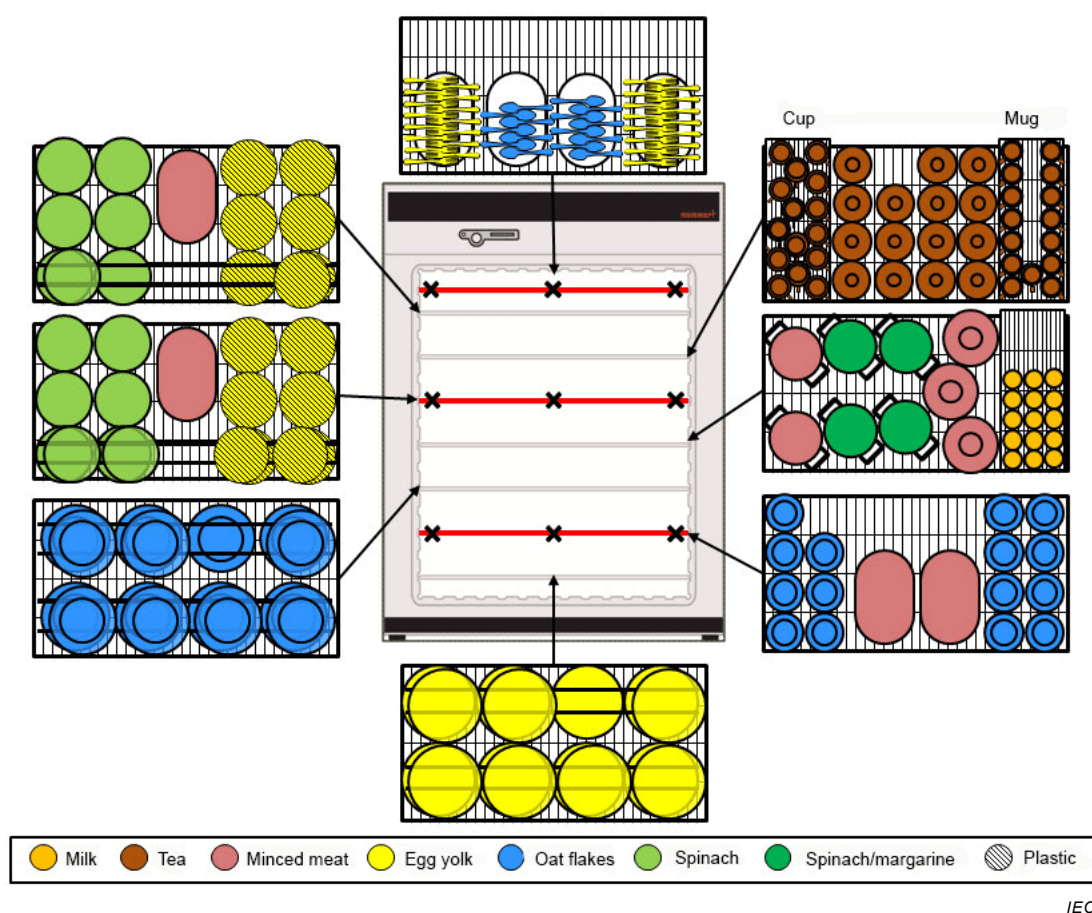
6.5 Drying of the soiled tableware items

6.5.1 General

Either the air drying method or the oven drying method can be used.

6.5.2 Oven drying method

All **tableware** items soiled according to 6.4, except the melamine bowls, shall be dried at 80°C in a thermal cabinet specified in Annex G. The thermal cabinet shall always be fully loaded with 30 **place settings** according to Figure 4. If necessary additional unsoiled **tableware** items shall be included to ensure that the thermal cabinet is fully loaded.



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Figure 4 – The thermal cabinet with soiled load items (30 place settings)

NOTE Different machines with different capacities require a different number of special items (pots, glass bowl and oval platter).

Immediately after completion of the 1 h pre-drying period, remove the items soiled with tea (specified in 6.4.3.4) and empty out any remaining tea and then load the thermal cabinet with the entire set of **tableware** items according to the loading procedure.

- Switch off the power and open the doors of the thermal cabinet.

- Remove all items soiled with tea from the thermal cabinet and empty out any remaining tea. Discard the tea.
- Load the **tableware** items into the thermal cabinet according to Figure 4.
- Close the doors and switch on the power of the thermal cabinet.
- This procedure shall be completed in 10 min.

The **tableware** items shall remain in the thermal cabinet for a period of 2 h after the power of the thermal cabinet is switched back on.

After the drying period of 2 h, the soiled **tableware** items shall be unloaded as quickly as possible and left to cool down outside the cabinet for at least 50 min under ambient conditions (according to 5.5).

The oven dried items may be loaded directly into the **dishwasher racks** to cool, but the **racks** shall remain outside the opened **dishwasher**.

Soiled **tableware** items that have been prepared by the oven drying method may be stored under ambient conditions for a maximum of 4 days when covered by an opaque plastic cover sheet.

