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Draft Indian Standard

ELECTRIC DISHWASHER FOR HOUSEHOLD USE – METHODS FOR MEASURING THE PERFORMANCE

ICS 97.040.40

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NATIONAL FOREWORD:

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

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

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

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

3.1.2 *Free-Standing Dishwasher*
dishwasher which is intended to be installed without an enclosing structure

3.1.3 *Built-in Dishwasher*
dishwasher which is intended to be installed inside an enclosing structure such as a kitchen cupboard

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

3.1.5 *Test Machine*
dishwasher under test

3.1.6 *Reference Machine*
dishwasher used to standardise cleaning and drying performance measurements

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

3.1.7 *Test Run*
single cycle performance assessment

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

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

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

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

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

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

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

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

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

Note 1 to entry—Usually, an end of programme indicator signals the end of the programme and the user has access to the load.

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

Note 1 to entry: The cycle can be equal to or last longer than the programme.

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 .

3.1.17 *Programme Time*
length of time beginning with the initiation of the programme, excluding any user programmed delay, until an end of programme indicator is activated and the user has access to the load.

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

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

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

3.1.20 *Water Softener*
device which reduces the hardness of water

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

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

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

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

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

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

3.1.25 *End of Programme Mode*
mode that begins immediately after the completion of the programme, and continues without any further intervention from the user
Note 1 to entry— This mode can persist indefinitely or can be of limited duration if the dishwasher is equipped with a power management system.

3.1.26 *Left on Mode*
mode that begins as soon as the dishwasher door has been opened and/or unlatched by the user after the completion of the programme, and continues without any further intervention from the user

Note 1 to entry–In some products, this mode can be equivalent to the off mode.

Note 2 to entry–This mode can persist indefinitely or can be of limited duration if the dishwasher is equipped with a power management system.

3.1.27 *Off Mode*
lowest power consumption mode of the dishwasher while it is connected to a mains power source, achieved either automatically by the power management system of the dishwasher or manually by switching it off using controls or switches on the dishwasher that are accessible and intended for operation by the user during normal use

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

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

3.1.29 *End-of-Programme Mode Duration*

time from the start of end of programme mode until the dishwasher reverts automatically to off mode

Note 1 to entry— This time span is only applicable to dishwashers equipped with power management systems.

3.1.30 *left on mode duration*
time from the start of left-on mode until the dishwasher reverts automatically to off mode

Note 1 to entry—This time span is only applicable to dishwashers equipped with power management systems

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 *Mannual fF*
Filter system which requires frequent cleaning by the user

3.1.36 *All Activity Ceases*
power consumption decreases to a low steady state in which the power fluctuates by no more than 10 % or 0,1 W, whichever is the greater, over a period of at least 60 min

Note 1 to entry—The current waveform shall be sampled at a frequency of 1000 Hz and averaged over the duration of 60 s.

3.1.37 *Intermittently Recurring Function*
function that occurs during some, but not all, cycles of a specific programme (or programmes) and that is directly related to water-softening operations, water-reuse operations or similar operations and that alters water consumption, energy consumption and/or programme time for the cycle

3.2 Symbols

3.2.1 *Symbols Related to the Application of Egg* **(**6.4.5.3)

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

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

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

3.2.2 *Symbols Related to the Calculation of the Drying Index (0)*

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.

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

$E_{\text{IEC15 °C-m}}$ 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;

$E_{\text{IEC15 °C-e}}$ the estimated energy for the dishwasher with a cold (NORMAL)water supply temperature of 15/30 °C;

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

3.2.5 Symbols Related to the Microwave Calibration (Annex F)

$t_{u,1}$ the required cooking time in min at the nominal output power P_1;

P_1 the nominal output power of 780 W;

t_1 the nominal cooking time at the nominal output power P_1 of 4 min;

$P_{u,1}$ the measured power output in W at the nominal output power P_1;

t_c the time correction in min depending on the cleaning performance of the milk glasses;

$t_{u,2}$ the required cooking time in min at the nominal output power P_2;

P_2 the nominal output power of 150 W;

t_2 the nominal cooking time at the nominal output power P_2 of 10 min;

$P_{u,2}$ the measured power output in W at the nominal output power P_2.

4 LIST OF MEASUREMENTS

The standard methods of measuring the performance characteristics are determined as follows:
combined cleaning and drying performance according to Clause 6 and 7;
energy consumption, water consumption, cycle time and programme time according to Clause 8;
airborne acoustical noise according to Clause 9;
additional aspects of energy consumption of dishwashers (low power modes) according to Annex K.

5 GENERAL CONDITIONS FOR MEASUREMENTS

5.1 General

5.1.1 *General Information*

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

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

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

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

Before commencing a test series, the reference and test machines shall be checked to ensure that they are operating properly.
All tests shall be started with the appliances at the ambient temperature according to 5.5.

NOTE — An appliance which has been stored for 12h 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.

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, 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 ± 1 % 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 programme may then be tested.

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

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

The name of the programme tested shall be reported.

5.5 Ambient Conditions

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

– Ambient temperature of the room: (27 ± 2) °C
– Relative humidity: (55 ± 10) %

5.6 Water

5.6.1 *General*

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

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

5.6.2 *Water temperature*

The temperature of the supply water shall be:

– cold water feed temperature:
- (15 ± 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.

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

For dishwashers that include a water supply line (i.e. the water inlet hose is supplied by the manufacturer), the volume of the water pipe between the measurement device for temperature and the connection point to the water inlet hose of the test dishwasher shall not exceed 250 ml. For dishwashers that do not include a water supply line (i.e. the water inlet hose is not supplied by the manufacturer), the volume of the water pipe between the measurement device for temperature and the connection point to the water inlet supply valve of the test dishwasher shall not exceed 400 ml. If a bypass to ensure water supply temperature is installed, at each connection to the water inlet hose(s), or water inlet supply valve, of the dishwasher, the

bypass shall be opened before starting tests until the water inlet temperature is in the required range. If the temperature is measured in the circulation loop the volume of the spur taking the water from the circulation loop shall not exceed 250 ml for dishwashers that include a water supply line, or shall not exceed 400 ml for dishwashers that do not include a water supply line.

5.6.3 Water Hardness

If hard water is used it shall have a total water hardness of (2.5 ± 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.

5.6.4 Water Pressure

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

5.7 Detergent

The reference detergent D, as described in Annex E, shall be used in the reference and test machines. The quantity for one test run shall be as recommended by the manufacturer, but not more than 8 g ± 1 g per place setting loaded.

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.

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

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

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

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

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

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

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

5.8 Rinse Aid

The rinse aid Formula "III", as described in 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.

5.9 Salt

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

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

5.10 Intermittently recurring functions

5.10.1 *Provision of Information*
Either the manufacturer or supplier shall provide information for all intermittently recurring functions that relate to the programme selected for testing. This data shall include details of changes to energy consumption, water consumption and programme duration that are caused by each intermittently recurring function. The data shall also include a description of the conditions that trigger each intermittently recurring function. An example of a format for describing intermittently recurring functions is shown in Table V.1. If no data is provided by the manufacturer or supplier, intermittently recurring functions may take place during valid test cycles and, if this happens, it is likely that the measured and averaged consumption values as well as the uncertainty of measurement will be significantly higher.
The measured energy, water, and time of intermittently recurring functions can vary. If these values differ by more than 10 % from the consumption values provided by the manufacturer, then the laboratory should seek further guidance from the manufacturer.

