FOREWORD: H WADHWA REVISED

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Electrical Appliances Sectional Committee had been approved by the Electrotechnical Division Council.

This standard covers the general, safety and performance requirement of electric dishwashing machines for household use.

This standard shall supersede the following standards. The requirements of which have been incorporated in this standard:

IEC 60436:2015	Electric dishwashers for household use - Methods for measuring the performance
IEC 60335-2-5 : 2012	Household and similar electrical appliances - Safety - Part 2-5: Particular requirements for dishwashers
IEC 60335-1 : 2010	Household and similar electrical appliances - Safety – Part 1:General requirements

As per the investigating and research the washing performance and water consumption values in dishwashers is comparatively lesser than the water consumption in hand wash.

Draft Indian Standard
ELECTRIC DISHWASHER 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. REFERENCES
2.1 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~~1~~ to entry: A dishwasher can have a specific drying operation at the end of the programme.

Note 2~~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~~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~~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~~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~~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~~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~~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~~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~~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~~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~~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~~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~~1~~ to entry: End of cycle is reached when all activities cease (according to 3.1.15 and 3.1.16).
Note 2~~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~~1~~ to entry: The left on mode duration is declared by the manufacturer.
Note 2~~2~~ to entry: End of cycle is reached when all activities cease (according to 3.1.15 and 3.1.16).
Note 3~~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 ± 3) °C

3.1.33 freeze
storage of foods at a temperature of (-18 ± 3) °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~~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 – α = 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 – α = 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 (NORMAL)water correction energy;(THIS NEEDS TO BE REVISED) AS NORMAL WATER AT 30°C
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(NORMAL) water supplied to the **test machine**.
$E_{Regional\text{-}e}$ the estimated energy consumption for the **dishwasher** for a cold(NORMAL) water supply temperature of t_{nr};
$E_{IEC15\ °C\text{-}m}$ the measured energy for the **dishwasher** in accordance with 8.2.2 with a cold (NORMAL)water supply temperature of 15/30 °C;
t_{nr} the nominal non-standard cold water temperature for the region;
Q_a the cold (NORMAL)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;
$E_{IEC15\ °C\text{-}e}$ the estimated energy for the **dishwasher** with a cold (NORMAL)water supply temperature of 15/30 °C;
$E_{Regional\text{-}m}$ 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 "±", 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~~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**

5.6

5.7 **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: (27 ± 2) °C
– Relative humidity: (55 ± 10) %

5.8 Water

5.8.1 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.

5.8.2 Water temperature

The temperature of the supply water shall be:

– cold water feed temperature:
  - (15 ± 2) °C.
  - NORMAL INLET WATER FEED TEMPERATURE (30 ± 2) °C

– hot water feed temperature:
  - temperature indicated by the manufacturer ± 2 °C, or
  - where a range is specified by the manufacturer which does include 60 °C, (60 ± 2) °C, or
  - where a range is specified by the manufacturer which does not include 60 °C, the value nearest to (60 ± 2) °C, or
  - (60 ± 2) °C, if instructions are not given.
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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.

5.8.3 Water hardness

If hard water is used it shall have a total water hardness of (2.5 ± 0.5) mmol/l. If soft water is used it shall have a total water hardness of ≤ 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.

5.8.4 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.

5.9 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.
NOTE: IN CASE OF NON-AVAILABILITY, COMMERCIALLY AVAILABLE DETERGENT OF REPUTED MFRS RECOMMENDED BY DISHWASHERS MFRS,(HAVING SIMILAR COMPOSITION), MAY ALSO BE USED TO JUDGE THE CLEANING PERFORMANCE.

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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.

5.10 Rinse aid

The **rinse aid** Formula "III", as described in Annex E, shall be used.
-NOTE: IN CASE OF NON-AVAILABILITY, COMMERCIALLY AVAILABLE RINSE-AID OF REPUTED MFRS RECOMMENDED BY DISHWASHERS MFRS,(HAVING SIMILAR COMPOSITION), MAY ALSO BE USED TO JUDGE THE CLEANING PERORMANCE.

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.

5.11 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. COMMERCIALLY AVAILABLE LUGOLS SOLUTION OF SIMILAR COMPOSITION MAY ALSO BE USED

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 r**eference 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

Sub clause 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 ± 2) °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.

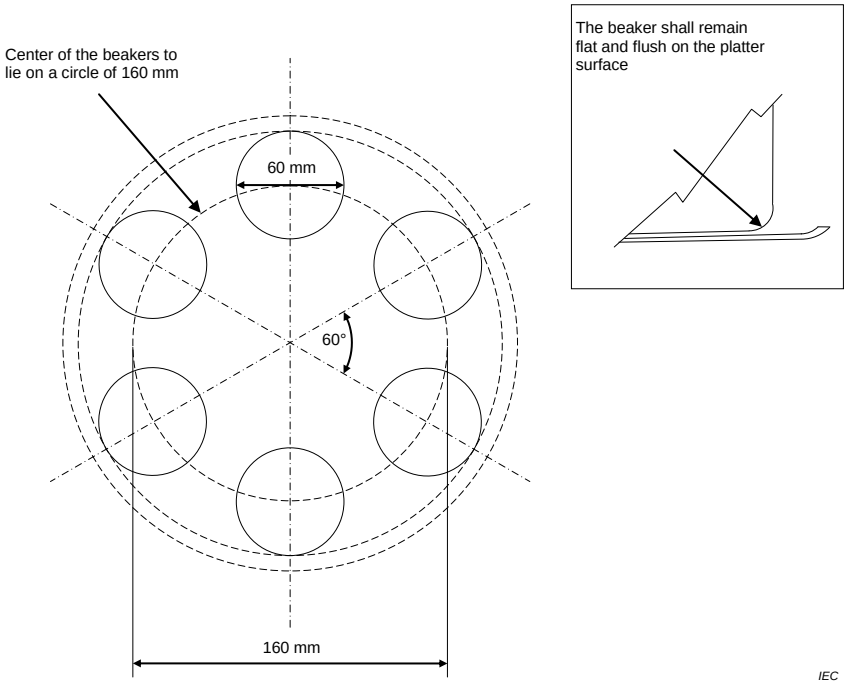

Figure 1 – Position of the glasses on the microwave turntable

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. TEA OF SIMILAR CHARACRERISTICS/ GRADE MAY ALSO BE USED FOR SOILING

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. An even 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~~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.

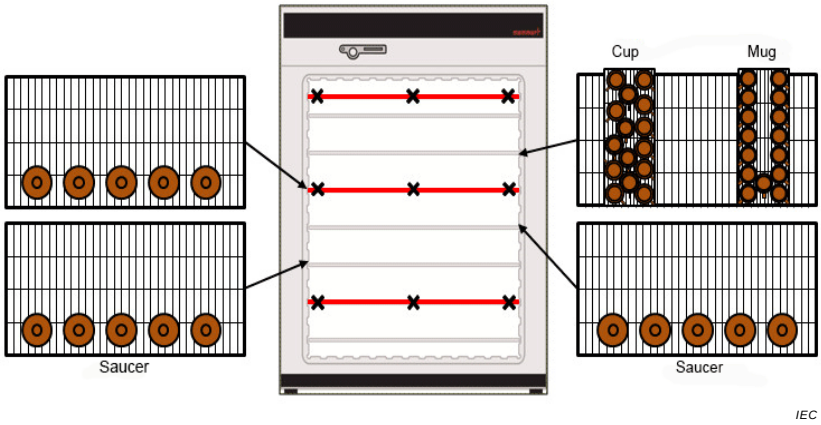

Figure 2 – The thermal cabinet for pre-drying of soiled cups, mugs and saucers

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~~Figure 3~~) and, depending on country, can be called round, silverside, topside, thick flank, etc.

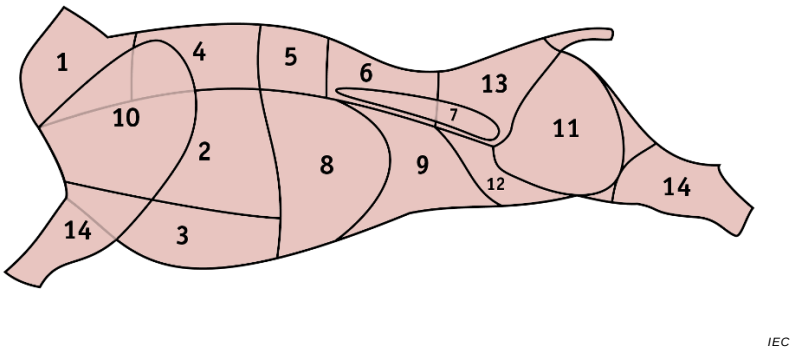

Figure 3 – Schematic view of the different beef pieces

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.
NOTE: AS ANIMAL MEAT WILL HURT THE RELIGIOUS SENTIMENTS AS INDIA BEING MULTI-RELIGIOUS SOCIETY, ANY OTHER SIMILAR FOOD MATERIAL LIKE SOYA CAKES, YAM FRUIT/FRESH CHEESE MAY ALSO BE SUBSTITUTED

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~~Figure 4~~. If necessary additional unsoiled **tableware** items shall be included to ensure that the thermal cabinet is fully loaded.

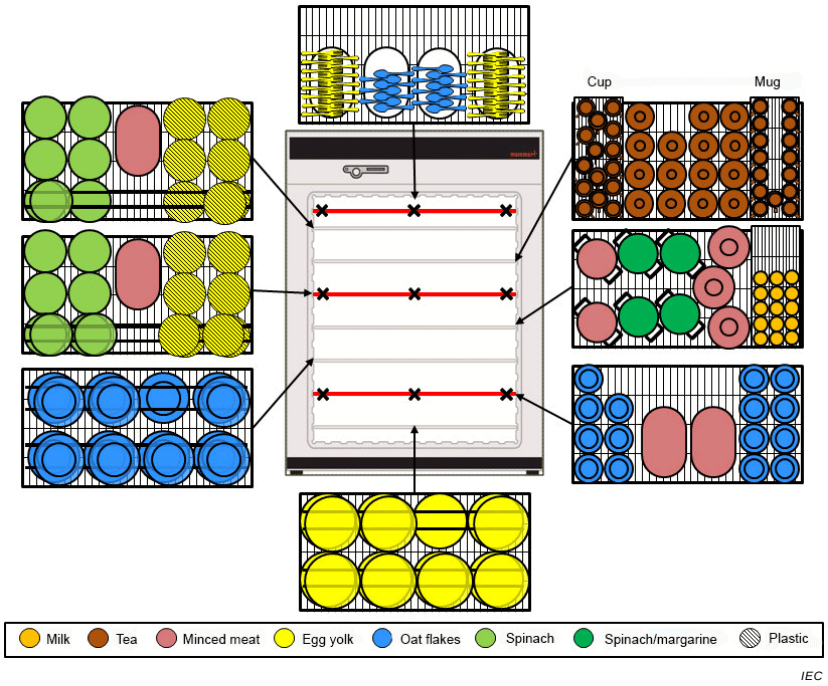

Figure 4 – The thermal cabinet with soiled load items (30 place settings)

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~~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 In 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 of 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~~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):

$$N = \sum_{z=1}^{22} s_z \tag{2}$$

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):

$$D_{\mathrm{R,i}} = \frac{1}{2N} \sum_{z=1}^{22} D_{\mathrm{R,z}} \tag{3}$$

$$D_{\mathrm{T,i}} = \frac{1}{2N} \sum_{z=1}^{22} D_{\mathrm{T,z}} \tag{4}$$

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**;
$D_{\mathrm{R,i}}$ is the average drying score for one **test run** of the **reference machine**;
$D_{\mathrm{T,i}}$ 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** $P_{\mathrm{D,i}}$:

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

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

$$\ln P_{\mathrm{D}} = \frac{1}{n} \sum_{i=1}^{n} \ln P_{\mathrm{D,i}} \tag{6}$$

where *n* is the number of combined cleaning and drying test **cycles**.
The total drying performance index for the **test series** is:

$$P_{\mathrm{D}} = \exp\,(\ln P_{\mathrm{D}}) \tag{7}$$

Next, calculate the drying standard deviation In s_{D} of the In $P_{\mathrm{D,i}}$

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

and the half range of the logarithmic drying confidence interval In W_D of In 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 – α = 0,95 with two-sided demarcation (see Table 5 for values of t-factors).

If the numerical value In W_D is more than 0,10, increase the number of tests until In 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:

lower bound = exp (ln P_D – In W_D) and upper bound = exp (In P_D + In 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~~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	$0 < A \leq 4$	4
5 – 10	$4 < A \leq 20$	3
> 10	$20 < A \leq 50$	2
Not Applicable	$50 < A \leq 200$	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_i =							ΣC_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):

$$N = \sum_{z=1}^{22} s_z \tag{10}$$

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):

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

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

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**, $P_{C,i}$:

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

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):

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

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 In s_C of the In $P_{C,i}$:

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

and the half range of the logarithmic cleaning confidence interval In W_C of In 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 – α = 0,95 with two-sided demarcation (see Table 5~~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 (In P_C – In W_C) and upper bound = exp (In 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 (In 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 (In 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 (In 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 ± 2) °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/NORMAL water temperature of 15 °C/30°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/NORMAL 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.

10. Safety Requirements

10.1 The Dishwashers shall comply with the requirements given in clause 8 to 32 of IEC 60335-2-5:2012

10.2 Type Tests
The test specified in Table 6 below shall constitute the type tests and shall be carried out on two samples of the same type and rating selected preferably at random from a regular production lot. Before commencement of the tests, the water heaters shall be visually

examined and inspected for obvious visuals defects in respect of components, parts and their assembly, construction, stability, markings, provision of suitable terminals for supply connections, earthing and the effectiveness of screws and connections. The external surface finish shall be even and free from finishing defects.

Table 6
Schedule Of Type Test

Sl. No.	Test	Clause Reference
i)	Safety requirement	8 to 16 and 27 of IEC 60335-2-5:2012
ii)	Combined cleaning and drying performance assessment	7
iii)	Energy consumption, water consumption, cycle time and programme time	8
iv)	Endurance	Not applicable in IEC 60335-1 & IEC 60335-2-5
v)	Finish	Not applicable in IEC 60335-1 & IEC 60335-2-5

RELEVANT IS 302-2-… MAY BE ALSO BE ADDED

10.2.1 Criteria for Acceptance

All samples shall successfully pass all the type test for proving conformity with the requirements of the standard. If any of the samples fails in any of the type tests, the testing authority, at its discretion, may call for fresh samples not exceeding twice the original number and subject them again to all tests or to the test(s) in which failure(s) occurred. No failure should be permitted in the repeat test(s).