6.5.3 Air drying method

All **tableware** items soiled according to 6.4, except the melamine bowls, shall be dried according to the procedure described below.

All soiled **tableware** items shall be dried under ambient conditions (according to 5.5). After the pre-drying period according to 6.4.3.5, the mugs, cups and saucers shall be placed on a level surface in their serving orientation to dry. After soiling, all other soiled **tableware** items shall be left to dry in their serving orientation to allow the soils to set; generally 1 h is sufficient. The total dry time shall be 15 h to 18 h and shall be in accordance with one of the options below. After the initial drying to allow the soils to set, the test load, excluding the cups, mugs and saucers, shall be:

- loaded into the **dishwasher racks** (see 6.6.1) with the **racks** still in the **dishwasher** – in this case, the **dishwasher** door shall be open and the **racks** pulled out; or
- loaded into the **dishwasher racks** (see 6.6.1) which have been placed on a level surface – in this case, a tray shall be placed under the **racks** and any soil that falls into the tray shall be placed on the **dishwasher** door before the **programme** is commenced; or
- left on a level surface – in this case, care is necessary to ensure that any loose soil particles are placed into the **dishwasher** during loading.

6.6 Loading and operating

6.6.1 Loading

After the soiled load items have been dried (and cooled to ambient temperature if necessary) arrange them in the dish **racks** inside the **reference** and **test machines** ensuring that they are evenly interspersed with the unsoiled items of the load. If the manufacturer provides a load plan that meets this requirement, follow the load plan provided. The **reference dishwasher** shall be loaded in accordance with I.4

If the mugs, cups and saucers have been air dried, collect the remaining tea from them before placing these items in the dish **racks**. Place the tea on the floor of the **reference** and **test machines** just before the start of the test **cycle**.

Any soil particles that fall from the load items while they are being placed in the dish **racks** shall be placed on the internal surface of the door of the **reference** and **test machines** before it is closed prior to the start of the test **cycle**.

6.6.2 Operating

During the performance tests the starting of the machines may have to be staggered to ensure there is enough time for a single assessor to assess the performance of each machine at the prescribed time after its **cycle** finishes. However, **test machines** shall run at the same time as part of the **reference machine cycle**.

Before the machines start, place the **detergent** according to 5.7.

If the **test machine** is identified as having a **manual filter** system according to 7.3.3, perform five combined cleaning and drying **test runs** of the test **programme**, cleaning the **test machine** filters between the measurements.

If the **test machine** is identified as having an **automatic** or **self-cleaning filter** system according to 7.3.4, perform 5 combined cleaning and drying **test runs** of the test **programme**, without cleaning the **dishwasher** filters between the measurements. If necessary, increase the number of combined cleaning and drying **test runs** until the condition $\ln W_C < 0,073$ described in 7.3.4 is fulfilled, up to a maximum of 8 combined cleaning and drying **test runs**, all without cleaning the **dishwasher** filters between measurements.

NOTE $\ln W_C$ refers to the natural log to base e of W_C .

Continue to perform the combined cleaning and drying test until both $\ln W_C$ and $\ln W_D$ values are satisfied or eight **test runs** have been completed. The index for cleaning, or index for drying, is calculated at the point in which their individual values of $\ln W_C$ and $\ln W_D$ are satisfied.

The filter of the **reference machine** shall only be cleaned prior to the start of a new **test series** and not between successive **test runs** in a **test series**.

Between two successive **test runs** in a **test series**, machines shall be allowed to cool down until they meet the ambient condition requirements of 5.5. The maximum time between successive **test runs** in a **test series** shall not exceed 4 days.

At the completion of the test **cycle**, the door shall be left undisturbed until commencing the evaluation procedure according to 7.2.2.

7 Combined cleaning and drying performance assessment

7.1 General requirements

Clause 7 describes the procedure for assessing the cleaning and drying performance.

For each **test run** the drying assessment of the **test machine**, including the evaluation of the **reference machine**, shall be carried out by one single assessor. The same applies for cleaning performance assessment. The assessor for drying may or may not be the same assessor for cleaning.

Lighting shall be installed where the evaluation takes place in order to avoid any direct glare. The luminance measured at the position of evaluation shall be 1 000 lux to 1 500 lux. The colour temperature shall be between 3 500 K to 4 500 K using diffused light.

The performance assessment shall be done in the following sequence:

1. Drying assessment;
2. Cleaning assessment.

Depending on the equipment of the **dishwasher**, with or without a separate cutlery **rack** (not combined with any other **rack**), the evaluation of the drying performance has to follow slightly different procedures.

7.2 Determination of the drying performance

7.2.1 General requirements to enable subsequent cleaning assessment

It is of general importance to avoid cross-contamination (falling off, transfer or dripping) of soil particles from one load item to another. In addition, the **tableware** shall be touched as little as possible (maximum at two positions).

When removing items with upward facing cavities (e.g. cups) they shall be kept in a horizontal orientation to avoid spilling any water residues.

If **serving pieces** or other parts of the cutlery are positioned in any **rack** which is not designed exclusively for cutlery, their drying performance shall be evaluated with the other items of the **rack**.