5.10.2 *Impact of Intermittently Recurring Functions on Reproducibility and the Validity of Test Results*
When a dishwasher is tested over a test series of 5 to 8 test runs, intermittently recurring functions may cause the results to be different to the true long-term average. For example, if the dishwasher regenerates its softener every 3 cycles and uses a significant amount of water to regenerate, the average water consumption for the test series would be higher if two regenerations occurred than if only one occurred in the test series. Neither of these cases would give the same result as the long-term average. Reproducibility of such a test would be poor. Two options to resolve this problem are given in 5.10.3.

5.10.3 *Treatment of Intermittently Recurring Functions*
For dishwashers with intermittently recurring functions, testing can be conducted according to one of the following two options:
i) Excluding consumption data from test runs where the intermittently recurring function takes place, from the calculation of the mean. In this case, testing shall follow the procedures in Clause 8. This option should give reproducible results, but the values determined will not account for the consumption associated with the intermittently recurring function(s).
ii) Extending the test series as necessary to include a suitable number of test runs where the intermittently recurring function does not take place and a suitable number of test runs where intermittently recurring function does take place. From such a test series, consumption data for each case can be combined to give an appropriately weighted average which would be representative of the long-term average. In this case, testing shall follow the procedures in Clause 8 and Annex V. This option should give reproducible results and account for the consumption associated with the intermittently recurring function(s).

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

6.3 Soiling Agents and Preparation Equipment

The following soiling agents are required:

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

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

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

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

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

6.4 Preparation and application of soiling agents

6.4.1 *General*

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.

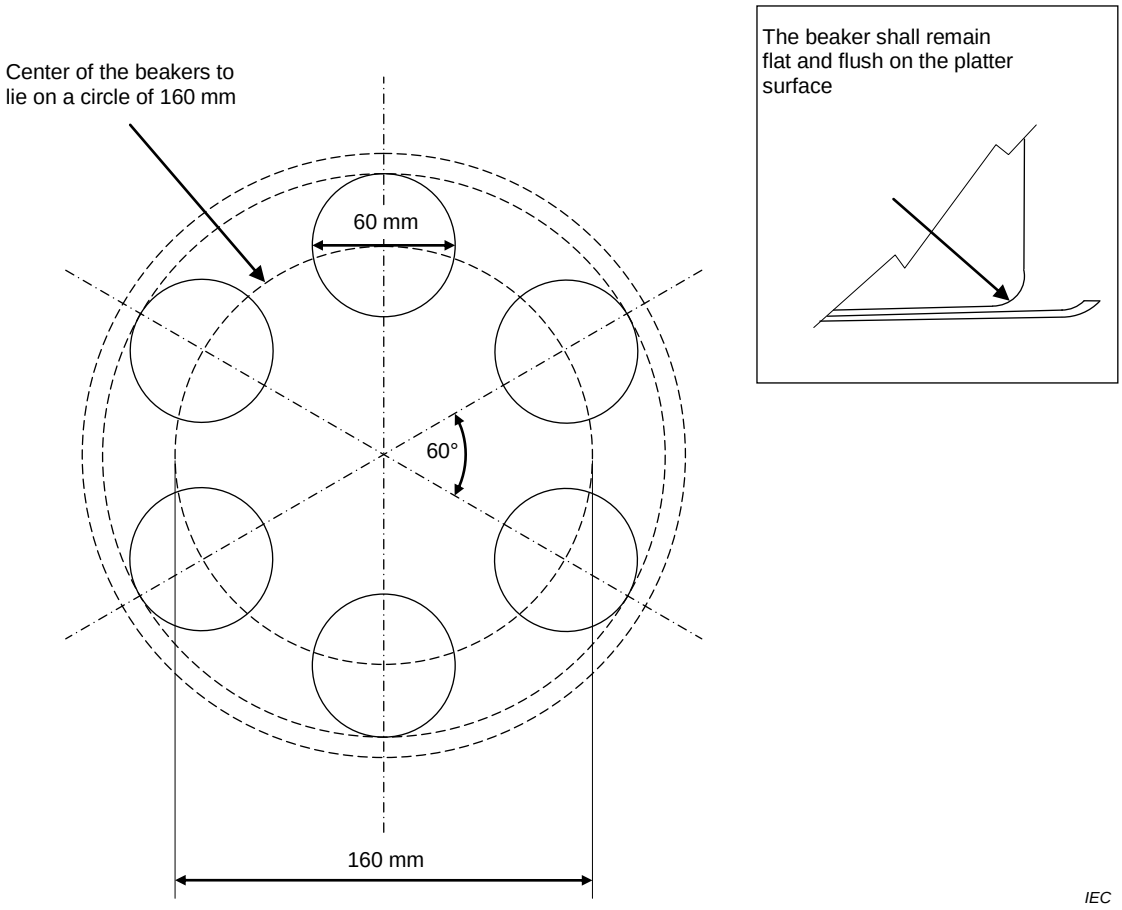


Fig. 1 – Position of the Glasses on the Microwave Turntable

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 Fig. **1** 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.

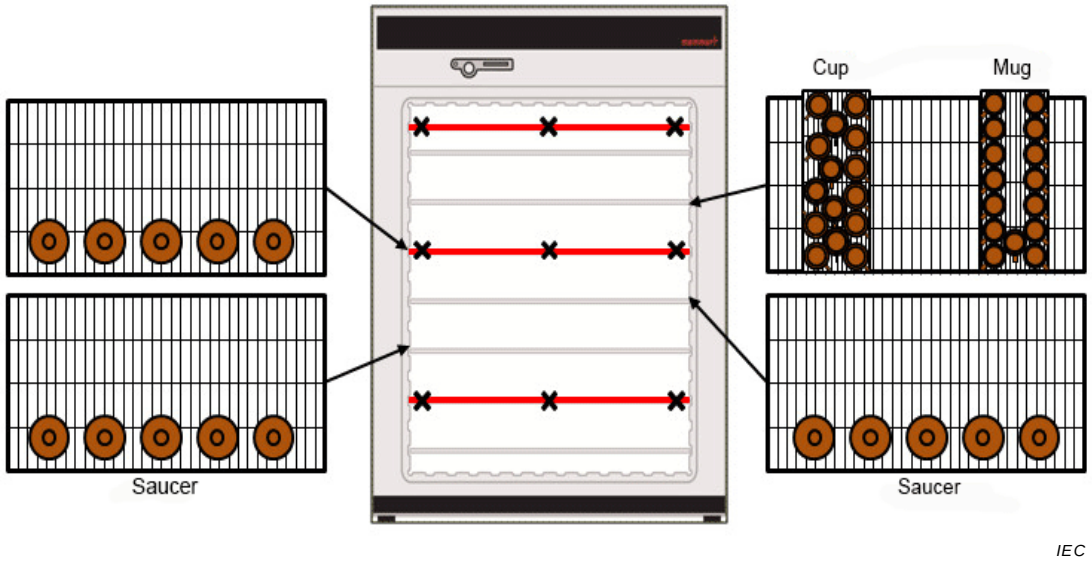


Fig. 1 – The thermal Cabinet for Pre-drying of Soiled Cups, Mugs and Saucers

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 (Fig. **3**) and, depending on country, can be called round, silverside, topside, thick flank, etc.