18.3 acceptance Tests

The following shall constitute the acceptance test:

Sl. No.	Test	Clause Reference
a)	Protection against electric shock	8 of IEC 60335-2-5
b)	Input	10 of IEC 60335-2-5
c)	Temperature rise	11 of IEC 60335-2-5
d)	Insulation resistance and leakage current	12 of IEC 60335-2-5
e)	Moisture resistant	13 of IEC 60335-2-5
f)	Insulation resistant and electric strength(after humidity treatment)	14 of IEC 60335-2-5
g)	Construction	22 of IEC 60335-2-5
h)	Provision for earthing	27 of IEC 60335-2-5
i)	Combined cleaning and drying performance assessment	7
j)	Energy consumption, water consumption, cycle time and programme time	8

RELEVANT IS 302-2-… MAY BE ALSO BE ADDED

NOTE – For the purpose of the acceptance tests, the humidity treatment is done for 24 h while conducting the test for moisture resistance (15 of IEC 60335-2-5:2012)

18.3 Routine Test

The following tests shall constitute the routine tests:

Sl. No.	Test	Clause Reference
a)	Protection against electric shock	8 of IEC 60335-2-5
b)	High Voltage	13.3 of IEC 60335-2-5
c)	Provision for earthing	13.3 of IEC 60335-2-5

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	Servng 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.*

NOTE: AS THE RECOMMENDED SUPPLIERS NEITHER SUPPLY NOR HAVE ANY DISTRIBUTORS IN INDIA, SIMILAR MATERIALS OF PREMIUM QUALITY OF REPUTED MFRS/EXPORTERS HAVING SIMILAR DIMENSIONS,SIZES,WEIGHTS SHAPES,COLOURS MAY ALSO BE USED : *TO BE EXAMINED ON REPEATABILITY & REPRODUCIBILITY*

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Table A.2 – Composition of test loads

		Number of each type of load item to be included in each test load															
	Rated dishwasher capacity (place settings):	**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).

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.

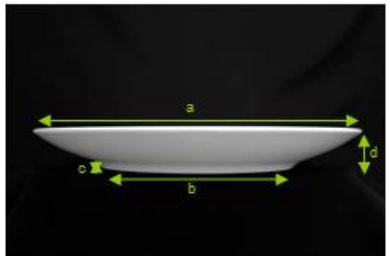
Annex B
(informative)

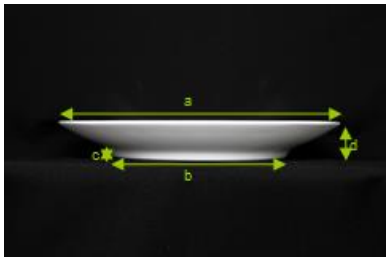
Tableware specifications

Tableware specifications are given in Table B.1

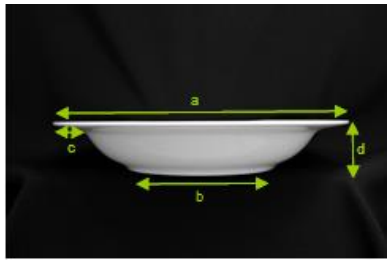
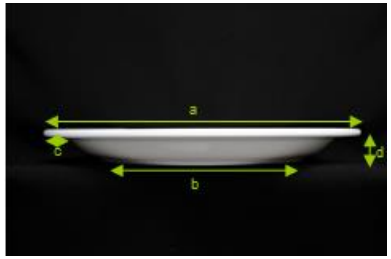
All values (a to f) are measured at the longest or widest length.

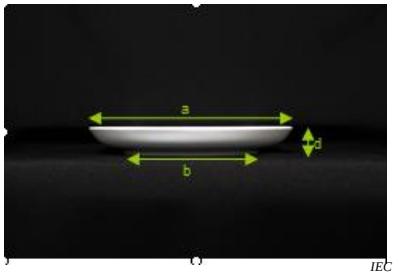
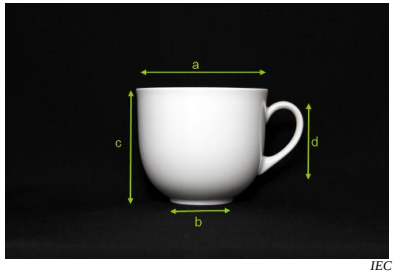
Table B.1 – Tableware specifications

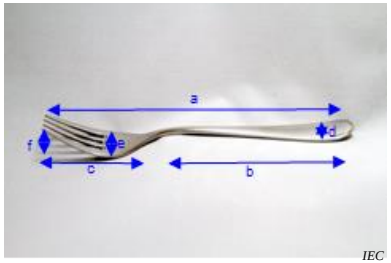
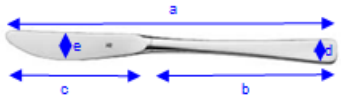
Item Id.	Item Description	Photograph	Measured value[a] (a, b, c, d, e, f)	Weight in g[b]	Material thickness bottom	Shape/style	Producer
A 1	Dinner plate	 IEC	a = 250 mm b = 150 mm c = 2 mm d = 20 mm e = -- f = --	531 g	4.4 mm	Form 2000 *(Arzberg product number: 20000000226)*	Arzberg

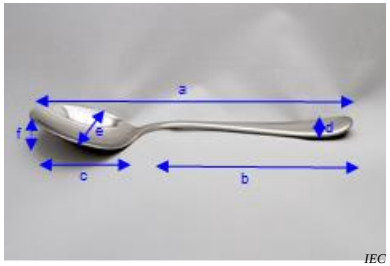
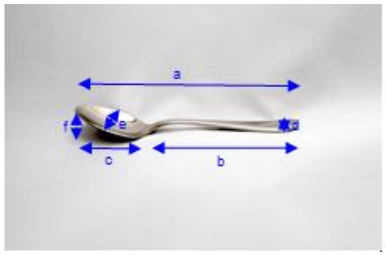
Item Id.	Item Description	Photograph	Measured value[a] (a, b, c, d, e, f)	Weight in g[b]	Material thickness bottom	Shape/style	Producer
A 2	Dessert plate	 IEC	a = 190 mm b = 115 mm c = 2 mm d = 20 mm e = -- f = --	253 g	3.2 mm	Form 2000 *(Arzberg product number: 2000000010219)*	Arzberg
A 3	Dessert bowl	 IEC	a = 130 mm b = 65 mm c = 5 mm d = 28 mm e = -- f = --	124 g	3.8 mm	Corelle	Corning #6003899

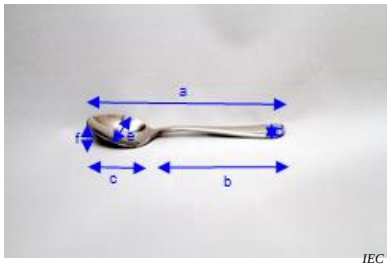
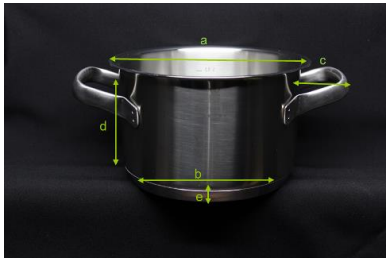
Item Id.	Item Description	Photograph	Measured value[a] (a, b, c, d, e, f)	Weight in g[b]	Material thickness bottom	Shape/style	Producer
A 4	Mug	 IEC	a = 70 mm b = 35 mm c = 105 mm d = 70 mm e = -- f = --	268 g	3.0 mm	Solo 8000	Kahla/Thüringer Porzellan GmbH
A 5 B 5	Glass	 IEC	a = 60 mm b = -- c = 50 mm d = 120 mm e = -- f = --	106 g	3.4 mm	Beaker (250ml)/Tall Form/Without Drain	Schott DURAN

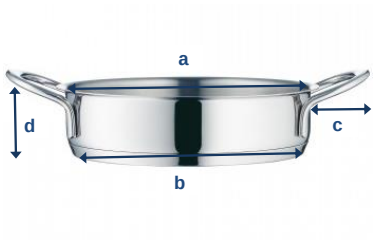
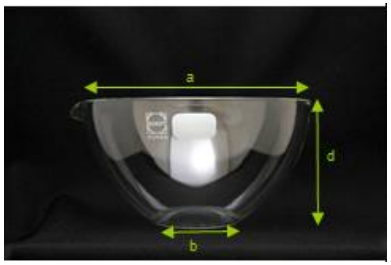
Item Id.	Item Description	Photograph	Measured value[a] (a, b, c, d, e, f)	Weight in g[b]	Material thickness bottom	Shape/style	Producer
B 1	Soup plate	 IEC	a = 230 mm b = 120 mm c = 25 mm d = 30 mm e = -- f = --	460 g	3.2 mm	1382 *(Arzberg product number: 13820000101 23)*	Arzberg
B 2	Melamine dessert plate	 IEC	a = 195 mm b = 125 mm c = 15 mm d = 15 mm e = -- f = --	121 g	2.4 mm	1924 *(WFK product number: 98255-1924)*	Waca Kunststoff-warenfabrik

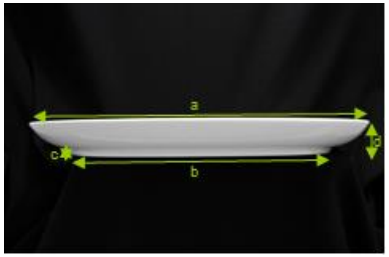
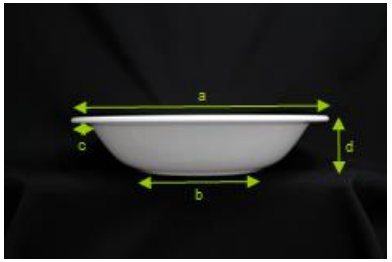
Item Id.	Item Description	Photograph	Measured value[a] (a, b, c, d, e, f)	Weight in g[b]	Material thickness bottom	Shape/style	Producer
B 3	Saucer		a = 140 mm b = 90 mm c = -- d = 15 mm e = -- f = --	157 g	3.8 mm	1382 *(Arzberg product number: 13820000147 31)*	Arzberg
B 4	Cup		a = 78 mm b = 36 mm c = 65 mm d = 45 mm e = -- f = --	112 g	3.1 mm	1382 *(Arzberg product number: 13820000147 32)*	Arzberg

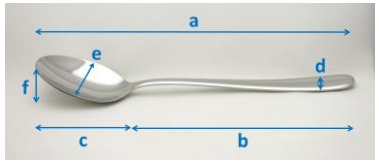
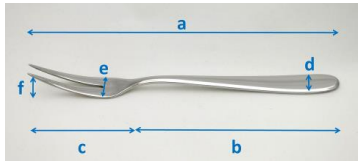
Item Id.	Item Description	Photograph	Measured value[a] (a, b, c, d, e, f)	Weight in g[b]	Material thickness bottom	Shape/style	Producer
A 6 + B 6	Fork	 IEC	a = 188 mm b = 128 mm c = 60 mm d = 17 mm e = 24 mm f = 22 mm	43 g	3.0 mm	"Signum 1900" Dessert fork *(WMF product number: 12.1905.6040)*	WMF
A 7 + B 7	Knife	 IEC	a = 208 mm b = 117 mm c = 91 mm d = 17 mm e = 20 mm f =	55 g	6.3 mm	"Gastro 0800" Table knife *(WMF product number: 12.0803.6047)*	WMF

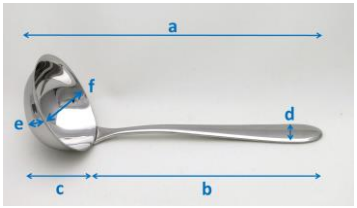
Item Id.	Item Description	Photograph	Measured value[a] (a, b, c, d, e, f)	Weight in g[b]	Material thickness bottom	Shape/style	Producer
A 8 + B 8	Soup spoon		a = 190 mm b = 125 mm c = 65 mm d = 16 mm e = 40 mm f = 25 mm	55 g	3.0 mm	"Signum 1900" Dessert spoon *(WMF product number: 12.1904.6040)*	WMF
A 9 + B 9	Dessert spoon		a = 156 mm b = 100 mm c = 56 mm d = 15 mm e = 33 mm f = 22 mm	36 g	2.8 mm	“Signum 1900” Coffee/tea spoon *(WMF product number: 12.1910.6040)*	WMF

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 10 + B 10	Tea spoon	 IEC	a = 136 mm b = 86 mm c = 50 mm d = 13 mm e = 29 mm f = 17 mm	24 g	2.4 mm	"Signum 1900" Tea/coffee spoon *(WMF product number: 12.1907.6040)*	WMF
S 1 a	Small pot	 IEC	a = 160 mm b = 148 mm c = 37 mm d = 105 mm e = f =	823 g	2.2 mm	Gourmet Plus High Casserole (without lid) *(WMF product number: 07.2416.6030)*	WMF

Item Id.	Item Description	Photograph	Measured value[a] (a, b, c, d, e, f)	Weight in g[b]	Material thickness bottom	Shape/style	Producer
S 1 b	Oven pot		a = 160 mm b = 150 mm c = 36 mm d = 41 mm e = f =	477 g	6.0 mm	Oven pan Ø 16 cm Mini *(WMF product number: 07.1679.6041)*	WMF
S 2	Glass bowl		a = 186 mm b = 75 mm c = 95 mm d = e = f =	295 g	2.1 mm	Evaporation dish *(Schott Duran product number: 411629190)*	Schott DURAN

Item Id.	Item Description	Photograph	Measured value[a] (a, b, c, d, e, f)	Weight in g[b]	Material thickness bottom	Shape/style	Producer
S 3	Oval platter	 IEC	a = 320 mm b = 250 mm c = 2 mm d = 30 mm e = -- f = --	655 g	4.0 mm	1382 *(Arzberg product number: 1382000012732)*	Arzberg
S 4	Melamine bowl	 IEC	a = 213 mm b = 105 mm c = 13 mm d = 40 mm e = -- f = --	166 g	2.2 mm	1926 *(WFK product number: 98255-1926)*	Waca Kunststoff-warenfabrik

Item Id.	Item Description	Photograph	Measured value[a] (a, b, c, d, e, f)	Weight in g[b]	Material thickness bottom	Shape/style	Producer
S 5	Serving spoon	 IEC	a = 260 mm b = 184 mm c = 76 mm d = 17 mm e = 48 mm f = 29 mm	75	2.5 mm	WMF “Supplement”	WMF
S 6	Serving fork	 IEC	a = 190 mm b = 130 mm c = 60 mm d = 15 mm e = 16 mm f = 13 mm	38	2.8 mm	WMF “Supplement”	WMF

Item Id.	Item Description	Photograph	Measured value[a] (a, b, c, d, e, f)	Weight in g[b]	Material thickness bottom	Shape/style	Producer
S 7	Gravy ladle		a = 180 mm b = 137 mm c = 43 mm d = 15 mm e = 24 mm f = 60 mm	50	2.3 mm	WMF “Supplement”	WMF

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.