A wet rim (no drop or streak) around milk residue shall not be taken into account for the drying assessment.

If any soil can be found in residual water in cavities (e.g. from bowls or cups), the cleaning performance of those items shall be evaluated during the drying performance evaluation. In such a case set the item aside for evaluation by the cleaning performance assessor. The soil particles shall be assessed as if they were dried on. The water and soil in the cavities shall not be emptied out into the machine (to avoid carry over to the next **cycle** run).

When **racks** have to be removed from the **dishwasher**, care shall be taken to avoid damaging delicate parts on the underside such as spray arms. Resting the **rack** on raised supports may help avoid such damage occurring. For example a **rack** with an attached spray arm may be placed on a holder.

7.2.2 Drying assessment procedure

At the end of the **cycle**, the **reference** and **test machines** shall remain connected to the supply and left undisturbed for a period of 30 min. At the end of this period, open the door of the machine completely and start the assessment of drying performance immediately.

Carry out the following evaluation procedures steps:

- 1) The lower **rack** shall be pulled out carefully and left on the open door of the **dishwasher**. The cutlery basket, if present, shall be removed carefully from the **dishwasher**.
- 2) Carry out the drying performance evaluation of the **tableware** in the lower **rack**. After assessing each item, replace it in its original location unless this would restrict access to other items in the **rack**. In this case place such items on a clean, light coloured surface.
- 3) The lower **rack** shall be removed from the machine or alternatively the **rack** shall be covered to avoid contamination through particles falling from **racks** on higher levels. Kitchen paper may be used to cover the baskets.
- 4) Working upwards through the **dishwasher**, carry out the drying performance evaluation of the **tableware** in each **rack** following the procedure given for the lower **rack** in step 2) and 3).
- 5) After evaluating the drying performance of the **tableware** in the uppermost **rack**, evaluate the drying performance of the cutlery. After assessing each item of cutlery, either place it separately on a clean, light coloured surface, or, if a **dishwasher** has a cutlery **rack** place each item back in its original position in the **rack**. Soil particles which fall from the cutlery during the evaluation shall be retained and included in the cleaning performance score.

- 6) When the drying performance evaluation of the whole load has been completed, carry out the cleaning performance evaluation of the **tableware**.

Inspect each item for possible water residue.

The drying evaluation shall be carried out near the **test machine** to avoid drying during transport of **tableware** load items in dish **racks** or cutlery baskets. Dish **racks** or cutlery baskets removed shall be placed somewhere where no additional heat or air ventilation can influence the drying result.

Drying performance shall be evaluated according to Table 1:

Table 1 – Evaluation of the drying performance

Score	Total wet area mm ²
2	The item is completely free from moisture.
1	The item has one or two drops of water or one wet streak (run). The total wet area shall be less than 50 mm ² .
0	The item has more than two drops of water, or one drop and one streak, or two streaks, or water in glass or cup cavity or a total wet area of more than 50 mm ² .

The average evaluation time per item shall be 8 s. The handling which consists of removing the item from the machine, putting it down and recording the score shall not require more than 5 s. The viewing time for evaluation shall not be longer than 3 s. Exceptions are the two pots where the evaluation of the four single scores shall not take longer than 15 s (9 s handling + 6 s viewing).

NOTE 1 Close adherence to these times can improve reproducibility and consistency of the drying performance results.

Assess each load item (except the pots) of the complete load individually and note the score. Note the total number of scores per item, s_z , according to Table 2 or Table H.1.

Evaluate for each pot, the drying of the inner bottom, the inner wall and the outer surfaces individually. Additionally give one score over the entire pot. This leads to a total number of four scores per pot. Do not include the pot handles in the evaluation.

Table 2 – Evaluation to determine the drying performance

Item Id. (Refer to Annex A)	Item No.	Items being dried	Total number of scores per item No.	Number of single items a _d with score d			$D_z = \sum_{d=0}^2 a_d \times d$
			s _z	2	1	0	
A 1	1	Dinner plate					
A 2	2	Dessert plate					
A 3	3	Dessert bowl					
A 4	4	Mug					
A 5 + B 5	5	Glass					
A 6 + B 6	6	Fork					
A 7 + B 7	7	Knife					
A 8 + B 8	8	Soup spoon					
A 9 + B 9	9	Dessert spoon					
A 10 + B 10	10	Tea spoon					
B 1	11	Soup plate					
B 2	12	Melamine dessert plate					
B 3	13	Saucer					
B 4	14	Cup					
S 1 a	15	Small pot					
S 1 b	16	Oven pot					
S 2	17	Glass bowl					
S 3	18	Oval platter					
S 4	19	Melamine bowl					
S 5	20	Serving spoon					
S 6	21	Serving fork					
S 7	22	Gravy ladle					
		N =	D _i =				ΣD _z =
		See Formula (2)	See Formula (3) or (4), as appropriate				
Notes:						Test No.:	

NOTE 2 An alternate table can be used in place of Table 2. The alternate table contains additional detail and capability: rows for every load item (e.g., for a 12 **place setting** load, line items for each of 12 glasses) and columns for every test (e.g., up to eight tests) are provided. The alternate table is shown in Annex H, Table H.1. This alternate table could contain calculation capability for the equations specified in 7.2.3, including the drying performance index. The alternate table format accommodates every assessment outcome for every item in the load for every **test run** and thereby provides a fully traceable test record.