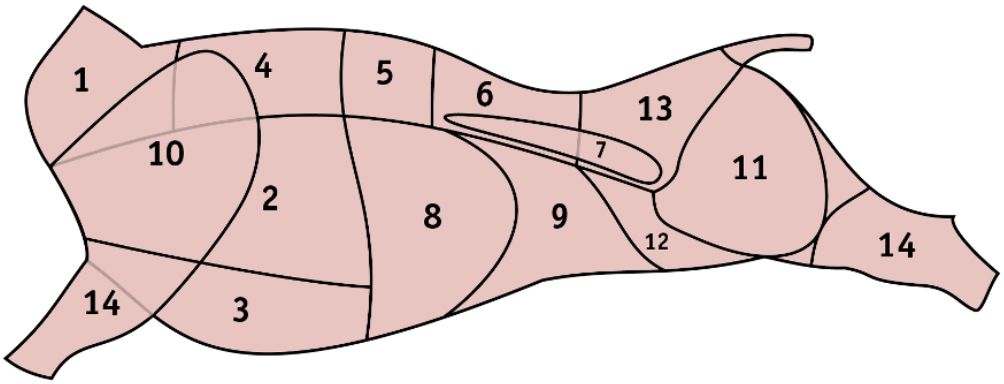


Fig. 3 – Schematic View of the Different Beef Pieces

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 20 g, or multiple of 20 g, portions. Store the portions in water-tight containers and **freeze.** Before use, allow to defrost to ambient temperature and mix with water (see 5.6 for specification) at a ratio of 20 g of minced meat to 6 g of water, until the minced meat mixture is 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 mixture 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 mixture 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 mixture 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 mixture 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:

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

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 simmering 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.

After mincing, the spinach may be freeze-dried using lyophilisation and stored until use. By using lyophilisation, the water content of the spinach is extracted and only 6 % to 8 % of the original weight will remain as dry matter spinach. This dry matter spinach may be stored for up to 12 months in an airtight container and kept in the dark. Once the container has been opened, the remaining dry matter spinach may be used for four weeks, provided it is stored in a re-sealed container in the dark.
For reconstitution of the quantities of minced spinach needed, an appropriate amount of this dry matter spinach is taken, and distilled water is added. Follow the supplier's (e.g. see L.1.11) instruction when reconstituting the spinach for a test. After reconstituting, the spinach shall be handled and stored like the de-frosted and ground spinach.
Freeze dried spinach from listed suppliers (refer to Annex L) has been proven to result in equivalent test results compared to using frozen spinach. Alternative sources shall prove equivalency through testing. Refer to Clause L.2 for guidance on equivalency.

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 Table Ware 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 Fig. 2. If necessary additional unsoiled tableware items shall be included to ensure that the thermal cabinet is fully loaded.

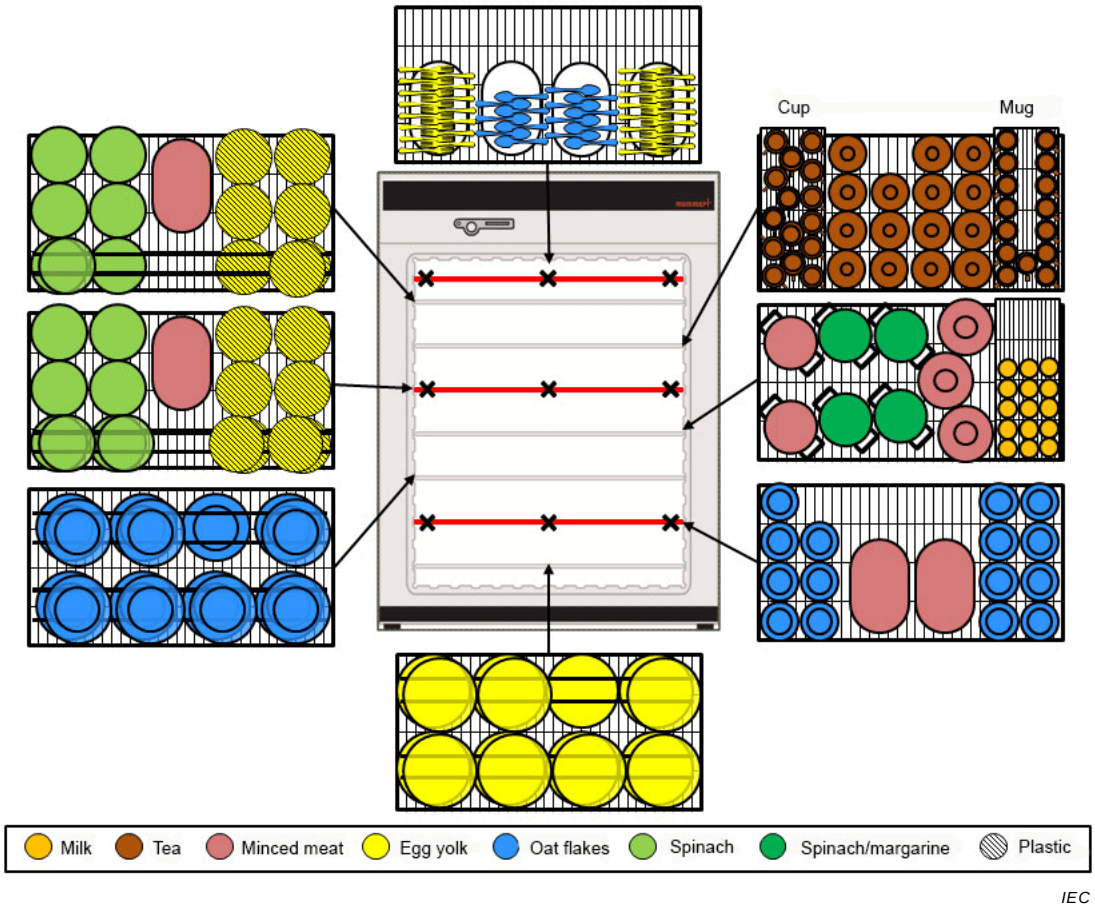


Fig. 2 – The Thermal Cabinet with Soiled Load Items (30 place settings)

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 Fig. 2.
- 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 can 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 programme finishes. However, test machines shall run at the same time as part of the reference machine programme.

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 partial or complete wet rim (not a drop or streak) around soil residue adhered to the surface of the tableware 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).

Check all surfaces during the drying evaluation. Do not take into consideration water found on unglazed edges of porcelain, pot handles or caught between a handle and a pot's body.

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 programme, 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	Residual water
2	The item is completely free from water residue.
1	The item has up to two drops of water, or one wet streak (run), or a total wet area of up to 50 mm2.
0	The item has more than two drops of water, or one drop and one streak, or two streaks, or a total wet area of more than 50 mm2.

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 Record four scores for each pot excluding pot handles:
– inner bottom;
– inner wall;
– outer surfaces;
– all pot surfaces .
Water found on the top side of the pot's rim is scored on the inner wall. Water found on the

bottom side of the pot's rim is scored on the outer surface. Do not include the pot handles in the evaluation and do not include any area of water which bridges both a pot handle and the pot

Table 2 or Table H.1.
Record four scores for each pot excluding pot handles:
– inner bottom;
– inner wall;
– outer surfaces;
– all pot surfaces .
Water found on the top side of the pot's rim is scored on the inner wall. Water found on the bottom side of the pot's rim is scored on the outer surface. Do not include the pot handles in the evaluation and do not include any area of water which bridges both a pot handle and the pot

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 $P_{\mathrm{D,i}}$:

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

where:

DR,t is (0,82) the target drying score of the reference machine

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:

$$P_D = \exp(\ln P_D) \tag{7}$$

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

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

and the half range of the logarithmic drying confidence interval In W_D of In P_D:

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

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 .

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.

Record four scores for each pot:
– inner bottom;
– inner wall;
– outer surfaces;
– all pot surfaces.