Annex C
(normative)

Illustration of soil application quantities

C.1 Soil application

C.1.1 Soil application example for type A tableware items

The following Table C.1 illustrates the type of soil and the amount of soil which is applied to each item of type A **tableware** for a machine with a **rated dishwasher capacity** of 12 **place settings**.

Table C.1 – Soil application example for type A tableware items

Item No.	Item description	Number of items	Kind of soil	Amount of soil per item (g)	Per 6 items of type A tableware (g)
A 1	Dinner plate	6	Egg yolk	2,16 [a]	13 [b]
A 2	Dessert plate	6	Spinach	5	30
A 3	Dessert bowl	6	Oat flakes (porridge)	3	18
A 4	Mug	6	Tea	120 [a]	720 [b]
A 5	Glass	6	Milk	10	60
A 6	Fork	6	Egg yolk	0,16 [a]	1 [b]
A 7	Knife	6	N/A	N/A	N/A
A 8	Soup spoon	6	N/A	N/A	N/A
A 9	Dessert spoon	6	N/A	N/A	N/A
A 10	Tea spoon	6	N/A	N/A	N/A

[a] Only indicates the approximate applied amount per item. Value has to be used to calculate the total amount per machine.

[b] Total amount of soil for this type of dishware is obligatory and distributed as equally and evenly on all items of this type as possible.

C.1.2 Soil application example for type B tableware items

The following Table C.2 illustrates the type of soil and the amount of soil which is applied to each item of type B **tableware** for a machine with a **rated dishwasher capacity** of 12 **place settings**.

Table C.2 – Soil application example for type B tableware items

Item No.	Item description	Number of items	Kind of soil	Amount of soil per item (g)	Per 6 items of type B tableware (g)
B 1	Soup plate	6	Oat flakes (porridge)	3	18
B 2	Melamine dessert plate	6	Egg yolk	1,5 [a]	9 [b]
B 3	Saucer	6	Tea	40 [a]	240 [b]
B 4	Cup	6	Tea	80 [a]	480 [b]
B 5	Glass	6	N/A	N/A	N/A
B 6	Fork	6	Egg yolk	0,16 [a]	1 [b]
B 7	Knife	6	N/A	N/A	N/A
B 8	Soup spoon	6	Oat flakes (porridge)	Dipped into porridge	Dipped into porridge
B 9	Dessert spoon	6	N/A	N/A	N/A
B 10	Tea spoon	6	N/A	N/A	N/A

[a] Only indicates the approximate applied amount per item. Value has to be used to calculate the total amount per machine.

[b] Total amount of soil for this type of dishware is obligatory and distributed as equally and evenly on all items of this type as possible.

C.1.3 Soil application on the serving pieces

The following Table C.3 illustrates the type of soil and the amount of soil which is applied to each serving piece for a machine with a **rated dishwasher capacity** of 12 **place settings**.

Table C.3 – Soil application on the serving pieces

Item No.	Item description	Number of items	Kind of soil	Amount of soil per item (g)	Total amount per 12 place setting machine
S 1 a	Small pot	1	Spinach	6	6
			Margarine	1	1
S 1 b	Oven pot	1	Minced meat	6	6
S 2	Glass bowl	1	Minced meat	8	8
S 3	Oval platter	1	Minced meat	8	8
S 4	Melamine bowl	2	Margarine	5,5	11
S 5	Serving spoon	2	N/A	N/A	N/A
S 6	Serving fork	1	N/A	N/A	N/A
S 7	Gravy ladle	1	N/A	N/A	N/A

C.1.4 Soil application quantities for different rated dishwasher capacities

The following Table C.4 illustrates the amount of soil which has to be applied on the type A, type B and **serving pieces** for a 6-, 9-, 12- or 15- **place setting** machine. The amounts per item, which are the basis for this calculation, are given in Table C.1, Table C.2 and Table C.3.

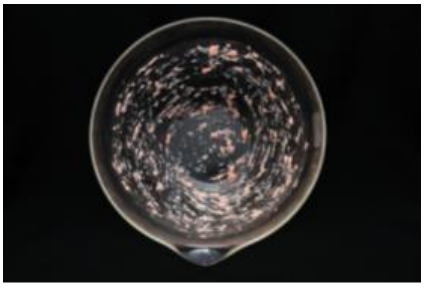
Table C.4 – Soil application quantities for different rated dishwasher capacities

Amount of soil for dishwashers with a rated capacity of 6, 9, 12 or 15 place settings (ps)																
Type of soil and amount (g)	Type A				Type B				Serving pieces				Total			
	6 ps	9 ps	12 ps	15 ps	6 ps	9 ps	12 ps	15 ps	6 ps	9 ps	12 ps	15 ps	6 ps	9 ps	12 ps	15 ps
Egg yolk [a]	6,96	11,60	13,92	18,56	4,98	6,64	9,96	11,62	N/A	N/A	N/A	N/A	11,9	18,2	23,9	30,2
Minced meat	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8	16	22	22	8	16	22	22
Oat flakes [b]	9	15	18	24	9	12	18	21	N/A	N/A	N/A	N/A	18	27	36	45
Spinach	15	25	30	40	N/A	N/A	N/A	N/A	6	6	6	6	21	31	36	46
Tea	360	600	720	960	360	480	720	840	N/A	N/A	N/A	N/A	720	1080	1440	1800
Milk	30	50	60	80	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	30	50	60	80
Margarine	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6,5	6,5	12	12	6,5	6,5	12	12
[a] The total amount for this type of soil is rounded to deliver the exact value which should be applied on all items with this soil.																
[b] The amount of porridge on the soup spoons is not included.																

Annex D
(informative)

Pictures of the soiled items

Minced meat: Glass bowl, oval platter, oven pot



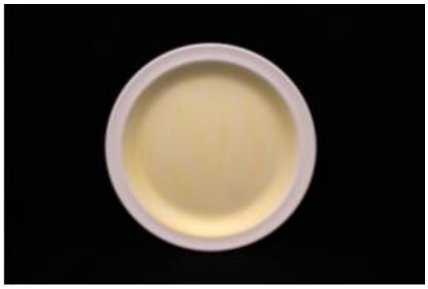
IEC

IEC

IEC

Egg yolk: Dinner plate, melamine dessert plate, fork

IEC



IEC

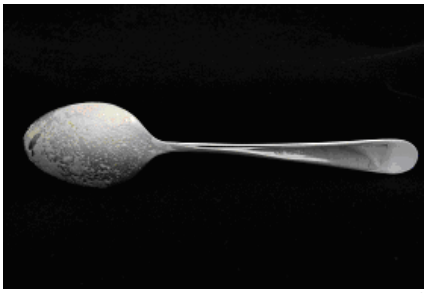
IEC

(picture of the fork was made after oven drying)

Oat flakes: Soup plate, dessert bowl, soup spoon

IEC

IEC

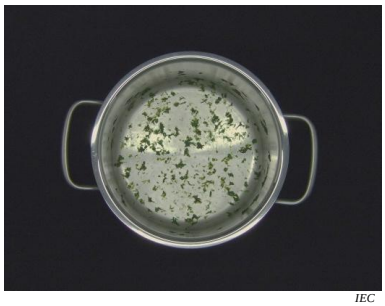


IEC

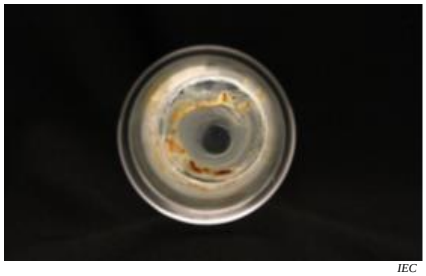
(picture of the spoon was made after oven drying)

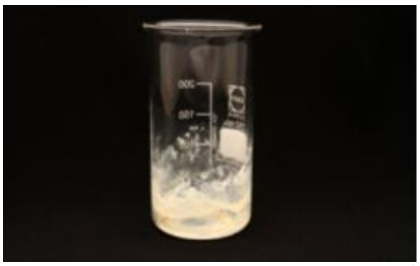
Spinach: Dessert plate, small pot


IEC


IEC

Milk: Glass


IEC


IEC

Tea: Cups, mugs and saucers
(pictures were made after oven drying)


IEC


IEC


IEC

Margarine: Melamine bowl

IEC

Annex E
(normative)

Test additives

E.1 General

Trademark information is provided for the convenience of users of this International standard and does not constitute an endorsement by the IEC of this trademark. Items of similar specification may be used if they can be shown to lead to equivalent results.

E.2 Detergent

The phosphate and sodium perborate free reference **detergent** type D consists of the following (see Table E.1):

Table E.1 – Ingredients of reference detergent type D

Chemical substance	Specification	Mass %
Sodium citrate dihydrate		30,0
Maleic acid/acrylic acid copolymer sodium salt	Sokalan CP 5 Gran (BASF), 50 % active on sodium carbonate	12,0
Sodium percarbonate		7,0
Tetraacetyl ethylene diamine (TAED)		2,0
Sodium disilicate		10,0
Linear fatty alcohol ethoxylate	Plurafac LF403 (BASF)	2,0
Protease	Savinase 16,0T 160KNPU/kg (Novozymes)	1,0
Amylase	Duramyl 120T, 600KNU/kg (Novozymes)	0,5
Sodium carbonate		Balance to 100
If using alternative components to those specified, it is essential that equivalent activity units, concentrations and ratios of active and carrier ingredients are used to obtain equivalent performance.		

NOTE The reference **detergents** B and C are not used for test according to this standard.

NOTE: COMMERCIALLY AVAILABLE DETERGENT OF REPUTED MFRS RECOMMENDED BY DISHWASHERS MFRS,(HAVING SIMILAR COMPOSITION), MAY ALSO BE USED TO JUDGE THE CLEANING PERFORMANCE.

E.3 Rinse aid/Agent

The reference **rinse aid** Formula “III” shall consist of the following (see Table E.2):

Table E.2 – Ingredients of reference rinse aid III

Chemical Substance	Specification	Mass %
Linear fatty alcohol ethoxylate (Nonionic surfactant, low foaming)	Plurafac LF 221/BASF	15.0
Cumene sulfonate	Steoven potate SCS/Steoven pot (40 % solution in water)	11.5
Citric acid (anhydrous)	--	3
H2O	Deionized water	Balance to 100
Physical parameters:		
Visocosity [mpas]		17.0
pH (1 % in water)		2.2

NOTE: COMMERCIALLY AVAILABLE RINSE-AID OF REPUTED MFRS RECOMMENDED BY DISHWASHERS MFRS,(HAVING SIMILAR COMPOSITION), MAY ALSO BE USED TO JUDGE THE CLEANING PERFORMANCE.

E.4 **Salt**

Purity > 99.4 % NaCl.
Insoluble components < 0.05 %.
Refer to manufacturer instructions for the type of salt to be used in the **water softener**.
pH maximum 9.5.

Annex F
(normative)

Microwave oven

F.1 Specification of the microwave oven

The microwave oven to be used for preparing milk soils according to 6.4.2 shall have the following features:
– a glass turntable having a flat surface diameter of (25 ± 3) cm;
– an oven chamber with a minimum height above the turntable of 12 cm;
– output power settings of (150 ± 50) W and (780 ± 80) W;
– a timer that is adjustable in 1 s steps.

Examples of products that comply with this specification are BOSCH[1] HMT 75M421, BOSCH HMT 742 C and BOSCH HMT 752 F.
NOTE: COMMERCIALLY AVAILABLE MICROWAVE OVENS OF REPUTED MFRS HAVING MATCHING SPECIFICATION & PERFORMANCE), MAY ALSO BE USED

NOTE Contacting the supplier referenced in L.1.9 guarantees that the test equipment is suitable to meet the requirements of this standard.

F.2 Calibration of the microwave oven

The primary aim of the calibration of the microwave oven is to establish power and cooking time settings to achieve the recommended cleaning performance for the milk glasses in the reference machine described in Annex I. Once this is done, no further calibration should be necessary, although as the microwave oven ages or the cleaning performance of the milk glasses varies, it may become necessary to repeat the calibration.

Calibrate the microwave oven at a nominal output power setting of 780 W, as follows:

Set the microwave oven power output to 780 W or the nearest available setting. Measure the power output according to IEC 60705. Record this value as $P_{u,1}$.

Calculate the required cooking time $t_{u,1}$ according to Equation (F.1)

$$t_{u,1} = \frac{P_1 \times t_1}{P_{u,1}} + t_c \qquad \text{(F.1)}$$

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

[1] "Bosch" is a trademark. This information is provided for the convenience of users of this International Standard and does not constitute an endorsement by the IEC of this trademark. Items of a similar specification may be used if they can be shown to lead to equivalent results.

Calibrate the microwave oven at a nominal output power setting of 150 W as follows:
Set the microwave oven power output to 150 W or the nearest available setting. Measure the power output according to IEC 60705. Record this value as $P_{u,2}$.
Calculate the required cooking time $t_{u,2}$ according to Equation F.2

$$t_{u,2} = \frac{P_2 \times t_2}{P_{u,2}} \quad \text{(F.2)}$$

where
$t_{u,2}$ is the required cooking time in min at the nominal output power P_2;
P_2 is the nominal output power of 150 W;
t_2 is the nominal cooking time at the nominal output power P_2 of 10 min;
$P_{u,2}$ is the measured power output in W at the nominal output power P_2.

The cooking times $t_{u,1}$ and $t_{u,2}$ for the particular microwave ovens specified in L.1.9 are provided in the accompanying technical instructions. The testing laboratory shall verify the performance of the milk glasses and adjust the time correction t_c if necessary.

Check the cleaning performance for glasses soiled with milk (Clause A.5, Annex C, Table C.1) prepared using the calculated times ($t_{u,1}$, $t_{u,2}$) by operating the **reference machine** with a fully soiled load in accordance with Clause 6 and Clause 7 of this standard.

The target range for the cleaning performance for milk glasses in the reference **programme** "Reference EN/IEC" when tested in accordance with this standard is:

- for the oven drying method specified in 6.5.2: average cleaning scores for six glasses: 0.50 – 1.50
- for the air drying method specified in 6.5.3: average cleaning scores for six glasses: 2.90 – 3.90

If the cleaning performance is not within the target range, adjust $t_{u,1}$ as follows:
- If the cleaning performance is too low, increase the time correction t_C.
- If the cleaning performance is too high, reduce the time correction t_C.

NOTE Practical steps for the time correction t_c can be multiples of 0.1 min.