7.2.3 Calculation of the drying index

To calculate the total number of scores for all items N , use the Equation (2):

$$N = \sum_{z=1}^{22} s_z \quad (2)$$

where:

N is the total number of scores for all items;

s_z the total number of scores per item number

Calculate the average drying score for one **test run** for the **reference** and **test machines**. Use the following Equations (3) and (4):

$$D_{R,i} = \frac{1}{2N} \sum_{z=1}^{22} D_{R,z} \quad (3)$$

$$D_{T,i} = \frac{1}{2N} \sum_{z=1}^{22} D_{T,z} \quad (4)$$

where:

$D_{R,z}$ is calculated according to the formula given in Table 2 for the **reference machine**;

$D_{T,z}$ is calculated according to the formula given in Table 2 for the **test machine**;

$D_{R,i}$ is the average drying score for one **test run** of the **reference machine**;

$D_{T,i}$ is the average drying score for one **test run** of the **test machine**;

Calculate the logarithm of the drying performance index for one **test run** of the **test machine** $P_{D,i}$:

$$\ln P_{D,i} = \ln \left(\frac{D_{T,i}}{D_{R,i}} \right) \quad (5)$$

On completion of n measurements, calculate the arithmetical average of $\ln P_{D,i}$ the logarithm of the total drying performance index P_D of the **test machine** using the following Equation (6):

$$\ln P_D = \frac{1}{n} \sum_{i=1}^n \ln P_{D,i} \quad (6)$$

where n is the number of combined cleaning and drying test **cycles**.

The total drying performance index for the **test series** is:

$$P_D = \exp (\ln P_D) \quad (7)$$

Next, calculate the drying standard deviation $\ln s_D$ of the $\ln P_{D,i}$

$$\ln s_D = \sqrt{\frac{1}{n-1} \left[\sum_{i=1}^n (\ln P_{D,i})^2 - \frac{1}{n} \left(\sum_{i=1}^n \ln P_{D,i} \right)^2 \right]} \quad (8)$$

and the half range of the logarithmic drying confidence interval $\ln W_D$ of $\ln P_D$:

$$\ln W_D = \frac{\ln s_D}{\sqrt{n}} t_{f; 1-\alpha/2} \quad (9)$$

where

$t_{f; 1-\alpha/2}$ is a numerical factor, depending on the number $f = n - 1$ degrees of freedom for the chosen confidence level $1 - \alpha = 0,95$ with two-sided demarcation (see Table 5 for values of t-factors).

If the numerical value $\ln W_D$ is more than 0,10, increase the number of tests until $\ln W_D$ is equal to or less than 0,10 as described in the procedure in 7.3.4 for $\ln W_C$. The maximum number of tests is 8 runs for drying performance.

The drying performance index has the following limits:

$$\text{lower bound} = \exp (\ln P_D - \ln W_D) \text{ and upper bound} = \exp (\ln P_D + \ln W_D).$$

The expected value of the total drying performance index will be in this interval with a probability of 95 %.

NOTE In addition to the described statistical analysis, other methods of statistical analysis can be used. The number of samples of **dishwashers** tested can be increased, by the testing laboratory, to increase the level of confidence of the performance and energy evaluation.

7.3 Determination of the cleaning performance

7.3.1 General

Inspect each item for possible soil traces, remains of soil or redeposited soils.

NOTE 1 If only a cleaning evaluation is to be undertaken, the evaluation can be commenced directly at the end of the **cycle** and when the evaluator can safely handle the load.

NOTE 2 The cleaning performance evaluation can be delayed until the next day if it is guaranteed that all items are stored adequately and no soil is lost.

Evaluation of each item except the pots shall not take longer than 10 s, excluding handling (for example, taking out, putting aside, noting score or confirming the nature of a mark or irregularity). The evaluation of the four single pot scores shall not take longer than 30 s.

Check all surfaces during the cleaning evaluation. Do not take into consideration soil residue found on unglazed edges of porcelain, pot handles or soils that are caught between handle and pot body.

To evaluate soil remaining, consult Table 3.

Assess each load item (except the pots) individually and note the score. Note the type of soil and total number of scores per item No. according to Table 4 or Table H.2.

Evaluate for each pot the cleaning of the inner bottom, the inner wall and the outer surfaces individually. Additionally give one score over the entire pot. This leads to a total number of four scores per pot.