Table 3 – Evaluation of the Cleaning Performance

Number of small dot soiled	**shaped soil particles Total area mm2**	**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 3 – 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 In $P_{C,i}$, 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:

$$P_C = \exp(\ln P_C) \tag{15}$$

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

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

and the half range of the logarithmic cleaning confidence interval In W_C of In P_C:

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

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 4).

Table 4 – 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, PROGRAMME TIME

8.1 General and purpose

Clause 8 defines how to measure and evaluate 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 in accordance with Annex K.

NOTE— This document 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

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, and programme time shall be measured for each complete cycle and the results for the test series shall be calculated as described in Clause 8.3.

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

8.3 Method of evaluation

8.3.1 *General*

When calculating the arithmetic mean value of the energy, water consumption and programme time for dishwashers where the relevant intermittently recurring function depends on parameters such as water hardness and frequency of use, and does not take place on every cycle, test runs where an intermittently recurring function took place within the test series shall be disregarded when increased water, energy consumption and programme time are in line with manufacturer's instructions to the consumer in regard to the following points:

– the quantity of water, and electrical energy and the period of time required to complete the relevant intermittently recurring function;
– the frequency with which the intermittently recurring function occurs;
– the moment(s) in time during the programme that the relevant intermittently recurring function event takes place.

The intermittently recurring function may consist of several stages. It may start during one test run and finish during the following test run. When the intermittently recurring function event is in line with manufacturer's suggestion, all test runs during which an intermittently recurring function affecting the consumption values took place within the test series shall be disregarded for the purposes of calculating the mean consumption values. No more than two test runs in a test series of five runs, and no more than three test runs in a test series of six to eight runs shall be disregarded.

NOTE—The information expected to be provided would include regeneration information relevant to the water used for testing in accordance with this document.

The measured energy, water, and time of intermittently recurring functions may vary. If these values differ by more than 10 % from the consumption values provided by the manufacturer, then the laboratory should seek further guidance from the manufacturer.

Data from all test runs shall be used for the calculation of the mean value for the test series if

• the information provided by the manufacturer is not in line with the measurement, or
• consumer information regarding the impact of the relevant intermittently recurring function on water, energy, and time, is not provided by the manufacturer.

In the test report, the test runs in which intermittently recurring functions occurred shall be identified. The information provided by the manufacturer concerning intermittently recurring functions shall also be included in the test report.

Specific guidance is provided in 8.3.2 to 8.3.5.

8.3.2 Energy consumption

The energy consumption for each whole test run shall be calculated from the electrical energy consumption Ee and the energy of the supplied hot water Eh (if any) and stated for each test run in the test report.

The mean energy consumption shall be calculated from the energy consumption for every whole test run, except those test runs where an intermittently recurring function event has been identified in accordance with the manufacturer's instructions to the consumer as described in 8.3.1.

NOTE Annex U provides an informative method to correct energy consumption from cold water within the (15 ± 2) °C limit or for larger differences that can arise owing to local regional requirements.

8.3.3 Hot water energy

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

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

$$Eh = (Qh \times (th - 15)) / 860 \quad (18)$$

where

Eh is the hot water energy, in kWh;

th is $(\Sigma (thi \times Qhi)) / \Sigma Qhi$; (19)

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

where

thi is the temperature of each increment of hot water supplied to the test machine;

Qhi is the volume of each increment of hot water supplied to the test machine;

Qh is the total volume of hot water (Σ Qhi), in litres, supplied to the test machine.

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

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

8.3.4 Water consumption

Total water consumption shall be reported for each test run (including water used for intermittently recurring functions). The mean water consumption for the test series shall be calculated from the water consumption for every test run, except those test runs where an intermittently recurring function event has been identified in accordance with the manufacturer's instructions as described in 8.3.1.

8.3.5 Time

Programme time shall be measured from the initiation of the programme, excluding any user-programmed delay until an end-of-programme indicator (this could be a sound, light or a 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 ends when all activity ceases. Programme time shall be reported for each test run. The mean programme time shall be calculated from the programme time for every whole test run, except those test runs where an intermittently recurring function event has been identified in accordance with the manufacturer's instructions to the consumer as described in 8.3.1.

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.

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).

10.3 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)

10.3 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)
(*clause* 6.2.1,6.4.2.2)
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

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	530	white
A 2	Dessert plate	porcelain	190	250	white
A 3	Dessert bowl	Corelle glass	130	118	white
A 4	Mug	porcelain	70	268	white
B 1	Soup plate	porcelain	230	460	white
B 2	Melamine dessert plate	melamine	195	130	white
B 3	Saucer	porcelain	140	140	white
B 4	Cup	porcelain	78	120	white
A 5 + B 5	Glass	borosilicate glass	60	110	transparent
A 6 + B 6	Fork	(18/10) stainless steel	188	41	metallic
A 7 + B 7	Knife	(18/10) stainless steel	209	55	metallic
A 8 + B 8	Soup spoon	(18/10) stainless steel	190	51	metallic
A 9 + B 9	Dessert spoon	(18/10) stainless steel	156	34	metallic
A 10 + B 10	Teaspoon	(18/10) stainless steel	136	23	metallic
Serving pieces					
S 1 a	Small pot	(18/10) stainless steel	160	820	metallic
S 1 b	Oven pot	(18/10) stainless steel	160	475	metallic
S 2	Glass bowl	borosilicate glass	186	330	transparent
S 3	Oval platter	porcelain	320	850	white
S 4	Melamine bowl	melamine	213	170	white
S 5	Serving spoon	(18/10) stainless steel	260	75	metallic
S 6	Serving fork	(18/10) stainless steel	190	35	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] The weight tolerance for single items B4 Cup, A5+B5 Glass and S2 Glass bowl, A7+B7 Knife, S5 Serving Spoon, S6 Serving fork and S7 Gravy ladle shall be within ±20 % of the absolute values; for all other single

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.

	Rated dishwasher capacity (place settings):	Number of each type of load item to be included in each test load															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Item No.	Item description																
A 1	Dinner plate	0	0	0	2	3	3	4	4	5	5	6	6	7	7	8	8
A 2	Dessert plate	3[b]	3[b]	5[c]	2	3	3	4	4	5	5	6	6	7	7	8	8
A 3	Dessert bowl	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8
A 4	Mug	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8
A 5	Glass	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8
B 5	Glass	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8
A 6 + B 6	Fork	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A 7 + B 7	Knife	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A 8	Soup spoon	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8
B 8	Soup spoon	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8
A 9 + B 9	Dessert spoon	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A 10 + B 10	Teaspoon	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

	Rated dishwasher capacity (place settings):	Number of each type of load item to be included in each test load															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Item No.	Item description																
Total mass of crockery including glasses (kg)		1,25	2,21	3,20	4,47	5,75	6,71	7,98	8,94	10,22	11,18	12,46	13,42	14,69	15,65	16,93	17,89
Total mass of cutlery excluding serving pieces (kg)		0,20	0,41	0,61	0,82	1,02	1,22	1,43	1,63	1,84	2,04	2,24	2,45	2,65	2,86	3,06	3,26
Total mass of serving pieces (kg)		0,26	0,26	0,26	2,08	2,08	2,08	2,08	2,41	2,41	2,41	3,05	3,05	3,05	3,05	3,05	3,05
Total mass of load (kg)[a]		1,71	2,87	4,07	7,36	8,84	10,01	11,49	12,98	14,46	15,63	17,75	18,91	20,39	21,56	23,04	24,20

[a] Loads prepared in accordance with 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).