Repeat the cleaning performance check and adjustment of $t_{u,1}$ until the cooking times produce milk glasses which meet the recommended cleaning performance. Use the adjusted value for $t_{u,1}$ for all cooking at 780 W and $t_{u,2}$ for all cooking at 150 W (see 6.4.2.5).

Annex G
(normative)

Through-circulation thermal cabinet

G.1 Specification of the thermal cabinet

An example of a product that complies with this specification is Memmert[2] UFP800-DW-D1, see L.1.8.

The through-circulation thermal cabinet shall guarantee that the sample of test soil is uniformly and consistently dried.

Temperatures shall be recorded during a calibration run.

The thermal cabinet shall have the following data:

- a volume of 750 l;
- eight wire shelves with a dimension of (1030 x 530) mm for loading of 30 **place settings**.

The air flow rate shall be set up with internal re-circulation only, while any outside air vents shall be closed. Air flow rate shall be switched on setting "max".

G.2 Calibration of the thermal cabinet

Performance requirements (to be conducted with unsoiled **tableware** prior to actual testing; this calibration should be conducted every 6 months) are as follows:

- Load 30 **place settings** into the thermal cabinet as outlined in Figure 3.
- In order to determine if the thermal cabinet is heating properly, place thermocouples as outlined in Figure 4~~Figure 4~~ and Figure G.1.
- With a starting temperature of (23 ± 2) °C, the thermal cabinet should reach at each thermocouple location a temperature of (80^{+2}_{-10}) °C for the first time at 60 min after start.
- During the heat rise, the difference between thermocouples at each temperature sensor location shall be within ± 10 °C.
- At any time after 90 min the temperature at all measuring points shall be (80 ± 3) °C.

[2] "Memmert" is a trademark. This information is provided for the convenience of users of this International Standard and does not constitute an endorsement by the IEC of this trademark. Items of the similar specification may be used if they can be shown to lead to equivalent results.

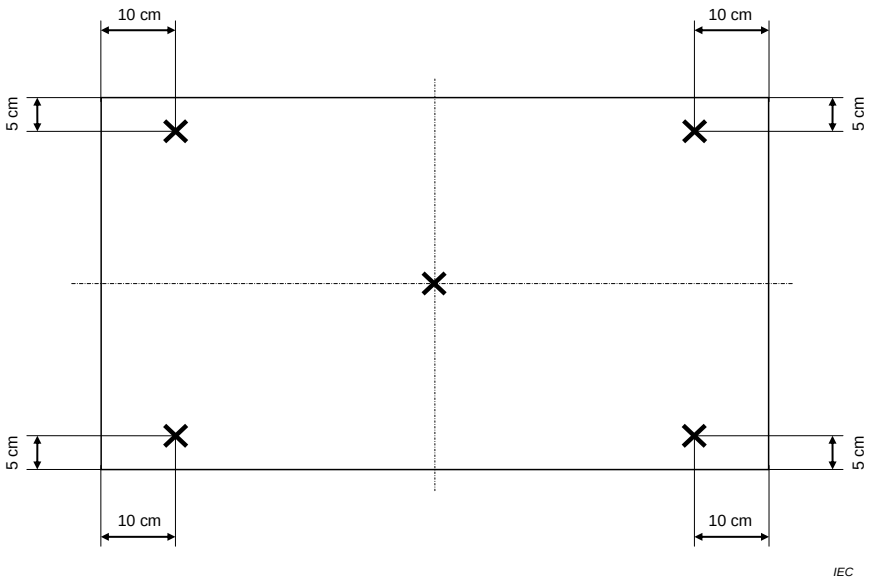


Figure G.1 – Location of the thermocouple on upper, intermediate and lower wire shelves

Annex H
(informative)

Alternate cleaning and drying assessment tables

H.1 General

Tables H.1 and H.2 for drying performance and cleaning performance are provided as alternates to those given in 7.2.2 (drying performance) and 7.3.1 (cleaning performance).

H.2 Alternate drying performance table

Table H.1 – Alternate drying performance table

RUN NUMBER	1	2	3	4	5	6	7	8
PROGRAMME SETTING								
DATE OF ASSESSMENT								
ASSESSOR								
Illuminance (Lux)								
ITEM & LOCATION	**SCORES (b)**	**SCORES (b)**	**SCORES (b)**	**SCORES (b)**	**SCORES (b)**	**SCORES (b)**	**SCORES (b)**	**SCORES (b)**
BOTTOM BASKET								
Load item 1								
Load item 2								
Load item 3								
Load item 4								
Load item 5								
Load item 6								
Load item 7								
Load item 8								
Load item 9								
Load item 10								
Load item 11								
Load item 12								
Load item 137								
Load item 138								
Load item 139								
Load item 140								
CUTLERY BASKET								
Load item 141								
Load item 142								
Load item 143								
Load item 144								
Load item 145								
Load item 146								
Load item 147								
Load item 148								
CALCULATIONS								
Parameter	**Symbol**							
Total number of scores for all items	N							
Sum of all scores	Σ_D							
Test dishwasher single drying index	$D_{T,i}$							
Reference dishwasher single drying index	$D_{R,i}$							
Single drying performance index	$P_{D,i}$							
Logarithm of single drying performance index	$Ln\,P_{D,i}$							
Average logarithm of all drying performance indices	$Ln\,P_D$							
Standard deviation of the logarithms of single drying performance indices	$Ln\,s_D$							
Half range of the logarithmic drying confidence interval	$Ln\,W_D$							

A table such as Table H.1 is prepared for each dishwasher to be tested. The load items are listed in the first column from the left in the order in which they are located in the dishwasher. Additional information can be provided in the right hand side of the first column to direct the assessor to a specific position in a specific rack. The first column should correspond to the

load plan supplied by the manufacturer. During the drying assessment, the list in the first column prompts the assessor to select items for assessment in a consistent order. The assessor records the score for each load item in the appropriate cell for the item and run being assessed. The procedure ensures that during the assessment the assessor always knows which items have been assessed and which ones have not. This procedure also ensures that every score for every item is recorded individually and can be traced and checked.

H.3 **Alternate cleaning performance table**

Table H.2 – Alternate cleaning performance table

RUN NUMBER		1	2	3	4	5	6	7	8
PROGRAMME SETTING									
DATE OF ASSESSMENT									
ASSESSOR									
Illuminance (Lux)									
ITEM & LOCATION	**SOIL**	**SCORES (b)**	**SCORES (b)**	**SCORES (b)**	**SCORES (b)**	**SCORES (b)**	**SCORES (b)**	**SCORES (b)**	**SCORES (b)**
BOTTOM BASKET									
Load item 1	Soil A								
Load item 2	Soil B								
Load item 3	Soil B								
Load item 4	Soil B								
Load item 5	Soil B								
Load item 6	Soil B								
Load item 7	Soil B								
Load item 8	Soil B								
Load item 9	Soil B								
Load item 10	Soil B								
Load item 11	Soil B								
Load item 12	Soil B								
Load item 137	Soil C								
Load item 138	Soil D								
Load item 139	Soil C								
Load item 140	Soil D								
CUTLERY BASKET									
Load item 141	No Soil								
Load item 142	No Soil								
Load item 143	No Soil								
Load item 144	No Soil								
Load item 145	No Soil								
Load item 146	No Soil								
Load item 147	No Soil								
Load item 148	No Soil								
CALCULATIONS									
Parameter	**Symbol**								
Total number of scores for all items	N								
Sum of all scores	$\sum_C$								
Test dishwasher single cleaning index	$C_{T,i}$								
Reference dishwasher single cleaning index	$C_{R,i}$								
Single cleaning performance index	$P_{C,i}$								
Logarithm of single cleaning performance index	$Ln\ P_{C,i}$								
Average logarithm of all cleaning performance indices	$Ln\ P_C$								
Standard deviation of the logarithms of single cleaning performance indices	$Ln\ s_C$								
Half range of the logarithmic cleaning confidence interval	$Ln\ W_C$								

A table such as Table H.2 is prepared for each dishwasher to be tested. The load items are listed in the first column from the left in the order in which they are located in the dishwasher. The soil type applied to the load item is entered into the second column from the left. Additional information can be provided in the right hand side of the first column to direct the assessor to a specific position in a specific rack. The first column should correspond to the load plan supplied by the manufacturer. During the cleaning assessment, the list in the first

column prompts the assessor to select items for assessment in a consistent order. The assessor records the score for each load item in the appropriate cell for the item and run being assessed. The procedure ensures that during the assessment the assessor always knows which items have been assessed and which ones have not. This procedure also ensures that every score for every item is recorded individually and can be traced and checked.

Annex I
(normative)

Description of the reference machine

I.1 Specification of the reference machine

I.1.1 General

A suitable **reference machine** is the Miele[3] G 1222 SC Reference, referred to as Type 2 **reference machine**.

NOTE Contacting the supplier referenced in L.1.13 guarantees that the test equipment is suitable to meet the requirements of this standard.

The Miele G590 and G595, referred to as Type 1 **reference machine**, are not produced anymore and are therefore out of stock. A detailed description of the **reference machine** Type 1 can be found in IEC 60436:2004 (third edition). The **reference machine** Type 1 may be used for testing according to this edition of IEC 60436 if results are proven equivalent to those of the **reference machine** Type 2.

All following descriptions refer only to the Type 2 **reference machine**, the Miele G 1222 SC Reference (writing on front panel: Miele Reference), which has been specially prepared for use as a **reference machine** by Miele. A complying **reference machine** can be obtained from the supplier as specified in L.1.13.

I.1.2 General specifications

Rated voltage 230 V a.c., rated frequency 50 Hz (refer to I.2)

Rinse aid dosage: setting 3

Specifications of the reference **programme** "Reference EN/IEC" using a clean load with no **detergent** are as follows:

– Spray arm rotations per minute: top: 41 ± 9 (refer to I.3.2)
middle: 24 ± 4
bottom: 35 ± 5
– Water hardness of sump water in the 2 heated rinses [mmol/l]: ≤ 0.5 (refer to I.3.3)
– Water consumption [litres]: 14.4 ± 0.4 (refer to I.3.4)
(run with **regeneration** of the **water softener**) [litres]: 16.9 ± 0.5
– Energy consumption [kWh]: 1.33 ± 0.08 (refer to I.3.4)
– Water level measured in the sump at the end of the **cycle** (refer to I.3.5)
– Maximum water temperatures measured in the sump [°C]:

- Cleaning **operation**: 50 ± 2 (refer to I.3.6)

[3] "Miele" is a trademark. This information is provided for the convenience of users of this international standard and does not constitute an endorsement by the IEC of this trademark. Items of similar specification may be used if they can be shown to lead to equivalent results.

- Heated rinse **operations**: 67 ± 2 (refer to I.3.6)

– **Cycle time** [min]: 99 ± 4 (refer to I.3.7)

NOTE As the Type 2 **reference machine** has no fan action after the **end of the programme** indication (as does Type 1) the **programme time** and **cycle time** are identical.

NOTE: COMMERCIALLY AVAILABLE DISHWASHERS OF REPUTED MFRS HAVING MATCHING SPECIFICATION & CLEANING/DRYING PERFORMANCE), MAY ALSO BE USED

I.1.3 Guidelines for performance values

Values for the reference **programme** "Reference EN/IEC" when tested in accordance with Clause 6 and Clause 7 (soiled load) using 20 g reference **detergent** type D should be:

- Cleaning performance – Oven drying method (refer to 6.5.2): 3.30 ± 0.40 (refer to I.3.8)
- Cleaning performance – Air drying method (refer to 6.5.3): 4.50 ± 0.40 (refer to I.3.8)

NOTE 1 These cleaning values for air dry and oven dry are based on preliminary tests and general experience with the **reference machine**. The values can be revised as additional experience is gained.

Values for the reference **programme** "Reference EN/IEC" when tested in accordance with Clause 6 and Clause 7 (soiled load) using 20 g reference **detergent** type D should be:
Drying performance: 0.81 ± 0.10 (refer to I.3.8)

NOTE 2 These drying values are based on preliminary tests and general experience with the **reference machine**. The values can be revised as additional experience is gained.

Details on verifying the performance of the **reference machine** are set out in I.3.

I.2 Installation and use of the reference machine

The manufacturer of the **reference machine** measures and checks each individual **reference machine** prior to supplying it.

When installing the **reference machine** in the laboratory ensure that the hoses are not kinked and the height of the drain hose (measured from the bottom of the machine to the highest point of the hose) is: (60 ±10) cm.

The **reference machine** shall always be installed as a **free-standing** type, irrespective of the type of **test machine**(s).

The supply voltage of the **reference machine** shall be 230 V a.c. ± 2 %. The supply frequency of the **reference machine** shall be 50 Hz ± 1 %. The **reference machine** supply voltage and supply frequency values are irrespective of the voltage and frequency of the **test machine**(s).

The **reference machine** shall always be loaded with 12 **place settings** according to Annex A.

I.3 Specification check of the reference machine

I.3.1 General

Regularly, and at least every six months, a specification check of the **reference machine** shall be undertaken. To perform a specification check on the **reference machine**, the following measurements or observations shall be made and compared with the specifications and requirements given in I.1.

NOTE 1 When performing a test, data from a **reference machine cycle** can be reviewed to confirm results are within specification. Data include: energy consumption, water consumption, drying results, cleaning results, and **cycle time**.

If the machine does not comply with I.1.2, the test conditions, equipment and procedure shall be checked and the measurements repeated as appropriate. If there are no apparent faults but the **reference machine** still does not meet the specifications, contact the manufacturer to get this rectified.

Prior to performing specification checks, ensure that all filters have been cleaned and that spray arm jets are free from any blockages. **Rinse aid** and salt are used according to the manufacturer's instruction. It is recommended that specification checks are undertaken in the following order.

NOTE 2 The checks on the **reference machine** specified in I.3.2 to I.3.7 can be verified with a single **cycle** with a clean load and without **detergent**. Tasks specified in I.3.8 are verified over 5 **cycles**.

I.3.2 Checking spray arm rotation

A service viewing window and associated key shall be used with the **reference machine** to facilitate the performance of specification checks of spray arm rotations. Spray arm rotations may be determined on any **programme** on the **reference machine** with a clean load installed and no **detergent**. If the spray arm requirements specified in I.1.2 are not met, remedial action shall be taken, e.g. contact the manufacturer.

I.3.3 Checking the water hardness

When the **reference machine** is run on reference **programme** "Reference EN/IEC" with a clean load and no **detergent**, the values specified in I.1.2 shall be achieved. The hardness is to be set within the prescribed range of tolerance degree exactly.

I.3.4 Checking the energy consumption and water consumption

When the **reference machine** is run on reference **programme** "Reference EN/IEC" and in accordance with Clause 6 and Clause 7, except with a clean load at ambient temperature and no **detergent**, the energy consumption and water consumption values specified in I.1.2 shall be achieved.