Table 3 – Evaluation of the cleaning performance

Number of small dot shaped soil particles	Total soiled area mm ²	Score
0	A = 0	5
1 – 4	0 < A ≤ 4	4
5 – 10	4 < A ≤ 20	3
> 10	20 < A ≤ 50	2
Not Applicable	50 < A ≤ 200	1
Not Applicable	200 < A	0

Each load item shall be awarded a score from the table according to the category of soil area or number of discrete soil particles adhering to the item. If the requirements for more than one score are met, the lowest applicable score shall be awarded.

Table 4 – Evaluation to determine the cleaning performance

Item Id. (Refer to Annex A)	Item No.	Items being cleaned	Type of soil	Total number of scores per item No.	Number of single items a _c with score c						$C_z = \sum_{c=0}^5 a_c \times c$
				s _z	5	4	3	2	1	0	
A 1	1	Dinner plate	Egg								
A 2	2	Dessert plate	Spinach								
A 3	3	Dessert bowl	Oat flakes								
A 4	4	Mug	Tea								
A 5 + B 5	5	Glass	Milk / None								
A 6 + B 6	6	Fork	Egg								
A 7 + B 7	7	Knife	None								
A 8 + B 8	8	Soup spoon	None / Oat flakes								
A 9 + B 9	9	Dessert spoon	None								
A 10 + B 10	10	Tea spoon	None								
B 1	11	Soup plate	Oat flakes								
B 2	12	Melamine dessert plate	Egg								
B 3	13	Saucer	Tea								
B 4	14	Cup	Tea								
S 1 a	15	Small pot	Spinach- margarine- mixture								
S 1 b	16	Oven pot	Minced meat								
S 2	17	Glass bowl	Minced meat								
S 3	18	Oval platter	Minced meat								
S 4	19	Melamine bowl	Margarine								
S 5	20	Serving spoon	None								
S 6	21	Serving fork	None								
S 7	22	Gravy ladle	None								
		N =	C ₁ =								Σ C _z =
		See Formula (10)	See Formula (11) or (12), as appropriate								
Notes:										Test No.:	

NOTE 3 An alternate table can be used in place of Table 4. The alternate table contains additional detail and capability: rows for every load item (e.g., for a 12 place setting load, line items for each of 12 glasses) and

columns for every test (i.e., up to 8 tests) are provided. The alternate table is shown in Annex H, Table H2. This alternate table could contain calculation capability for the equations specified in 7.3.2, including the cleaning performance index. The alternate table format accommodates every assessment outcome for every item in the load for every **test run** and thereby provides a fully traceable test record.

7.3.2 Calculation of the cleaning index

To calculate total number of scores for all items N , use the following Equation (10):

$$N = \sum_{z=1}^{22} s_z \quad (10)$$

where:

N is the total number of scores for all items;

s_z the total number of scores per item number

Calculate the average cleaning score for one **test run** for the **reference** and **test machines**. Use the following Equations (11) and (12):

$$C_{R,i} = \frac{1}{N} \sum_{z=1}^{22} C_{R,z} \quad (11)$$

$$C_{T,i} = \frac{1}{N} \sum_{z=1}^{22} C_{T,z} \quad (12)$$

where

$C_{R,z}$ is calculated according to the formula given in Table 4 for the **reference machine**;

$C_{T,z}$ is calculated according to the formula given in Table 4 for the **test machine**;

$C_{R,i}$ is the average cleaning score for one **test run** of the **reference machine**;

$C_{T,i}$ is the average cleaning score for one **test run** of the **test machine**.

Calculate the logarithm of the cleaning performance index for one **test run** of the **test machine**, $P_{C,i}$:

$$\ln P_{C,i} = \ln \left(\frac{C_{T,i}}{C_{R,i}} \right) \quad (13)$$

On completion of n measurements, calculate the arithmetical average of $\ln P_{C,i}$, the logarithm of the cleaning performance index for the **test series** P_C , of the **test machine** using the following Equation (14):

$$\ln P_C = \frac{1}{n} \sum_{i=1}^n \ln P_{C,i} \quad (14)$$

where n is the number of combined cleaning and drying **test runs**.

The cleaning performance index for the **test series** is:

$$P_C = \exp (\ln P_C) \quad (15)$$

Next, calculate the logarithm of the cleaning standard deviation $\ln s_C$ of the $\ln P_{C,i}$:

$$\ln s_C = \sqrt{\frac{1}{n-1} \left[\sum_{i=1}^n (\ln P_{C,i})^2 - \frac{1}{n} \left(\sum_{i=1}^n \ln P_{C,i} \right)^2 \right]} \quad (16)$$

and the half range of the logarithmic cleaning confidence interval $\ln W_C$ of $\ln P_C$:

$$\ln W_C = \frac{\ln s_C}{\sqrt{n}} t_{f;1-\alpha/2} \quad (17)$$

where

$t_{f;1-\alpha/2}$ is a numerical factor, depending on the number $f = n - 1$ of degrees of freedom for the chosen confidence level $1 - \alpha = 0,95$ with two-sided demarcation (see Table 5).