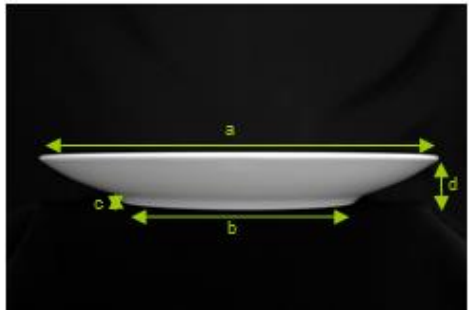
Alternate load item: Item Id. B1 in the **test machine** (soup plate) may be replaced with item Id. A1 (dinner plate). This substitution shall not apply to the **reference machine**. The use of alternate loads shall be reported.

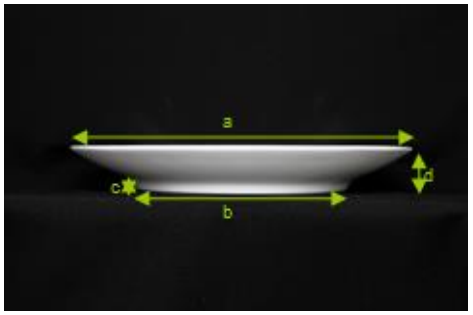
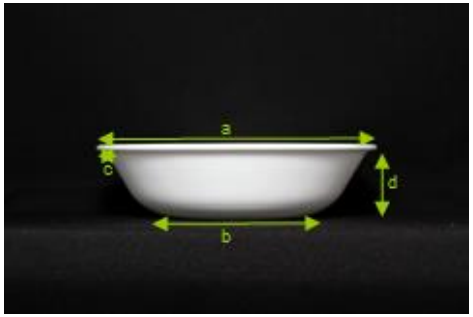
ANNEX B
(informative)
(clause 5.1.1)
TABLEWARE SPECIFICATIONS

Tableware specifications are given in Table B.1

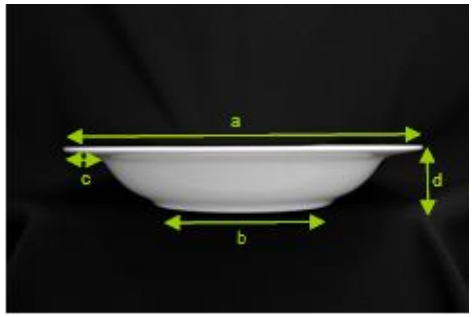
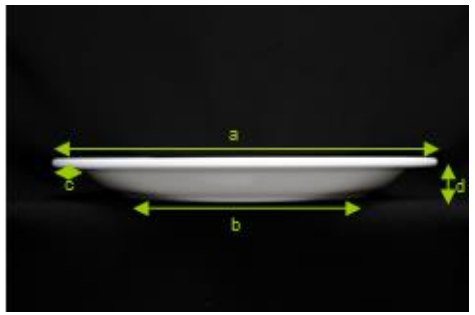
All values (a to f) are measured at the longest or widest length.

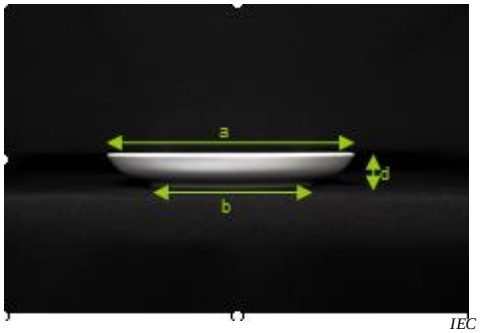
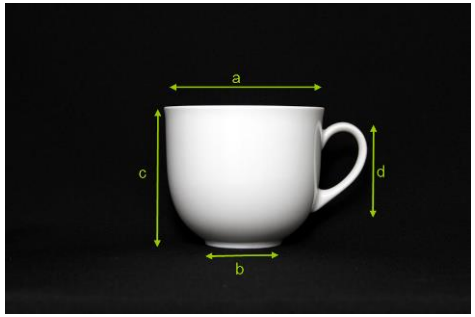
Table B.1 – Tableware specifications

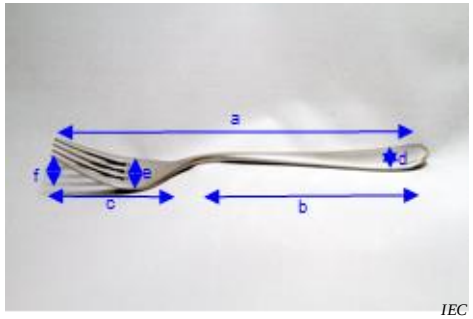
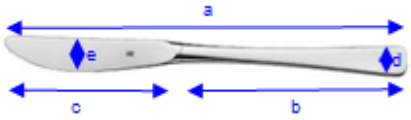
Item Id.	Item Description	Photograph	Measured value[a] (a, b, c, d, e, f)	Weight in g[b]	Material thickness bottom	Shape/style	Producer
A 1	Dinner plate	 IEC	a = 250 mm b = 150 mm c = 2 mm d = 20 mm e = -- f = --	530 g	4.4 mm	Form 2000 *(Arzberg product number: 20000000226)*	Arzberg/ Rosenthal

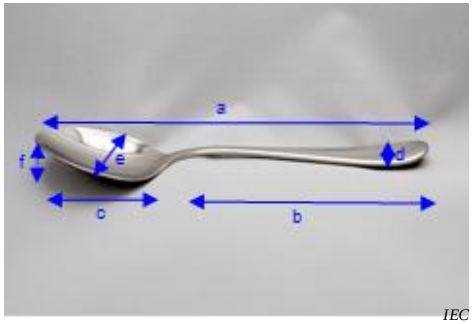
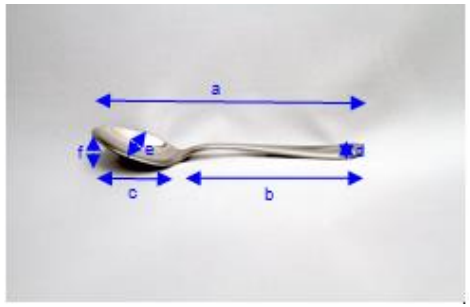
Item Id.	Item Description	Photograph	Measured value[a] (a, b, c, d, e, f)	Weight in g[b]	Material thickness bottom	Shape/style	Producer
A 2	Dessert plate	 IEC	a = 190 mm b = 115 mm c = 2 mm d = 24 mm e = -- f = --	250 g	3.2 mm	Form 2000 *(Arzberg product number: 2000000010219)*	Arzberg
A 3	Dessert bowl	 IEC	a = 130 mm b = 65 mm c = 5 mm d = 28 mm e = -- f = --	118 g	3.8 mm	Corelle (Corning/Comcor product number: 6003899, AHAM)	Corning #6003899

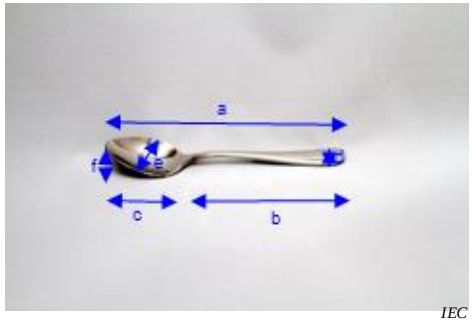
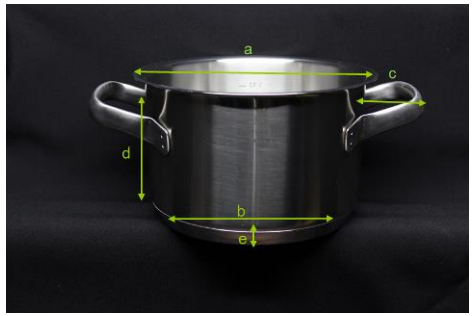
Item Id.	Item Description	Photograph	Measured value[a] (a, b, c, d, e, f)	Weight in g[b]	Material thickness bottom	Shape/style	Producer
A 4	Mug	 IEC	a = 70 mm b = 35 mm c = 105 mm d = 70 mm e = -- f = --	268 g	3.0 mm	Solo 8000	Kahla/Thüringer Porzellan GmbH
A 5 B 5	Glass	 IEC	a = 60 mm b = -- c = 50 mm d = 120 mm e = -- f = --	110 g	3.4 mm	Beaker (250ml)/Tall Form/Without Drain (Schott Duran product number: 211173603	Schott DURAN