In each 5th **cycle** a **regeneration operation** occurs and the **water softener** is rinsed out. The water consumption value of a normal run and of a run where **regeneration** takes place is noted in I.1.2.

I.3.5 Checking the water level in the sump

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

I.3.6 Checking the water temperature in the sump

The water temperature in the sump is used as an indicator of temperature control performance of the heating system in the **reference machine**. The water temperature shall be measured on the reference **programme** during the heated wash **operation** and the heated rinse **operation**s by means of a temperature sensor installed in the central hole of the sump (to prevent any bending of sieves). The temperature sensor shall be fully immersed. The temperature during each heating **operation** should be logged at regular intervals to verify compliance with I.1.2.

I.3.7 Checking the cycle time

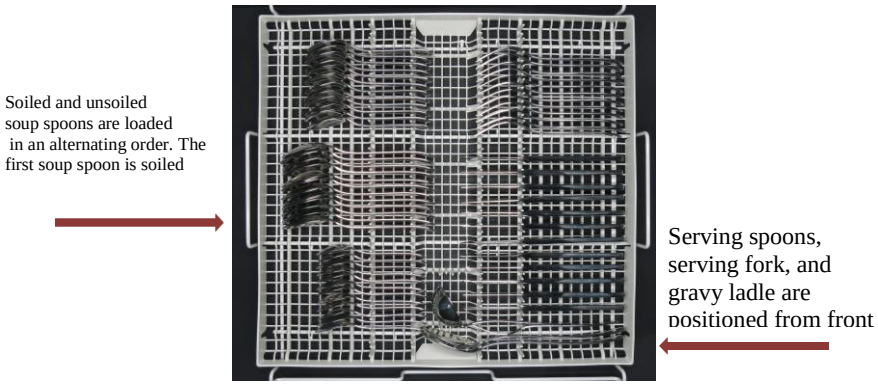
When the **reference machine** is run on reference "Reference EN/IEC" and in accordance with Clause 6 and 7, except with a clean load at room temperature and no **detergent**, the **cycle time** specified in I.1.2 shall be achieved.

I.3.8 Checking the cleaning and drying performance

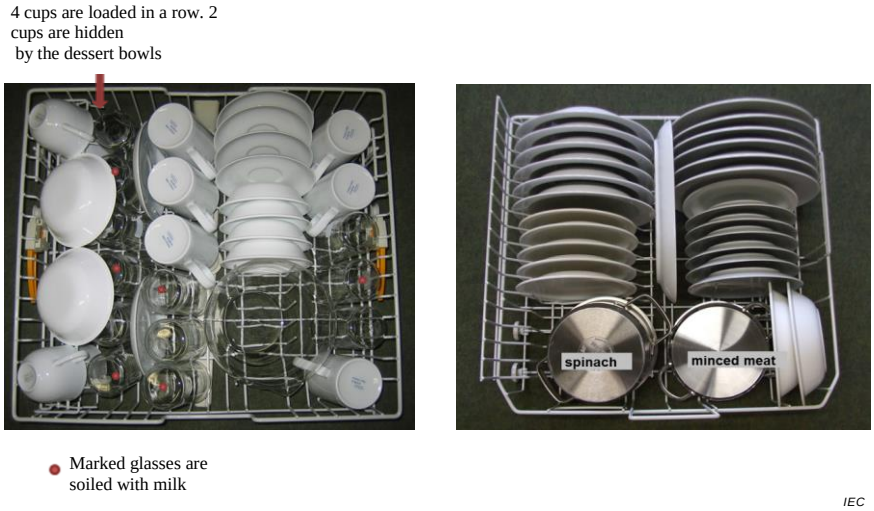
When the **reference machine** is run on reference **programme** "Reference EN/IEC" and in accordance with Clause 6 and 7 (with a soiled load and **detergent**) and the loading plan in I.4, the values specified in I.1.3 should be achieved (average value based on 5 runs).

I.4 Reference machine loading plan

The **reference machine** shall be loaded as indicated in the following pictures for each **rack**:



Cutlery rack



Upper basket **Lower basket**

Annex J
(informative)

Shade chart

J.1 General

Annex J specifies the relation between reflection value R_y, an NCS shade chart and a certain shade number. Each NCS shade chart corresponds to one shade number. The shade number scale from 4 to 15 should be used to assess the degree of browning.

J.2 Classification of shade numbers

Table J.1 – Shade chart

Measured reflection value R_y			NCS shade chart	Shade number
≥	<	=		
9,3	*12,2*	*10,4*	S 6030 -Y50R	15
12,2	*16,4*	*14,2*	S 5040 - Y40R	14
16,4	*20,1*	*18,8*	S 4050 - Y30R	13
20,1	*22,9*	*21,4*	S 4040 - Y30R	12
22,9	*26,5*	*24,5*	S 4030 - Y30R	11
26,5	*31,7*	*28,7*	S 3020 - Y30R	10
31,7	*38,5*	*34,9*	S 2060 - Y20R	9
38,5	*46,9*	*42,3*	S 2040 - Y20R	8
46,9	*54,2*	*51,7*	S1050 - Y20R	7
54,2	*64,3*	*56,9*	S 1040 - Y20R	6
64,3	*75,2*	*72,3*	S 0530 - Y10R	5
75,2		*78,3*	S 0520 - Y10R	4

A separate colour gauge and more detailed information can be found in IEC 60350 (see L.1.7 for details).

Annex K
(normative)

Additional aspects of energy consumption of dishwashers

K.1 General

Annex K sets out determination of **left on mode** power, **end of cycle mode** power**, off mode** power and **delay start mode** power. The first three are steady state modes that can persist for an indefinite period, while **delay start mode** is a short duration mode associated with active mode (selection and use of a particular **programme**). The **end of cycle mode** is an intermediate mode that may persist until the user accesses the load. These are the only four low power modes specified in this International Standard. Other low power modes may exist in some products, but for the current designs of **dishwashers**, these are not considered important in terms of duration and energy consumption.

Where low power modes are determined, they shall be determined in accordance with Annex K.

Ensure that the following conditions remain relevant for the duration of the measurement:

- instructions for use regarding installation, **operation** and settings of the **dishwasher** (as applicable) are followed;
- the appliance shall be connected to mains power for the duration of the test;
- no adverse warning indicators (including **rinse aid** and salt indicators, where applicable) are present;
- laboratory supply water is left on at the specified pressure;
- ensure that no network is connected to the product;
- follow manufacturer's instructions regarding the configuration of the **dishwasher** when there is no network present (where applicable).

Power measurements for **left on mode**, **end of cycle mode**, **off mode** and **delay start mode** shall be made in accordance with the requirements of IEC 62301 except for 5.3 . The measurement procedure and measurement duration is specified in Annex K.

The average power is measured in watts and rounded to second decimal place.

Data for the required parameters, power and energy consumption, shall be recorded at regular intervals of 1 s or less throughout the test using a data logger or computer.

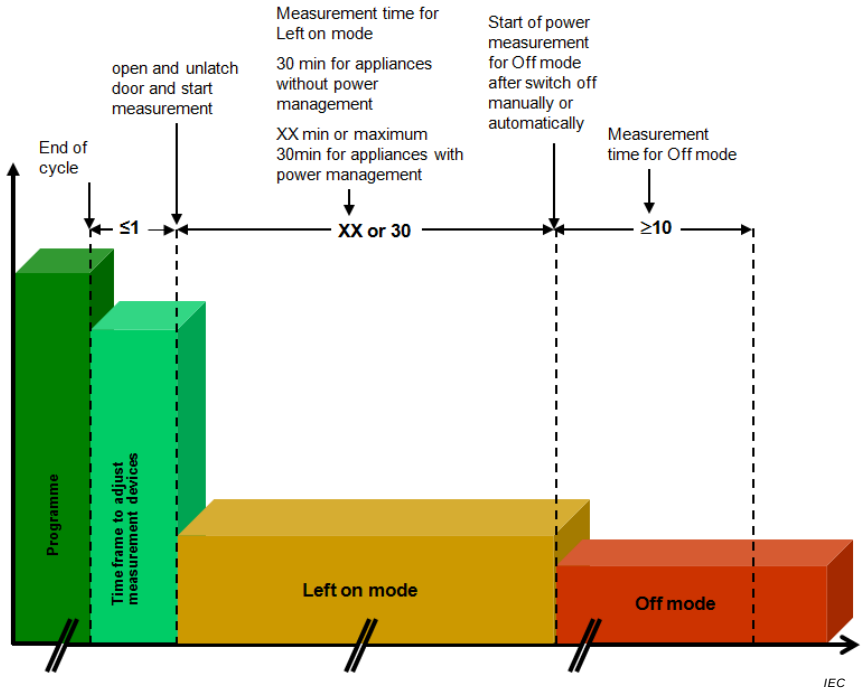


Figure K.1 – Measurement procedure for low power modes (Left on mode and Off mode)

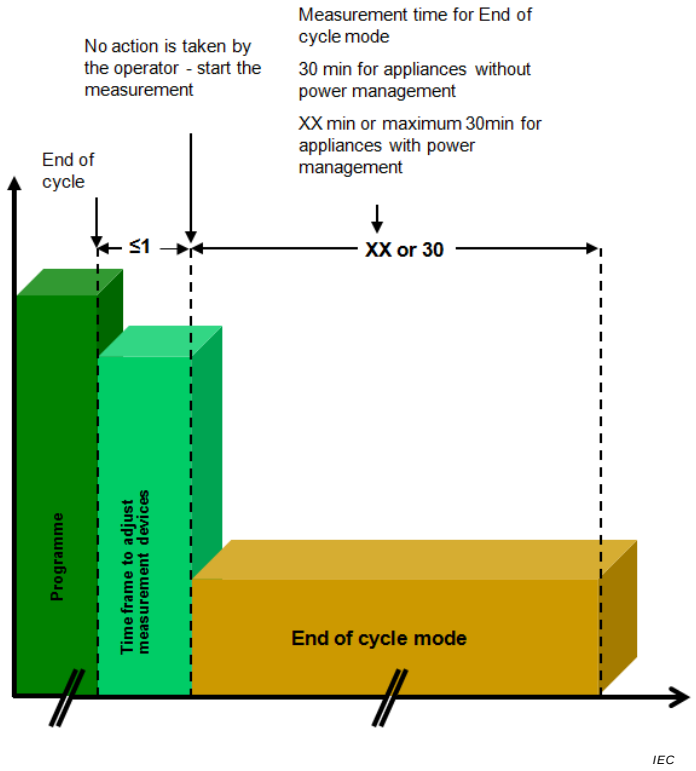


Figure K.2 – Measurement procedure for low power mode (End of cycle mode)

Manufacturers or suppliers may have information on the design and **operation** of their **dishwashers** which would allow an accurate determination of these modes through methods other than the methods specified below. For the purposes of declaration, a manufacturer or supplier may use any method which gives an equivalent result to the methods specified below. For verification purposes, the methods specified below take precedence over any other determination.

K.2 Determination of left on mode power

At the completion of any **cycle** the door of the **dishwasher** is opened within 1 min and the measurement shall begin immediately. For determination of this mode, no additional action is taken by the operator to switch off the **dishwasher** (i.e. do not initiate **off mode**) after the door has been opened. The door remains unlatched during the measurement. The procedure is explained in Figure K.1.

NOTE 1 This mode is not applicable where the user turns off the product before the door can be opened.

NOTE 2 For a **dishwasher**, the term unlatched means the door is closed as far as possible without engaging the latch.

For machines without **power management system** (where **left on mode** persists for an indefinite period), the measurement of **left on mode** shall be determined over a period of 30 min. In this case the **left on mode** average power is reported.

When the **test machine** is equipped with a **power management system** that automatically reverts to **off mode** but the time to activation of the **power management system** is longer than 30 min, the measurement of **left on mode** phase shall be determined over a period of 30 min. In this case the product is noted as having a **power management system** that activates in > 30 min and only the **left on mode** power is reported.

When the **test machine** is equipped with a **power management system** that automatically reverts to **off mode** and the time to activation of the **power management system** is 30 min or less, the measurement of **left on mode** shall be determined over the actual duration. In this case the **left on mode** power and the **left on mode duration** are reported.

The power consumption of **left on mode** is the average of the measured data.

K.3 Determination of left on mode duration

If a **test dishwasher** is equipped with a **power management system** to revert the machine automatically to **off mode** the **left on mode duration** is determined in accordance with Clause K.3

At the completion of any **cycle** the door of the **dishwasher** is opened within 1 min and kept unlatched during the measurement which shall begin immediately. For determination of the **left on mode duration**, no action is taken by the operator to switch off the **dishwasher** (i.e. do not initiate **off mode**).

The time measurement of the **left on mode duration** is started immediately until the machine reverts automatically to the **off mode**.

The dimension of the measured time is given in minutes and is rounded to the nearest minute.

K.4 Determination of end of cycle mode power

At the completion of any **cycle** no action is taken by the operator and the measurement shall begin immediately or at the latest after 1 min including adjusting measurement devices. For determination of this mode, no additional action is taken by the operator to switch off the **dishwasher** (i.e. do not initiate off mode) after the **cycle** has been completed. The procedure is explained in Figure K.2.

For machines without **power management** (where **end of cycle mode** persists for an indefinite period), the measurement of **end of cycle mode** shall be determined over a period of 30 min. In this case the **end of cycle mode** average power is reported.

When the **test machine** is equipped with a **power management system** that automatically reverts to **off mode** but the time to activation of the **power management system** is longer than 30 min, the measurement of **end of cycle mode** phase shall be determined over a period of 30 min. In this case the product is noted as having a **power management system** that activates in > 30 min and only the **end of cycle mode** power is reported. When the **test machine** is equipped with a **power management system** that automatically

reverts to **off mode** and the time to activation of the **power management system** is 30 min, or less, the measurement of **end of cycle mode** shall be determined over the actual duration. In this case the **end of cycle mode** power and the **end of cycle mode duration** are reported. The power consumption of **end of cycle mode** is the average of the measured data.

K.5 Determination of end of cycle mode duration

If a **test machine** is equipped with a **power management system** to revert the machine automatically to **off mode** the **end of cycle mode duration** is determined in accordance with Clause K.5.

At the completion of any **cycle** no action is taken by the operator. Start the measurement immediately or at the latest after 1 min including adjusting measurement devices.

The time measurement of the **end of cycle mode duration** continues until the machine reverts automatically to the **off mode**.

The dimension of the measured time is given in minutes and is rounded to the nearest minute.