Table 5 – Numerical Values of the t-factor for statistical calculations

n	f	$t_{f;1-\alpha/2}$
2	1	12,71
3	2	4,30
4	3	3,18
5	4	2,78
6	5	2,57
7	6	2,45
8	7	2,37

The total cleaning performance index has the following limits:

lower bound = $\exp (\ln P_C - \ln W_C)$ and upper bound = $\exp (\ln P_C + \ln W_C)$.

The expected value of the cleaning performance index for the **test series** will be in this interval, between the lower bound and the upper bound, with a probability of 95 %.

If a **dishwasher** scores zero in one or more **cycles** from 1 to 8, this score shall be included in the assessment of the total score.

NOTE In addition to the described statistical analysis, other methods of statistical analysis can be used. The number of samples of **dishwashers** tested can be increased, by the testing laboratory, to increase the level of confidence of the performance and consumption assessments.

7.3.3 Dishwasher filter systems

Useful definitions for describing filter systems are **automatic filter**, **self-cleaning filter** and **manual filter**. These should be declared by the manufacturer for the user.

7.3.4 Assessing $\ln W_C$

The requirement is that $\ln W_C$ is equal to or less than 0,073.

If the manufacturer declares that the **test machine** has **automatic filter** cleaning or **self-cleaning filter**, start by conducting 5 **test runs** without filter cleaning.

- If $\ln W_C$ is equal to or less than 0,073 after 5 **test runs**, stop. Otherwise, conduct **test run** 6.
- If $\ln W_C$ is equal to or less than 0,073 after 6 **test runs**, stop. Otherwise, conduct **test run** 7.
- If $\ln W_C$ is equal to or less than 0,073 after 7 **test runs**, stop. Otherwise, conduct **test run** 8.
- If $\ln W_C$ is equal to or less than 0,073 after 8 **test runs**, stop.
- If $\ln W_C$ is equal to or less than 0,073 after 5, 6, 7 or 8 **test runs**, it is verified that the filter system is **automatic** or **self-cleaning**.
- If $\ln W_C$ is greater than 0,073 after 8 **test runs**, the **test machine** has a **manual filter** system, the results of this **test series** is disregarded and a new **test series** of 5 **test runs** shall be conducted with filter cleaning before each **test run**.

After a new **test series** of 5 **test runs** with filter cleaning, the result from these last 5 runs is recorded as the final result.

If the manufacturer declares that the **test machine** has a **manual filter**, a **test series** of 5 test **cycles** shall be conducted with filter cleaning before each **test run**.

The filter of the **reference machine** shall only be cleaned prior to the start of a new **test series** and not between successive **test runs** in a **test series**.

If a **test machine** is tested with filter cleaning, this shall be declared with the results.

NOTE See Annex S for a flow chart which shows the **test series**.

7.4 Results

7.4.1 Expressing drying results

The final drying result of the **test machine** shall be reported in relation to the **reference machine**. Record the drying performance index for the **test series** P_D [$P_D = \exp(\ln P_D)$] of the **test machine** rounded to 2 decimal places.

7.4.2 Expressing cleaning results

The final cleaning result of the **test machine** is the average of the initial series of **test runs** without filter cleaning, in relation to the **reference machine**. Record the cleaning performance index for the **test series** P_C [$P_C = \exp(\ln P_C)$] of the **test machine**, rounded to 2 decimal places. The filter system is to be declared as **automatic** or **self-cleaning**.

If the **dishwasher** is tested with filter cleaning (see 7.3.4), the score is the average of the 5 test **cycles**, in relation to the **reference machine**. Record the cleaning performance index for the **test series** P_C [$P_C = \exp(\ln P_C)$] of the **test machine**, rounded to 2 decimal places. The filter system shall be declared as a **manual filter**.

8 Energy consumption, water consumption, cycle time and programme time

8.1 General and purpose

Clause 8 defines how to measure the electrical energy consumption, the calculated energy contained in the hot water if an external source of hot water is used, the quantity of water consumed by the **dishwasher** and the time it takes to complete a particular **cycle** used for measuring the cleaning and drying performance.

Low power mode measurements shall be conducted according to Annex K.

NOTE This standard recognises that in some countries other legally mandated national standards are required for testing and labelling, pre-empting Clause 8.

8.2 Method of measurement

8.2.1 General

Energy consumption, water consumption, **cycle time** and **programme time** measurements shall be measured in conjunction with combined cleaning and drying performance tests specified in Clause 6 and 7.

The energy consumption, the water consumption, the **cycle time** and **programme time** are measured for each complete **cycle** and the arithmetical mean of the values measured is calculated and reported for each **test series**. Specific guidance is provided in 8.2.2 to 8.2.5.

There may be significant variations in the water consumption, energy consumption, **cycle time** or **programme time** measured for some of the **test runs** in a **test series**. These variations can be caused by features on the **test machine** such as water management systems and **water softeners**. The existence of these variations should not be considered to be a reason for excluding data from the calculation of the mean value for the **test series**, or for rejecting the entire **test run** from the **test series**.

Measurements shall be made using equipment meeting the specifications given in Annex T.

8.2.2 Energy consumption

The energy consumption for the whole **test run** is calculated from the measured electrical energy consumption E_e and the energy of the supplied hot water E_h (if any).