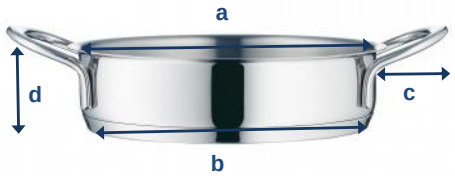
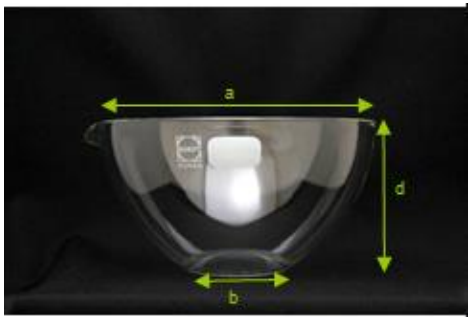
Item Id.	Item Description	Photograph	Measured value[a] (a, b, c, d, e, f)	Weight in g[b]	Material thickness bottom	Shape/style	Producer
B 1	Soup plate	 IEC	a = 230 mm b = 120 mm c = 25 mm d = 30 mm e = -- f = --	460 g	3.2 mm	1382 *(Arzberg product number: 1382000010123)*	Arzberg
B 2	Melamine dessert 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

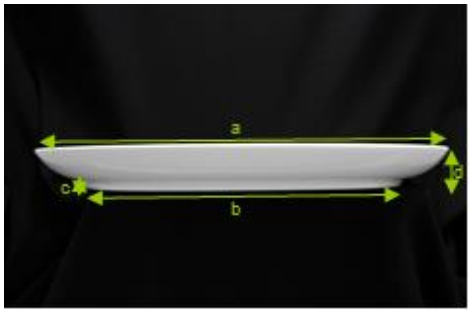
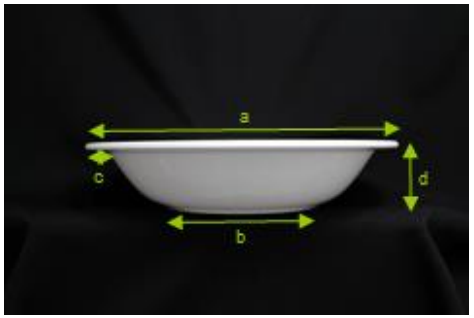
Item Id.	Item Description	Photograph	Measured value[a] (a, b, c, d, e, f)	Weight in g[b]	Material thickness bottom	Shape/style	Producer
B 3	Saucer	 IEC	a = 140 mm b = 90 mm c = -- d = 15 mm e = -- f = --	140 g	3.8 mm	1382 *(Arzberg product number: 1382000014731)*	Arzberg
B 4	Cup	 IEC	a = 78 mm b = 36 mm c = 65 mm d = 45 mm e = -- f = --	120 g	3.1 mm	1382 *(Arzberg product number: 1382000014732)*	Arzberg

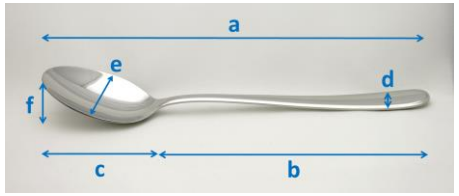
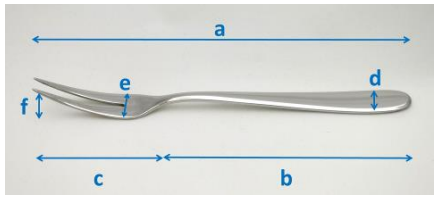
Item Id.	Item Description	Photograph	Measured value[a] (a, b, c, d, e, f)	Weight in g[b]	Material thickness bottom	Shape/style	Producer
A 6 + B 6	Fork	 IEC	a = 188 mm b = 128 mm c = 60 mm d = 17 mm e = 24 mm f = 22 mm	41 g	3.0 mm	"Signum 1900" Dessert fork *(WMF product number: 12.1905.6040)*	WMF
A 7 + 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

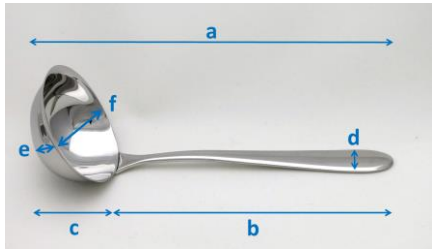
Item Id.	Item Description	Photograph	Measured value[a] (a, b, c, d, e, f)	Weight in g[b]	Material thickness bottom	Shape/style	Producer
A 8 + B 8	Soup spoon	 IEC	a = 190 mm b = 125 mm c = 65 mm d = 16 mm e = 40 mm f = 25 mm	51 g	3.0 mm	"Signum 1900" Dessert spoon *(WMF product number: 12.1904.6040)*	WMF
A 9 + B 9	Dessert spoon	 IEC	a = 156 mm b = 100 mm c = 56 mm d = 15 mm e = 33 mm f = 22 mm	34 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	23 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 =	820 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	 IEC	a = 160 mm b = 150 mm c = 36 mm d = 41 mm e = f =	475 g	6.0 mm	Oven pan Ø 16 cm Mini *(WMF product number: 07.1679.6041)*	WMF
S 2	Glass bowl	 IEC	a = 186 mm b = 75 mm c = 95 mm d = e = f =	330 g	2.1 mm	Evaporation dish with spout; 1,5 l *(Schott Duran product number: 213015906))*	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 = --	850 g	4.0 mm	1382 *(Arzberg product number: 1382000012732)*	Arzberg/ Rosenthal
S 4	Melamine bowl	 IEC	a = 213 mm b = 105 mm c = 13 mm d = 40 mm e = -- f = --	170 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	Chafing dish spoon WMF product number: 12.8386.6041	WMF
S 6	Serving fork	 IEC	a = 190 mm b = 130 mm c = 60 mm d = 15 mm e = 16 mm f = 13 mm	35	2.8 mm	Serving fork WMF “Supplement” product number: 12.8393.6040)	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
S 7	Gravy ladle	 IEC	a = 180 mm b = 137 mm c = 43 mm d = 15 mm e = 24 mm f = 60 mm	50	2.5 mm	Gravy ladle WMF product number: 12.8395.6040)	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.

The weight tolerance for single items B4 Cup, A5+B5 Glass, A7+B7 Knife, S2 Glass bowl, S5 Serving Spoon, S6 Serving fork and S7 Gravy ladle shall be within ± 20 % of the absolute values; for all other single items the weight tolerance shall be within ± 10 % of the absolute values

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*

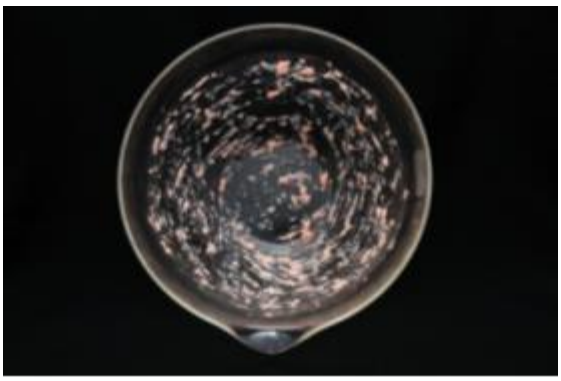
The following Table C.4 illustrates the amount of soil which has to be applied on the type A, type B and **serving pieces** for a 6-, 9-, 12- or 15- **place setting** machine. The amounts per item, which are the basis for this calculation, are given in Table C.1, Table C.2 and Table C.3.