K.6 Determination of off mode power

Off mode is measured after the determination of **left on mode** with an unlatched door as explained in Figure K.1. For appliances with no **power management system** or with a power management system that activates in more than 30 min, **off mode** is determined when the **dishwasher** is switched off by the user in accordance with manufacturers' instructions. For appliances with a **power management system** that activates in 30 min or less, **off mode** is determined after the **dishwasher** automatically reverts to **off mode**.

In all cases, **off mode** shall be determined over a period of not less than 10 min.

The power consumption of the **off mode** is the average of the measured data.

K.7 Determination of delay start mode power

Where **delay start mode** power is determined, it shall be determined in accordance with Clause K.7. This mode is only applicable to **dishwashers** with a built in delay start function.

For determination of this mode, any programme can be selected and a user programmed delay of 3 h (or as close as possible to 3 h if 3 h cannot be selected) is selected by the operator. The average power consumption during this period is determined.

Latch the door and keep it latched for the duration of the test. Select any **programme** to be measured and **programme** the delay start period. Power measurements in **delay start mode** shall commence from the moment the **delay start mode** is activated and shall continue until the **cycle** starts.

The **programme** name selected shall be stated with the measured power value. Where the display changes during the timer countdown, there can be some small variations in power consumption during this mode.

NOTE For a **dishwasher**, the term latched means that the door is closed and the door interlock is engaged so that the product could operate if required.

The power consumption of the **delay start mode** is the average of the measured data.

Annex L
(informative)

Addresses of suppliers[4]

L.1 General suppliers

L.1.1 All items that comply with the specification in Annex A and Annex B can be obtained from Supplier L.1.6.

L.1.2 Cutlery that complies with the specification in Annex A and B may be obtained from:

WMF Hotel
Eine Marke der proHeq GmbH — Tel: +49 7231 4885 520
c/o Mr. Scherf — Fax: +49 7231 4885 590
Carl-Benz-Straße 10 — karl-heinz.scherf@wmf-hotel.de
D – 75217 Birkenfeld
Germany
or from Supplier L.1.6.

L.1.3 Tea that complies with the specification in 6.4.3.1 is:

Sir Winston Tea
Broken Orange Pekoe
Finest tea blend from Indian and Ceylon tea gardens
This brand of tea may be obtained in retail shops or from:
Teekanne GmbH
c/o Mr Kompch — Tel: +49 211 5085 321
Kevelaerstraße 21-23 — Fax:+49 211 5084 139
D-40549 DUESSELDORF — holger.kompch@teekanne.de
Germany

4 Trademark information provided for products are examples of suitable products available commercially This information is given for the convenience of users of this International Standard and does not constitute an endorsement by IEC of these brands or suppliers.

L.1.4 Oat flakes that comply with the specification in 6.4.6.1 are "Bluetenzarte Koellnflocken" and these may be obtained from:

Peter Koelln KgaA
Koellnflockenwerke
c/o Mrs. Krebs
c.krebs@koelln.de
Wester Str: 22-24
25336 ELMSHORN
Germany
Tel: +49 4121 64 81 43
Fax: +49 4121 64 66 39

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L.1.5 Spinach that complies with the specification in 6.4.7.1 is "Junger Spinat" and this may be obtained from:
Fa. Langnese-Iglo GmbH
Unileverhaus Tel: +49 40 3493 0
20355 Hamburg Fax: +49 40 3597 2445
Germany

L.1.6 Test materials like **tableware** or the reference **detergent** may be obtained from:
Wfk – Testgewebe Tel: +49 2157 87 1977
c/o Mr. Hilgers Fax: +49 2157 90 657
Christenfeld 10 testgewebe@wfk.de
D – 41379 BRÜGGEN-BRACHT
Germany
Or
wfk America, LLC Tel. +1 (803) 328-6200
c/o Mr. Karnilowicz info@wfkamerica.com
P.O. Box 4530
Rock Hill, SC 29732, USA
NOTE The pastry brush (see 6.4.5.3 / 6.4.6.3 / 6.4.7.3) and the plastic fork (see 6.4.4.3 / 6.4.7.3) will be added to every delivery of **detergent**.

L.1.7 The NCS shade charts can be ordered at official NCS Centres all over the world. The following address shows potential distributors.
Sweden (Head Office) Tel: +46-(0)8-617 47 00
Scandinavian Colour Institute AB Fax: +46-(0)8-617 47 47
Address: P.O. Box 49022 Visitors: Igeldammsgatan 30
S -100 28 Stockholm
Internet: www.ncscolour.com
info@ncscolour.com
mailto:info@ncscolour.com

L.1.8 A through-circulation thermal cabinet that complies with the specification in Annex G may be obtained from:
Memmert GmbH + Co. KG Tel: +49 9122 9250
PO Box 1720 Fax: +49 9122 14 585
D – 91107 SCHWABACH sales@memmert.com
Germany

Ensure that the 8 required shelves are included.

L.1.9 A microwave oven that complies with the specification in Annex F may be obtained from:

BSH Hausgeräte GmbH
Mrs. Karin Nicklaser
Robert-Bosch-Straße 16
D – 89407 DILLINGEN/DONAU
Germany
Fax: +49 9071 521503
karin.nicklaser@bshg.com

See F.1 for a complete specification.

L.1.10 Load glasses and bowl that comply with the specification in Annex A and B may be obtained from:

Schott Glas
c/o Mr. Schaefer
Hattenbergstraße 10
55122 Mainz
Germany
Tel.: +49 6131 664445
Fax: +49 6131 664040
wolfgang.schaefer@schott.com

or
Supplier L.1.6.

L.1.11 All **dishwasher** test soils (except egg) specified in this standard may be obtained from:

Stamminger & Demirel Testmaterialien
Erbsenboden Straße 31
D-91207 LAUF
Germany
Tel: +49 9123 98 89 75
Fax: +49 9123 98 84 89
r.stamminger@web.de
www.sta-de.com

L.1.12 Suitable sample dividing device for **detergent** to comply with ISO 607 (refer to 5.7) may be obtained from:

Retsch GmbH & Co. KG
c/o Mrs. Hogefeld
Rheinische Straße 36
42781 HAAN
Germany
Tel: +49 2129 5561 121
Fax: +49 2129 5561 184
info@retsch.de
www.retsch.de

Type: PTZ 100 with DR 15/40

L.1.13 A **reference dishwasher** that complies with the requirements of Annex I and the required service window may be obtained from:

Miele & Cie GmbH & Co
Contact: Mr Wedeking
Carl-Mielestraße 29
D – 33332 Gütersloh
Germany
Tel: +49 5241 891434
Fax: +49 5241 892 470
lothar.wedeking@miele.de

Technical information on the **reference machine** can be requested from:

Anna Wendker
reference.machine@miele.de

L.1.14 A suitable pipette is the “Calibra Digital 832” makropipette which may be obtained from Socorex and covers a range from 1 ml to 10 ml.

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Socorex ISBA S.A.
Champ Colomb 7
PO Box
1024 Ecublens/Lausanne
Switzerland
Tel +41 21 634 2672
Fax + 41 21 634 2783
socorex@socorex.com
www.socorex.com

L.1.15 Chemicals
– Citric acid (Merck 100247)
– Lugols solution (1 % Iodine/Potassium iodide solution) (Merck 109261)
A local distribution centre can be found via internet: www.vwr.com

L.1.16 A suitable dosing pump is the Dispensette "Organic" from Brand GmbH & Co KG, which covers a range from 5 ml to 50 ml.

NOTE The usage of a dosing pump where the indication is given in digital format can avoid problems with the adjustment and not decrease the measurement accuracy.

Additionally a laboratory glass bottle with a capacity of 5 000 ml is recommended.

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L.1.17 A suitable grinder is the Bosch grinder model MUM6N21.
- Attachment MUZ6FW4 is necessary; this attachment includes 4,5 mm hole diameter disk, 4-blade knife, food tray and pusher.
- The 2 mm hole diameter disk is available as part of a set of two disks available by numbers 00461250 – MUZ7LS2, EAN-Nr. 424002146560.
- A replacement 4,5 mm hole diameter disk is available by number EAN-Nr.4242002146928.
- A replacement 4-blade knife is available by number EAN-Nr.4242002146584.

Alternative suppliers

General

IEC Standards are intended to provide results of measurements which are repeatable and reproducible. As the testing of **dishwashers** as described in this standard is using natural food ingredients as soils for the dish items, the variability as well as availability of the soils may affect the repeatability and reproducibility of the measurement. The use of a **reference machine** is reducing this effect to a large extent. But further considerations may be needed especially when soils of different origin, brand or batch are used.

As global availability of soils may be made impossible by custom regulations the reproducibility may be limited when comparing measurement results achieved with different type or kind of soils. For single or open markets and when a good reproducibility is requested it is recommended to limit the choice of food sources to be used. If alternative sources shall be used, they need to be proven to deliver at least equal results of the cleaning performance in the **reference machine** within the given tolerance. This qualification may be made on a national or regional level and documented by the relevant standardization committee.

L.2.2 Alternative food soils

L.2.2.1 General
The following soils may be used as alternatives for regions like North America where original soils are not available. The requirements of L.2 apply to alternate soils. These soils should be used as a set and not as individual item alternatives.

L.2.2.2 Tea
Lipton Loose Tea
Orange Pekoe and Pekoe cut black tea

L.2.2.3 Oat flakes
Quaker Oats (Quick 1 Minute) whole grain rolled oats

L.2.2.4 Spinach
Birds Eye chopped spinach

L.2.2.5 Margarine
Fleischmann's Original Stick
(not whipped)

Annex M
(informative)

Test report format

M.1 General

A test report including the following information should be prepared for each test undertaken.

M.2 Machine description

- Brand, model, serial number, type, country of manufacture, date of manufacture (if indicated), **rated dishwasher capacity**.
- Water connection available (hot/cold/dual), internal heater (Y/N), **water softener** fitted?
- Appliance dimensions.
- Origin of **test machine** (how obtained).
- Claimed values: energy consumption, water consumption, **cycle time** and **programme time** (label values if applicable), filter type.
- Recommendations for use: **rinse aid** setting or dose, **detergent** dose (and placement), **water softener** adjustment (if available), **programme**.

M.3 Laboratory details

- Laboratory details (name address, test officers, dates of test, accreditation).
- Test report number or identifier.

M.4 Test Conditions

- Ambient conditions (temperature and humidity).
- Water hardness and supply system, water supply pressure, water supply temperature.
- Electricity supply (voltage & frequency) and regulation system.
- Details of measuring equipment (see Annex T).
- **Reference machine** brand, model, serial number, specification and check details.
- Reference **detergent** and batch.
- **Rinse aid** and batch.
- Salt (or other softener catalyst) and batch.
- **Tableware** and soiling agents used.

M.5 Test Results and measurements

M.5.1 Setup

Programme selected, water connection mode tested, **detergent** dosage (pre-wash and main wash), **rinse aid** setting or dose, **water softener** settings (if applicable), **dishwasher** loading diagram, configuration of the **dishwasher racks**, **place settings** tested.
Type of test (research, basis of claim, verification).

M.5.2 Results

Report the following results for the test machine and the reference machine:

- Cleaning scores (include Table 4 or equivalent).
- Drying scores (include Table 2~~Table 2~~ or equivalent).
- Measured energy consumption, water consumption, cycle time and programme time, details of operations for each test (time, heater operation, water consumption, cold water energy correction and hot water energy).
- Electricity supply measurements (voltage and frequency).
- Noise measurements (where applicable).
- Type of filter system (declared and determined).

Annex N
(normative)

Test enclosure for built-in and integrated dishwashers

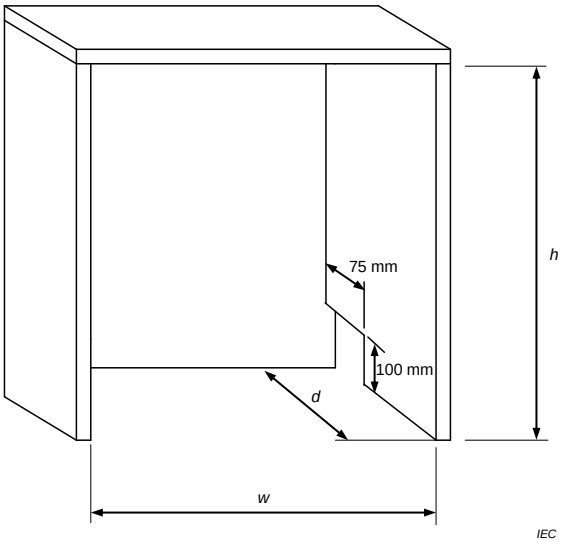
Figure N 1 shows a test enclosure for built-in and integrated dishwashers.

The front edge of the housing of the **dishwasher** (except the door) shall be 20 mm to 25 mm behind the front edge of the test enclosure. If required by the manufacturer's instructions, the enclosure shall be provided with ventilation openings accordingly.

If an appliance is provided with spacers, strips or other special means of solid or resilient material for closing the gap(s) between the contours of the appliance and the cabinet enclosure, these means shall be used accordingly. If such means are not provided, the gap(s) shall be left open.

Appliances to be **integrated** shall be installed under the same conditions as **built-in** appliances. In addition, the door of the **dishwasher** shall be equipped, in accordance with the manufacturer's instruction, with a board of the maximum size allowed by the manufacturer and of the same material and thickness as the test enclosure.

Moreover, for **integrated** types, the test enclosure shall be provided, in accordance with the manufacturer's instructions, with a skirting board of the same material and thickness as the test enclosure. If no instructions are given by the manufacturer, no skirting board shall be fitted.



Key
h = Inside height = Nominal height of **dishwasher** + (2 to 4) mm;
w = Inside width = Nominal width of **dishwasher** + (4 to 6) mm;
d = Inside depth = Overall depth of **dishwasher** + (20 to 50) mm, but *d* not less than 550 mm.

Enclosure material: 19 mm thick untreated particle board (chipboard) or untreated plywood with a density of (600 to 750) kg/m^3.

Figure N.1 – Test enclosure for built-in and integrated dishwashers

Annex O
(informative)

Internal evaluation guidelines

To ensure that repeatable results are obtained in a laboratory, it is recommended that laboratories develop their own internal guidelines for the evaluation of cleaning and drying. These internal evaluation guidelines should be developed in the local language of the laboratory technicians and should cover types of stains and marks that are commonly left or re-deposited on loads in the particular laboratory. The types of stains and marks will be influenced by the design of typical machines tested (performance, presence of **water softeners,** etc.) as well as local factors (water hardness and quality of water used). Internal assessment guidelines should only provide guidance on interpretation for those stains and marks that may be ambiguous with regard to assessment for cleaning performance. Any particle, mark or spot that is clearly soil or has a soil content shall be assessed as soil in accordance with 7.3.1.

The use of internal guidelines is an important way of helping to achieve consistency within laboratories and also will assist in the development and training of new assessors.