NOTE Annex U provides an informative method to correct energy consumption from cold water within the $(15 \pm 2)^\circ\text{C}$ limit or for larger differences which can arise due to local regional requirements.

8.2.3 Hot water energy

Hot water energy shall be calculated if the **dishwasher** uses any hot water from an external source.

It is calculated as the energy contained in the externally supplied hot water relative to the cold water temperature of 15°C according to the following Equation (18)

$$E_h = (Q_h \times (t_h - 15)) / 860 \quad (18)$$

where

E_h is the hot water energy, in kWh;

t_h is $(\sum (t_{hi} \times Q_{hi})) / \sum Q_{hi}$; (19)

which means the volume-weighted average inlet temperature, in degrees Celsius, of all hot water supplied to the **test machine**;

where

t_{hi} is the temperature of each increment of hot water supplied to the **test machine**;

Q_{hi} is the volume of each increment of hot water supplied to the **test machine**;

Q_h is the total volume of hot water ($\sum Q_{hi}$), in litres, supplied to the **test machine**.

Incremental measurements of water volume and temperature shall be made with a minimum sampling frequency of once per second.

NOTE The hot water energy, so calculated, includes only the energy embodied in the hot water, relative to the nominal cold water temperature and does not take into account any losses associated with the conversion and distribution of hot water that occur in different households and different countries.

8.2.4 Water consumption

Total water consumption shall be reported for each **cycle** (including water softener regeneration or other variations).

8.2.5 Time

Programme time shall be measured from the initiation of the **cycle** (of the selected **programme**), excluding any user programmed delay until an end of **programme** indicator (this could be a sound, light or symbol on a display to indicate that the **programme** is complete and the user has access to the load). If there is no end of **programme** indicator, the **programme time** is equal to the **cycle time**. **Programme time** shall be reported for each **cycle**.

Cycle time shall be measured from the initiation of the **cycle** (of the selected **programme**), excluding any user programmed delay until all activity ceases (e.g. the end of the **cycle**). At the end of the **cycle**, when all activity in the **dishwasher** has ceased, the **dishwasher** may revert to **off mode** or it may have a steady state power consumption until the user opens the **dishwasher** or turns the unit off. The **cycle time** shall be reported for each **cycle**.

9 Airborne acoustical noise

Airborne acoustical noise measurement shall be determined in accordance with IEC 60704-2-3 when it is required.

Annex A (normative)

Place settings and serving pieces

A.1 General information

The **tableware** described below shall be used for testing.

All items shall be free of chips, cracks, discolorations and surface changes or any other damage likely to affect the cleaning and drying assessment. Additionally, items should be removed if there are too many scratches to evaluate them accurately.

The glaze of the porcelain shall be in good condition. The glasses shall be clear and free from cloudiness. The melamine parts shall have no observable signs of discoloration and surface changes.

NOTE A guidance value for the allowed number of test **cycles** when soil is applied, is 200 for the dishware, cutlery and glass items. The melamine items can be used for approximately 100 **cycles** when soil is applied. To aid in longevity of some load items, some labs place paper between load items for handling and storage.

Forks shall not have sharp edges. The prongs of forks, bowls of spoons, and blades of the knives shall be polished as well as the handles.

A.2 Test load specifications

Test loads shall consist of the items specified in Table A.1 in the quantities specified in Table A.2.

Additional information concerning the test load items can be found in Annex B, Table B.1.

For **rated dishwasher capacities** of 17 or more **place settings**, the quantities required shall be established by continuing the pattern established in Table A.2 for **rated dishwasher capacities** 11 through 16.

NOTE 1 Type A and type B items refer to a combination of breakfast/lunch and dessert/dinner **tableware** items. Type S items refer to **serving pieces**.

NOTE 2 Suppliers of load items that meet these specifications are provided in Annex L.

NOTE 3 The item descriptions in Table A.1 and Table A.2 can deviate from the article name used by a supplier.

Table A.1 – Specifications of tableware items

Item Id.	Item description	Material	Diameter/ length in mm ^a	Weight in g ^b	Surface colour
Load items type A + type B					
A 1	Dinner plate	porcelain	250	531	white
A 2	Dessert plate	porcelain	190	253	white
A 3	Dessert bowl	corelle glass	130	124	white
A 4	Mug	porcelain	70	268	white
B 1	Soup plate	porcelain	230	460	white
B 2	Melamine dessert plate	melamine	195	121	white
B 3	Saucer	porcelain	140	157	white
B 4	Cup	porcelain	78	112	white
A 5 + B 5	Glass	borosilicate glass	60	106	transparent
A 6 + B 6	Fork	(18/10) stainless steel	188	43	metallic
A 7 + B 7	Knife	(18/10) stainless steel	209	55	metallic
A 8 + B 8	Soup spoon	(18/10) stainless steel	190	55	metallic
A 9 + B 9	Dessert spoon	(18/10) stainless steel	156	36	metallic
A 10 + B 10	Tea spoon	(18/10) stainless steel	136	24	metallic
Serving pieces					
S 1 a	Small pot	(18/10) stainless steel	160	823	metallic
S 1 b	Oven pot	(18/10) stainless steel	160	477	metallic
S 2	Glass bowl	borosilicate glass	186	295	transparent
S 3	Oval platter	porcelain	320	641	white
S 4	Melamine bowl	melamine	213	166	white
S 5	Serving spoon	(18/10) stainless steel	260	75	metallic
S 6	Serving fork	(18/10) stainless steel	190	38	metallic
S 7	Gravy ladle	(18/10) stainless steel	180	50	metallic
^a A length and diameter tolerance of 2,5 % of the absolute values is acceptable.					
^b A weight tolerance of 5 % of the absolute value is acceptable.					