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)
(*clause* 6.4.1,6.4.7)
PICTURES OF THE SOILED ITEMS

Minced meat: Glass bowl, oval platter, oven pot



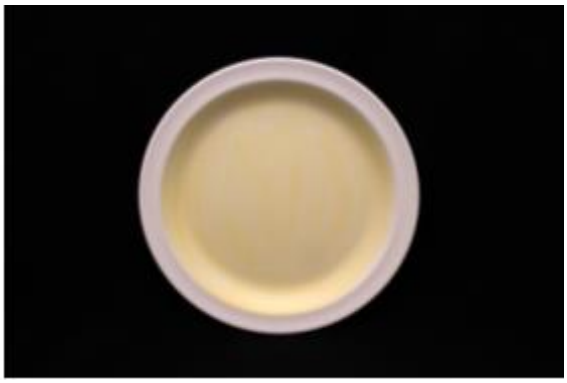
IEC

IEC

IEC

Egg yolk: Dinner plate, melamine dessert plate, fork

IEC



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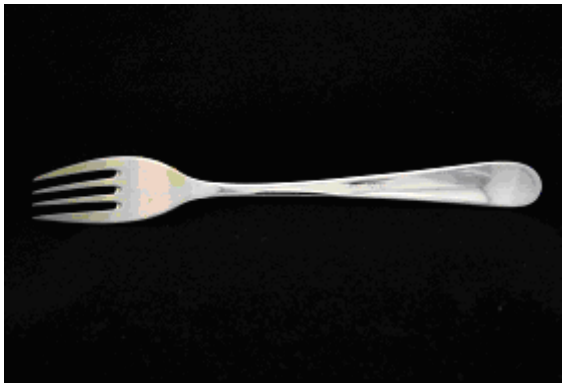


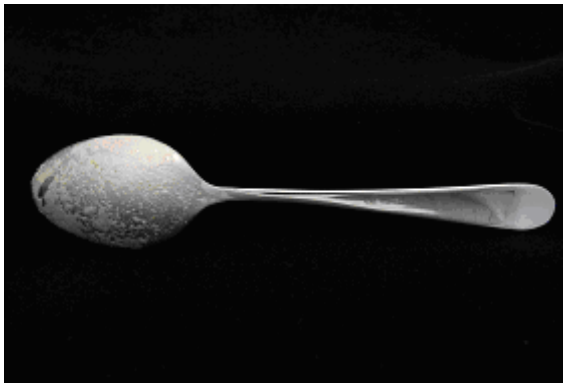
IEC

(picture of the fork was made after oven drying)

Oat flakes: Soup plate, dessert bowl, soup spoon

IEC

IEC



IEC

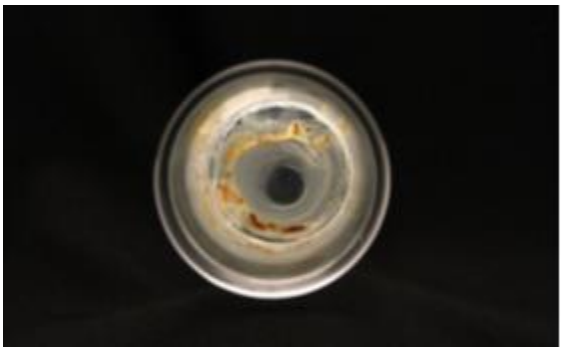
(picture of the spoon was made after oven drying)

Spinach: Dessert plate, small pot

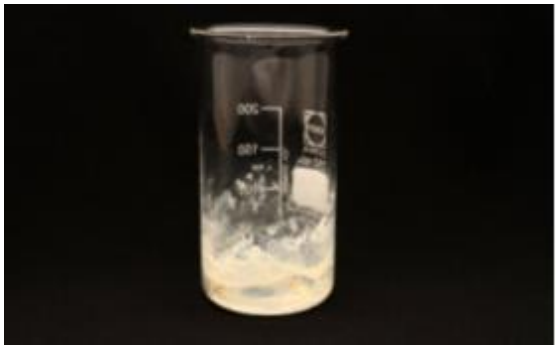
IEC

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)
(*clause* 5.7,5.8,5.9)
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)
(*clause* 6.4.2.2,6.4.2.3)
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.

The microwave oven shall be operated with stabilized power as defined in 5.3.1.1 and 5.3.1.2.

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, the microwave shall be recalibrated at least every 6 months or if in two consecutive test series, the average of the milk glasses score from each test series is out of the specified range.

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;

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.

$P_{u,1}$ 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.

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 to 2,00
- for the air drying method specified in 6.5.3: average cleaning scores for six glasses: 2,50 to 4,00

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)
(*clause* 6.4.3.4,6.5.2)
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 accommodate at least 30 place settings. Indicative values for such a cabinet would be:

- a volume of around 750 litres;
- eight wire shelves with a dimension of (1030 x 530) mm.

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 Fig. 2 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.

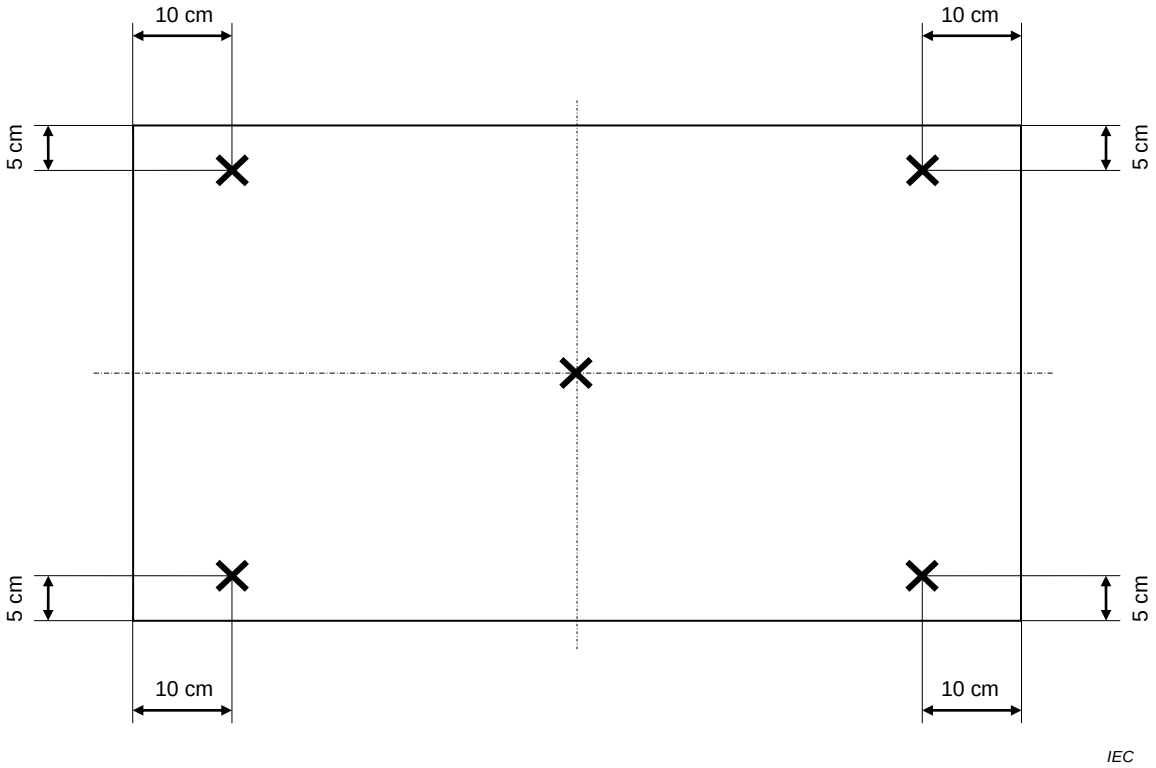


Figure G.1 – Location of the thermocouple on upper, intermediate and lower wire shelves