Annex P
(informative)

Test procedure for sensing programmes

P.1 General

The purpose of the description of an additional test procedure is to have the possibility to evaluate the efficiency of sensing programmes. Sensing programmes are programmes where the dishwasher adjusts the programme execution according to sensor signals automatically. This should enable the user to clean variable loads with an optimised programme without a personal selection of the programme. To test the adjustment of the machine to varying load and soil conditions, the total amount of soil and the number of load items is varied in 10 different test scenarios.

P.2 General conditions

All general conditions of measurement concerning electricity supply, ambient conditions or water supply shall fulfil the requirements of Clause 5.

The same soils and **tableware** items are used for the test of sensing **programmes** as for the standard cleaning and drying performance tests. The procedure of soiling the **tableware** items for a sensing **programme** test corresponds to the soiling described in Clause 6.

The **detergent** is dosed according to 5.7 in accordance with the number of **place settings** of the test load. For a fully loaded machine the whole amount of **detergent** for the **rated dishwasher capacity** is used, while for no load no **detergent** is employed. For half loaded machines the amount is reduced in accordance to the number of **place settings** of the test load.

If there is a selectable range of temperature options for the sensing **programme**, the **programme** temperature should be similar to the temperature of the test **programme** according to 5.4.

For testing a sensing **programme** the described test scenarios are obligatory. The number of **cycles** per test scenario varies between 1 and 3 (Table P.1~~Table P.1~~).

Table P.1 – Test scenarios for testing the sensing programme

Type of scenario	Amount of test load	Total amount of soil (depending on the rated dishwasher capacity)	Evaluation of the cleaning performance	Number of cycles
a	full-load 1/1	100 %	with evaluation	3
b	full-load 1/1	no soiling	without evaluation	2
c	half-load 1/2	50 %	with evaluation	2
d	half-load 1/2	no soiling	without evaluation	2

e	no load	-	without evaluation	1

When scenario “a” or scenario “c” are performed, the **reference machine** shall be run in parallel with a fully soiled load of 12 **place settings.**
All tests may be performed in the following order (Table P.2~~Table P.2~~) within one week.

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Table P.2 – Example for a one week schedule

Time of day/ Time plan/ Timing	Monday	Tuesday	Wednesday	Thursday	Friday
morning	e	b	b	d	d
afternoon	a	a	a	c	c

The sequence of tests should be observed. The **cycles** with soil and without soil should follow consecutively.

P.3 Loading

The test load shall be identical to the one used for the cleaning and drying performance tests according to 6.2.

Full-load describes the total number of **place settings** (type A and type B) and serving pieces corresponding to the **rated dishwasher capacity**. The **dishwasher** should be loaded in accordance with the manufacturer’s instructions.

Half-load describes a reduced number of **place settings** and **serving pieces** in comparison to the full load. It represents half of the **rated dishwasher capacity**. To determine the number of **place settings** and **serving pieces** for the half load, the number of **place settings** for a full load is halved and rounded up to an integer number of **place settings** type A and type B. If an unequal number of **place settings** A and B would result, type A shall prevail, that is, one additional **place setting** of type A shall be used. The **dishwasher** should be loaded in accordance with the manufacturers instruction, but every second position is left free.

NOTE As an example of a half load, a **rated dishwasher capacity** of 13 **place settings** means that the content of a 7 **place setting** rated machine will be used. See Table A.2 for more details.

P.4 Soiling

For test scenario a and c the test load is soiled in accordance with Clause 6. The amount of soil per item (grams/item) is identical with Clause 6 and Annex C.

P.5 Measured data

The evaluation of the cleaning and drying performance is not an obligatory component in each test scenario (Table P.1~~Table P.1~~). When the cleaning and drying performance is assessed it shall be done in accordance with Clause 7.

For each **cycle** the energy consumption, the water consumption, **cycle time** and **programme time** shall be recorded. For the scenarios with a cleaning and drying assessment those values shall be recorded too.

The arithmetical mean value of all parameters is calculated and reported for each scenario measured. The numerical values ln W_D and ln W_C shall not be calculated when evaluating sensing programmes according to Annex P.

The loading plan, especially for the half load, shall be reported.

Annex Q
(informative)

Additional rinse performance evaluation

Q.1 General

The purpose of the description of an additional rinse performance test procedure is to have the opportunity to evaluate the rinsing efficiency of household **dishwashers**. An ideal rinsing process combines the accurate amount of water, temperature and **rinse aid** and leads to perfectly clean and dry **tableware** at the end of the dishwashing **cycle**. The rinse performance can be measured by evaluating the formation of spots and streaks. Spots and streaks mainly result from dried on water droplets that occur on contact spaces or in dish item specific cavities.

Q.2 General conditions

All general conditions of measurement concerning electricity supply, ambient conditions or water supply shall fulfil the requirements of Clause 5.

The same soils, **tableware** items and procedures are used as for the cleaning and drying performance tests according to Clauses 6, 7 and 8.

The **detergent** is dosed in accordance with the number of **place settings** of the test load (refer to 5.7). The **rinse aid** is used as described in 5.8.

The evaluation of the rinse performance on selected items follows after the combined cleaning and drying evaluation. To minimise variations in the rinse performance evaluation the items to be evaluated have to be handled with special care during the cleaning and drying evaluation. After the cleaning and drying evaluation the items shall be placed into the prior position to allow them to dry off under similar conditions as if not taken out of the machine before.

NOTE Generally, watermarks arise during the drying process and are assessed when all water residue is dried off. Items taken out of the machine for the combined cleaning and drying evaluation will presumably not show the same rinse performance as items which remained in the machine until they are completely dried.

Q.3 Loading

The items to be evaluated for rinse performance are the unsoiled glasses, as described in Annex C, Table C.2. Item B 5. The number of items depends on the **rated capacity** of the machine and has to be calculated according to Clause A.2.

For all items the requirements of 6.2 shall be fulfilled. Additionally, all items used for the rinse evaluation shall be spot- and film-free prior to testing.

Q.4 Evaluation

Rate the glasses visually for spotting after each **cycle** in the light box as described below. The glasses evaluated are those which were not soiled according to 6.4. Pick up the glasses by the base to avoid fingerprints on the sides and evaluate them by viewing them upside down.

NOTE Gloves can be worn so that fingerprints do not affect results.

Use the photo catalogue (Figure Q.2~~Figure Q.2~~) to assess the spots on the glasses.
The evaluation of the **tableware** shall be done using a light box with standardised conditions. The light box should be rectangular and open to the front with a black inside surface (Figure Q.1~~Figure Q.1~~). It should be large enough to hold up at least 6 glasses side by side. Fluorescent lights are mounted in the base of the box in such a manner that light passes up through the glass. The light shall fulfil the requirements of 7.1 concerning luminance and colour temperature.

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Figure Q.1 – Example for an assessment light box

Q.5 Measured data

The arithmetical mean value of the glasses is calculated per **cycle** and test scenario.

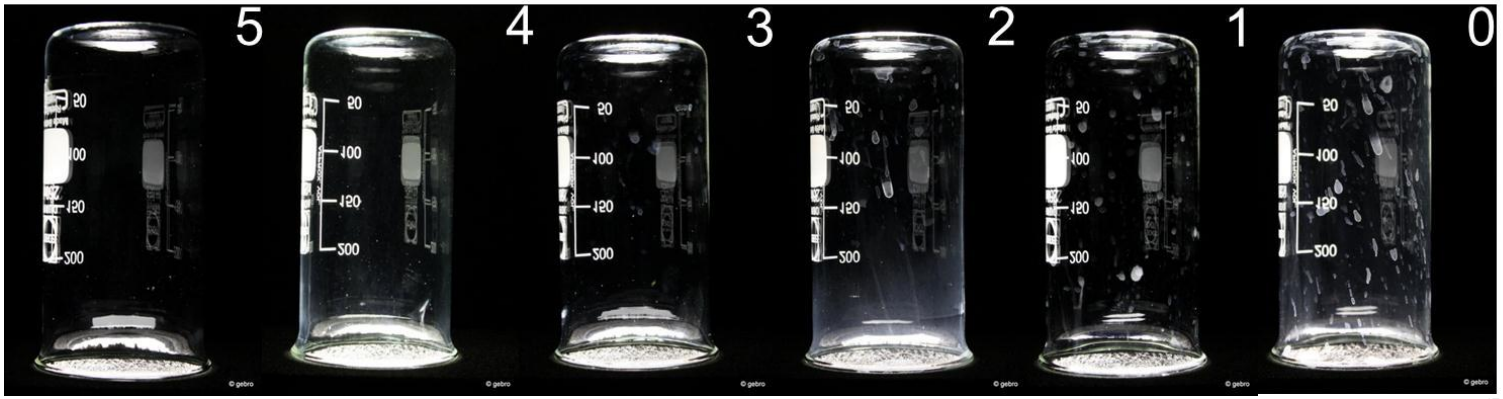


Figure Q.2 – Photo catalogue to assess spots on glasses

NOTE A glass with a score of 5 is a completely spotless glass which has been polished and is therefore without any residue. A glass with a score of 4 has no visible spots but minor residue.

Annex R
(informative)

Dishwasher filtration evaluation

R.1 General

The purpose of this additional test procedure is to have the possibility to evaluate the efficiency of **dishwasher** filtration. Water inside the **dishwasher** can be filtered in a number of ways depending on construction. This test procedure introduces an additional test soil (coffee grounds) to evaluate filtration.

R.2 General conditions

All general conditions of measurement described in Clause 5 apply.
The same soils and **tableware** items are used for the evaluation of filtration efficiency as in the standard cleaning and drying performance tests. The procedure for soiling the **tableware** items in this test evaluation corresponds to the soiling described in Clause 6 with the exceptions of the addition of coffee grounds to the melamine bowl and a reduction in amount of spinach applied. These exceptions apply only to the **test machine** and not to the **reference machine**.

For 5.2, when conditioning the **test machine**, include the following note:

When checking for soil residue in the **dishwasher**, particular attention should be paid to accumulations of coffee grounds in locations such as filters, sump, door seals and **rack** rails.

R.3 Test procedure

R.3.1 General

After completion of the **test series** described in the combined cleaning and drying performance tests and assessment in Clause 6 and Clause 7, perform an additional **test series** containing a minimum of 3 **test runs**, with the option to include more **test runs** to improve accuracy of results. The additional **test series** is performed with the following deviation to preparation of soils for the dish load for the **test machine**. For the additional **test series** the **reference machine** soils are not changed and are used as described in Clause 6.

R.3.2 Coffee grounds

R.3.2.1 General

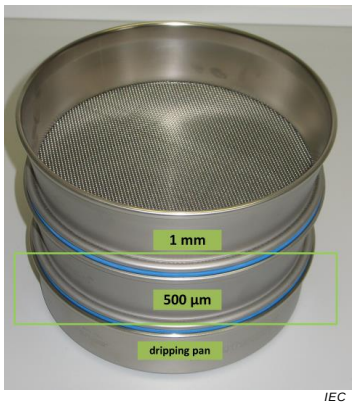
Natural caffeinated coffee shall be used. Coffee grounds should be purchased in the already ground condition and not ground by the laboratory. Dry, not brewed, coffee grounds are prepared and applied.

R.3.2.2 Preparation and storage

Before usage, the coffee shall be stored sealed at ambient conditions. Coffee grounds shall be sieved to obtain the required particle size of 0.5 mm to 1.0 mm.

Avoid overloading the sieves. The bottom or mesh of the sieve with the required mesh size of 0.5 mm should be at least partly visible after the sieving process. Details for suitable sieves

are provided here. The coffee grounds which fulfil these requirements should then be used for the performance tests.



A suitable sieve is the 500 µm analytical test sieve from Retsch with a frame size of 200 x 50 mm.

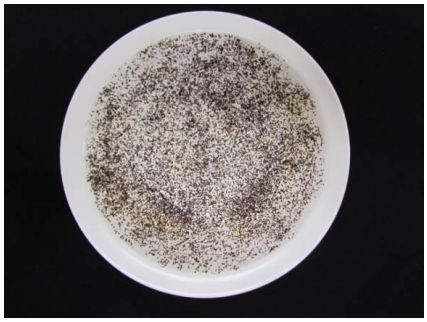
To gain the required sieve fraction, an analytical test sieve with a mesh size of 1 mm and a dripping pan is additionally required.

R.3.2.3 Application

- Items to be soiled:
  The melamine bowls are soiled with the coffee grounds.
- Quantity of soil:
  Each melamine bowl is soiled with 2 g of coffee grounds.
- Method of soiling:
  Weigh out 2 g of coffee grounds and sprinkle them on top of the margarine layer (specified in 6.4.8.3) for each melamine bowl.

  The melamine bowls shall be soiled with margarine and coffee grounds shortly before the start of the **test run** and then placed into the **test machine** (6.6.1).

The following photograph shows a soiled melamine bowl with margarine and coffee grounds:



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R.3.3 **Spinach**

R.3.3.1 General

Preparation and application of spinach is as described in 6.4.7, except for application amounts.

R.3.3.2 Spinach application amounts

Items to be soiled:
The dessert plates and the small pot are soiled with spinach.
Quantity of soil:
Each dessert plate is soiled with 4 g of spinach. The small pot is soiled with a mixture of 1 g of margarine (see 6.4.8.1 for specifications) and 6 g of spinach (Table R.2 and Table R.3).

R.4 **Evaluation**

A minimum of three **test runs** should be performed with additional **test runs** to improve accuracy.

Table R.1 is used to evaluate cleaning performance.

For the evaluation of **dishwasher** filtration efficiency, a ratio is used to compare this **test series** index with coffee grounds, per Clause R.3, with a cleaning **test series** index without coffee grounds, per Clause 6 and Clause 7.

Collect any coffee ground soil particles which fall off of load items prior to grading and add them to the particle scores of the load items to which they were originally attached. If coffee ground soil particles fall off of load items, and the origin is not known, add the particles which fall off to the particle scores of the melamine bowls, dividing the particles evenly between the melamine bowls.