Table A.2 – Composition of test loads

Rated dishwasher capacity (place settings):		Number of each type of load item to be included in each test load															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Item No.	Item description																
A 1	Dinner plate	0	0	0	2	3	3	4	4	5	5	6	6	7	7	8	8
A 2	Dessert plate	3 ^b	3 ^b	5 ^c	2	3	3	4	4	5	5	6	6	7	7	8	8
A 3	Dessert bowl	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8
A 4	Mug	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8
A 5	Glass	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8
B 5	Glass	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8
A 6 + B 6	Fork	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A 7 + B 7	Knife	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A 8	Soup spoon	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8
B 8	Soup spoon	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8
A 9 + B 9	Dessert spoon	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A 10 + B 10	Tea spoon	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
B 1	Soup plate	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8
B 2	Melamine dessert plate	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8
B 3	Saucer	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8
B 4	Cup	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8
S 1 a	Small pot	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
S 1 b	Oven pot	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
S 2	Glass bowl	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
S 3	Oval platter	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
S 4	Melamine bowl	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
S 5	Serving spoon	0	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2
S 6	Serving Fork	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
S 7	Gravy ladle	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Total number of items		14	24	34	47	57	67	77	88	98	108	120	130	140	150	160	170
Total mass of crockery including glasses (kg) ^a		1,26	2,21	3,22	4,44	5,70	6,66	7,92	8,88	10,14	11,10	12,36	13,32	14,58	15,54	16,80	17,76
Total mass of cutlery excluding serving pieces (kg) ^a		0,21	0,43	0,64	0,85	1,07	1,28	1,49	1,70	1,92	2,13	2,34	2,56	2,77	2,98	3,20	3,41
Total mass of serving pieces (kg) ^a		0,25	0,254	0,254	1,88	1,882	1,88	1,882	2,18	2,177	2,18	2,82	2,82	2,82	2,82	2,82	2,82
Total mass of load (kg) ^a		1,72	2,89	4,11	7,17	8,65	9,82	11,30	12,76	14,24	15,41	17,53	18,70	20,17	21,34	22,82	23,99
^a Loads prepared according to this table shall have the mass indicated ± 5%																	
^b One dinner plate (A1) and oval platter (S3) is replaced by a dessert plate (A2) each. The respective soil agent and amount for A1 and S3 is applied to the substituted dessert plate(s).																	
^c Two dinner plates (A1) and one oval platter (S3) are replaced by a dessert plate (A2) each. The respective soil agent and amount for A1 and S3 is applied to the substituted dessert plate(s).																	

^a Loads prepared according to this table shall have the mass indicated $\pm$ 5%

^b One dinner plate (A1) and oval platter (S3) is replaced by a dessert plate (A2) each. The respective soil agent and amount for A1 and S3 is applied to the substituted dessert plate(s).

^c Two dinner plates (A1) and one oval platter (S3) are replaced by a dessert plate (A2) each. The respective soil agent and amount for A1 and S3 is applied to the substituted dessert plate(s).

Alternate load item: Item Id. B1 in the **test machine** (soup plate) may be replaced with item Id. A1 (dinner plate). This substitution shall not apply to the **reference machine**. The use of alternate loads shall be reported.

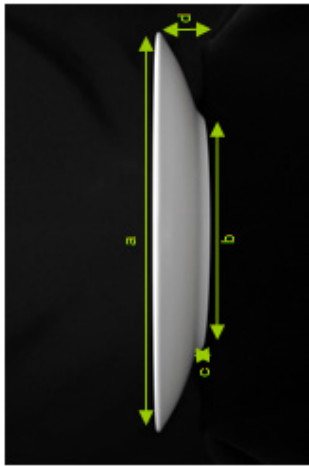
Annex B (informative)

Tableware specifications

Tableware specifications are given in Table B.1

All values (a to f) are measured at the longest or widest length.

Table B.1 – Tableware specifications

Item Id.	Item Description	Photograph	Measured value ^a (a, b, c, d, e, f)	Weight in g ^b	Material thickness bottom	Shape/style	Producer
A 1	Dinner plate		a = 250 mm b = 150 mm c = 2 mm d = 20 mm e = -- f = --	531 g	4,4 mm	Form 2000 (Arzberg product number: 20000000226)	Arzberg