Table R.1 – 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 and coffee grounds								
S 5	20	Serving spoon	None								
S 6	21	Serving fork	None								
S 7	22	Gravy ladle	None								
		N =		C_i =							ΣC_Z =
		See Formula (10)		See Formula (11) or (12), as appropriate							
Notes:										Test No.:	

Table R.2 – Soil application on the serving pieces

Item No.	Item description	Number of items	Kind of soil	Amount of soil per item (g)	Total amount per 12 place setting machine
S 1 a	Small pot	1	Spinach	6	6
			Margarine	1	1
S 1 b	Oven pot	1	Minced meat	6	6
S 2	Glass bowl	1	Minced meat	8	8
S 3	Oval platter	1	Minced meat	8	8
S 4	Melamine bowl	2	Margarine	5,5	11
			Coffee grounds	2	4
S 5	Serving spoon	2	N/A	N/A	N/A
S 6	Serving fork	1	N/A	N/A	N/A
S 7	Gravy ladle	1	N/A	N/A	N/A

Table R.3 – Soil application quantities for different rated dishwasher capacities

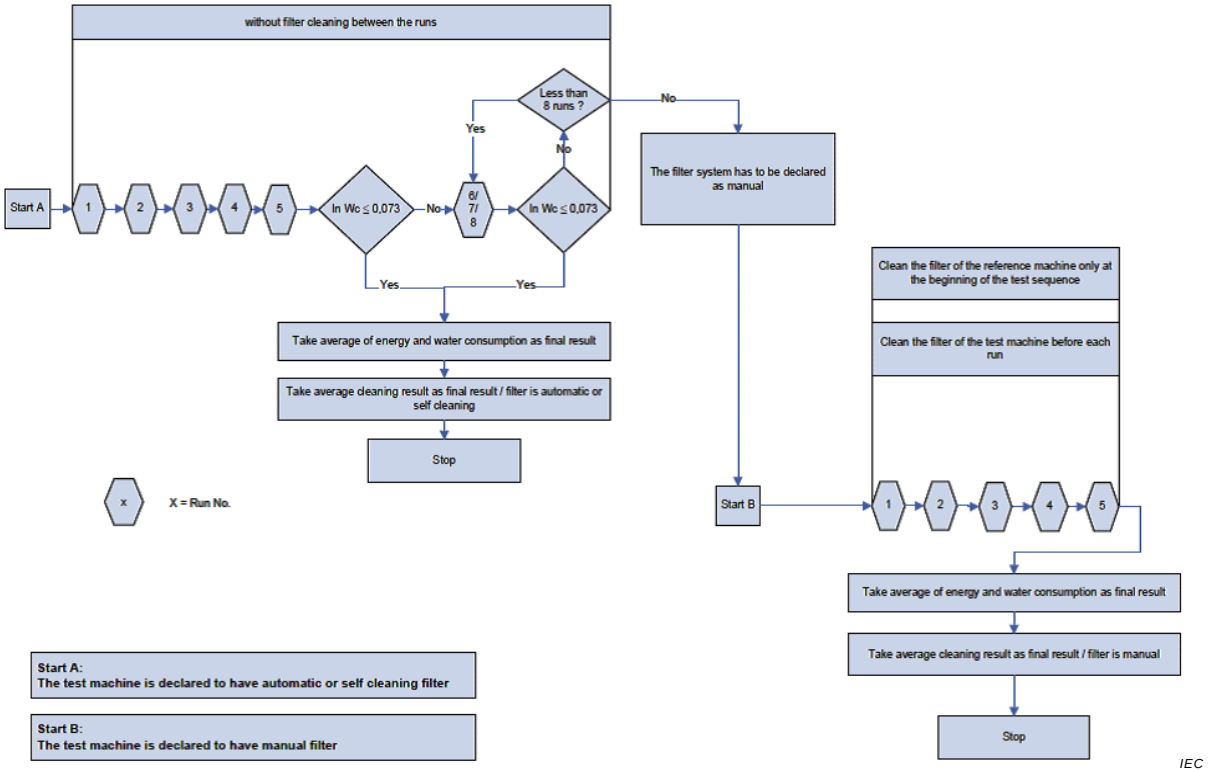
Amount of soil for dishwashers with a rated capacity of 6, 9, 12 or 15 place settings (ps)																
Type of soil and amount (g)	Type A				Type B				Serving pieces				Total			
	6 ps	9 ps	12 ps	15 ps	6 ps	9 ps	12 ps	15 ps	6 ps	9 ps	12 ps	15 ps	6 ps	9 ps	12 ps	15 ps
Egg yolk [a]	6,96	11,60	13,92	18,56	4,98	6,64	9,96	11,62	N/A	N/A	N/A	N/A	11,9	18,2	23,9	30,2
Minced meat	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8	16	22	22	8	16	22	22
Oat flakes [b]	9	15	18	24	9	12	18	21	N/A	N/A	N/A	N/A	18	27	36	45
Spinach	12	20	24	32	N/A	N/A	N/A	N/A	6	6	6	6	18	26	30	38
Tea	360	600	720	960	360	480	720	840	N/A	N/A	N/A	N/A	720	1080	1440	1800
Milk	30	50	60	80	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	30	50	60	80
Margarine	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6,5	6,5	12	12	6,5	6,5	12	12
Coffee grounds	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2	2	4	4	2	2	4	4

[a] The total amount for this type of soil is rounded to deliver the exact value which should be applied on all items with this soil.

[b] The amount of porridge on the soup spoons is not included.

Annex S
(Informative)

Test sequence - Flow chart



Annex T
(normative)

Instrumentation and accuracy

Instruments used for this International Standard shall comply with the specifications set out in Table T.1~~Table T.1~~.

Devices using viscosity to measure water volume shall be calibrated at the nominal temperature ± 5 °C, and the nominal flow rate.

Table T.1 – Specification of instruments

Parameter	Unit	Resolution	Accuracy	Additional requirements
Masses above 100 g	g	0.5 g	± 1 g	-
Masses in the range up to 100 g	g	0.05 g	± 0,1 g	-
Ambient temperature	°C	0.1 °C	± 0,5 K	-
Ambient humidity	% (RH)	1% (RH)	± 3 % (RH)	The specifications shall be met over a temperature range of 15 °C to 25 °C.
Water temperature	°C	0.1 °C	± 0,5 K	-
Water pressure	kPa	10 kPa	± 5 %	-
Water hardness	mmol/l	As specified in IEC 60734.		
Time	s	5 s	± 10 s	-
Water volume (water inlet)	l	0.01 l	± 2 %	-
Electrical energy consumption	kWh	-	± 1 %	-
Off mode, left on mode, and **end of cycle mode** power	W	Measurement instrumentation for **off mode, left on mode**, and **end of cycle mode** power are described in IEC 62301.		

Annex U
(informative)

Inlet water temperature influence on energy consumption

U.1 General

Annex U provides a method to estimate the energy consumption when the water inlet temperature differs from that specified in this standard, i.e. 15/30 °C.

Small differences may arise due to difficulty in maintaining cold/NORMAL water inlet temperature at the specified value. Where such variance does not exceed ± 2 K, the energy consumption correction may be estimated using Equation (U.2).

Larger differences may arise due to local regional requirements, e.g. cold water inlet at 20 °C, for which case an appropriate energy consumption may be estimated using Equation (U.3). This allows regions to deviate from the standard base conditions if necessary, but an equivalent standard energy consumption is estimated, based on a correction calculation given in Clause U.3.

In recent years, **dishwashers** with water management systems have been introduced into the market. For example, water management systems for household **dishwashers** may store or reuse water in order to increase their water and energy efficiency. However, these systems have made it increasingly difficult, if not impossible, for test institutes to determine when water is supplied, what amount of water is supplied, and how the water is used during heated or unheated **operations** of a cleaning **cycle**. Therefore, this standard does not offer any normative procedure to address differences in water temperature.

In Annex U, energy correction procedures are described that may be applicable for appliances with less complex water management systems. For systems with higher complexity further research needs to be done.

U.2 Cold/NORMAL water energy correction

This correction compensates for water supply temperatures which are not exactly 15 °C, but lie between 13/27°C and 17/33°C. Outside this range the test is not valid.

This correction should only be used if the quantity of water that is heated is clearly measurable.

Cold/NORMAL water energy correction shall be calculated for all quantities of cold water that are heated by the internal heater of the **test machine**.

NOTE 1 The value of E_C can be positive or negative.

Calculate the cold/NORMAL water energy correction E_C according to the following equation

$$E_C = (Q_C \times (t_C - 15/30)) / 860 \quad \text{(U.1)}$$

where

E_C is the cold/NORMAL water energy correction, in kWh;

t_C is $(\sum (t_{ci} \times Q_{ci})) / \sum Q_{ci}$; (U.2)

which means the volume-weighted average inlet temperature, in degrees Celsius, of all cold/NORMAL water supplied to the **test machine** which is subsequently heated by the internal heater of the machine;

where

t_{ci} is 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} is 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 is the total volume of the cold/NORMAL water ($\sum Q_{ci}$), in litres, supplied to the **test machine** which is subsequently heated by the internal heater of the machine.

To determine E_C accurately, the incremental measurements should be made with a minimum frequency of 1 s.

NOTE 2 The value of 1/860 is the energy in kWh required to raise the temperature of 1 l of water by 1 °C. 1 calorie is the energy required to raise the temperature of 1 g (0,001 l) of water by 1 °C at standard atmosphere. 1 000 calories = 4 186 J. 1 kWh = 3 600 000 J. The value is 1/860 kWh (4 186/3 600 000) per litre of water.

Where the cold/NORMAL water correction (if any) is applied to an energy measurement it is added to the electrical energy (E_e) and this fact shall be reported.

U.3 Correlating energy consumption tests with different cold/NORMAL water inlet temperatures

U.3.1 General

Clause U.3 provides a methodology that allows regions to use the Standard test conditions for cold/NORMAL water supply temperature (15/30 °C) but to calculate the energy consumption of the **dishwasher** that would occur if the cold/NORMAL water supply temperature was at a value that is more regionally relevant. This methodology encourages alignment with test conditions according to Clause 5 while allowing the Standard measurement data to be adjusted to provide the most locally relevant information.

Historical test data indicates that the energy (thermal mass) of the water is about one third of the total heating related energy in a **dishwasher**. Consider the case of a **dishwasher** tested to standard conditions. If the first **operation** is cold (without heating) then the supply water (15 °C) will cool the load and the **dishwasher** shell somewhat (these

nominally start at 23 °C). The cooling will be such that they are all in thermal equilibrium (e.g. approximately 20 °C). If the supply water was colder (10 °C), the load and **dishwasher** would be cooler after the first **operation** and the **dishwasher** would also have to make up this deficit in the subsequent heated **operation**. Not all of the thermal deficit (in this case) from the volume of supply water carries over to the next **operation** as the initial rinse water is drained away. The initial estimate is that 0,7 of the thermal impact of a different cold water supply temperature carries over to the next heated **operation** and 0,3 of the impact is removed through the draining of the water. This initial estimate will be refined as test data accumulates.

The same conceptual approach will apply to non-heated **operations** between heated **operations**. Any non-heated **operation** that occurs after the final heated **operation** will have no impact on the energy and should be ignored.

So in summary, the proposed approach for a correction takes into account all of the energy difference in the supply water for heated **operations**, most of the energy difference in the supply water for non-heated **operations** that are followed by heated **operations** and ignores any other non-heated **operations**. This approach is only valid for machines connected to cold water and that heat water internally.

Test machines that have significant on-board water storage and recycling of water will have more complex impacts, as it depends on the volume of water stored and the temperature of the stored water when it is used (which is a function of the initial temperature and the time until the next **programme**). Additional corrections may be needed to take into account some of these factors.

Test machines that are connected to a hot water supply and that do not heat, cannot be estimated using this approach – the only option is to undertake a **test run** at standard conditions to quantify the impact (as noted previously, this may have impacts on performance as well as energy).

U.3.2 Estimating regional energy consumption from standard cold/NORMAL water temperature

For **dishwashers** that are only connected to cold/NORMAL water and that heat water internally, energy consumption may be estimated in accordance with the following formula:

$$E_{\text{Regional-e}} = E_{\text{IEC15 °C-m}} + \frac{(15 - t_{\text{nr}}) \cdot Q_{\text{a}}}{860} + \frac{0{,}7 \cdot (15 - t_{\text{nr}}) \cdot Q_{\text{b}}}{860} \qquad \text{(U.3)}$$

where:

$E_{\text{Regional-e}}$ is the estimated energy consumption for the **dishwasher** for a cold water supply temperature of t_{nr};

$E_{\text{IEC15 °C-m}}$ is the measured energy for the **dishwasher** in accordance with 8.2.2 with a cold water supply temperature of 15 °C; FORMULA & (15 TO BE 30) TO BE REVISED TO 30°C

t_{nr} is the nominal non-standard cold water temperature for the region; this is limited to values between 15°C and 20°C

Q_a is the cold water volume of all cold fills that occur in heated **operations**;

Q_b is the cold water volume of all cold fills for non-heated **operations**, excluding any cold fills that occur after the last heated **operation**.

This estimate is only valid for the same **dishwasher** testing the same load on the same **programme** with all other test conditions remaining unchanged. This estimate is useful only for energy consumption. This method provides no information about the influence on any other performance characteristic treated in this standard such as cleaning performance, drying performance, water consumption and **cycle time**.

The test report shall include values $E_{\text{IEC15 °C-m}}$ and $E_{\text{Regional-e}}$ when a non-standard cold water temperature is specified for a region.

U.3.3 Estimating standard energy consumption from regional cold water temperature

Where a regional test procedure or regulation that references this standard specifies a non-standard cold water temperature that differs from 15 °C, the tests in accordance with this standard may be undertaken using a water supply at this regional temperature (t_{nr}). The methodology in Clause U.3 provides the estimated energy consumption that would have occurred at the standard cold water inlet temperature of 15 °C. Reporting regional and standard energy values together provides valuable information for regional benchmarking of energy data. Wherever possible, the standard cold water supply temperature of 15 °C shall be used for testing and the methodology to calculate a regionally relevant energy value in U.3.2 adopted.

For **dishwashers** that are only connected to cold water and that heat water internally, an estimated value in accordance with the Formula (U.4) may be used in lieu of a physical test:

$$E_{\text{IEC15 °C-e}} = E_{\text{Regional-m}} + \frac{(t_{nr} - 15) \cdot Q_a}{860} + \frac{0{,}7 \cdot (t_{nr} - 15) \cdot Q_b}{860} \quad \text{(U.4)}$$

where:

$E_{\text{IEC15 °C-e}}$ is the estimated energy for the dishwasher with a cold water supply temperature of 15 °C;

$E_{\text{Regional-m}}$ is the measured energy consumption for the **dishwasher** for a cold water supply temperature of t_{nr} but otherwise in accordance with 8.2.2;

t_{nr} is the nominal non-standard cold water temperature; this is limited to values between 15°C and 20°C

Q_a is the cold water volume of all cold fills that are heated;

Q_b is the cold water volume of all cold fills for a non-heated **operation**, excluding any cold fills that occur after the last heated **operation**.

This estimate is only valid for the same **dishwasher** testing the same load on the same **programme** with all other test conditions remaining unchanged.
The test report shall include values $E_{\text{IEC15 °C-e}}$ and $E_{\text{Regional-m}}$ when a non-standard cold water temperature is specified for a region.