ANNEX H
(informative)
(*clause* 7.2.2,7.3)
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	$\sum_D$								
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)
(*clause* 3.1.6,5.1.1,6.1)
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]: 1,27 ± 0,05 (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)
- Heated rinse operations: 67 ± 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.

– Cycle time [min]: 98 ± 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 *Specification of 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): 3,55 ± 0,25 (refer to I.3.8)
- Cleaning performance – Air drying method (refer to 6.5.3): 3,90 ± 0,25(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: 0,82 ± 0,05 (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. ± 1 %. 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 5^{th} 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.

Maximum water level
at the end of a **cycle**

IEC

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 operations 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.

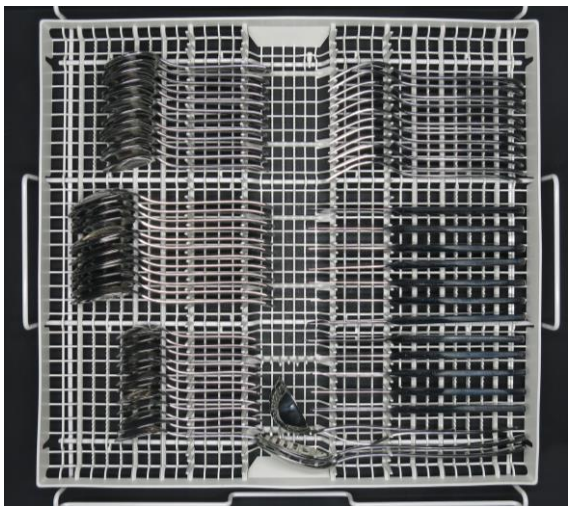
I.3.8 *Checking the cleaning and drying performance*

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:

Soiled and unsoiled
soup spoons are loaded
in an alternating order. The
first soup spoon is soiled

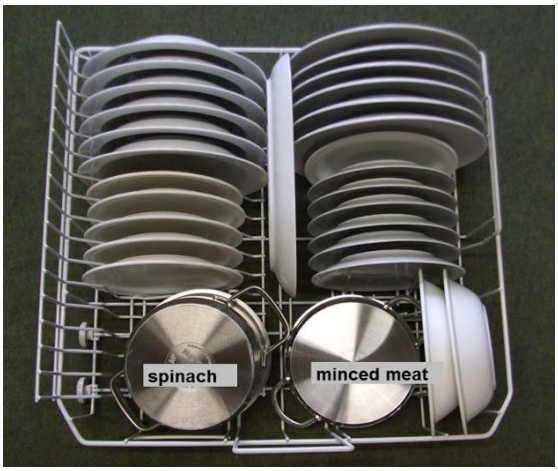


Serving spoons,
serving fork, and
gravy ladle are
positioned from front

IEC

Cutlery rack

4 cups are loaded in a row. 2 cups are hidden by the dessert bowls



- Marked glasses are soiled with milk

IEC

Upper basket

Lower basket

ANNEX J
(informative)
(*clause* 6.4.2.5)
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)
(*clause* 4,18.1)
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 programme 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 document. Other low power modes can 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 programme mode, off mode and delay start mode shall be made in accordance with the requirements of IEC 62301 except for the measurement procedure.. 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.

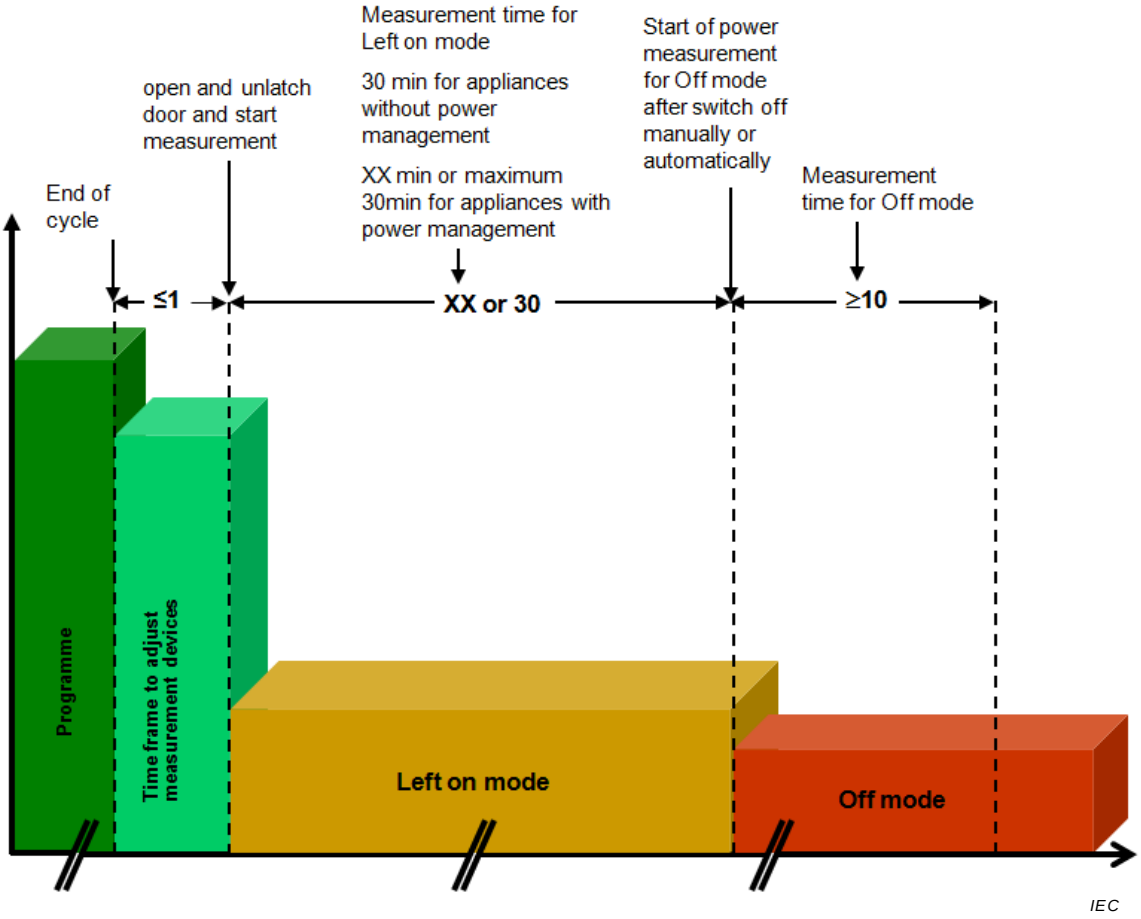


Figure K.1 – Measurement procedure for low power modes (Left on mode and Off mode)

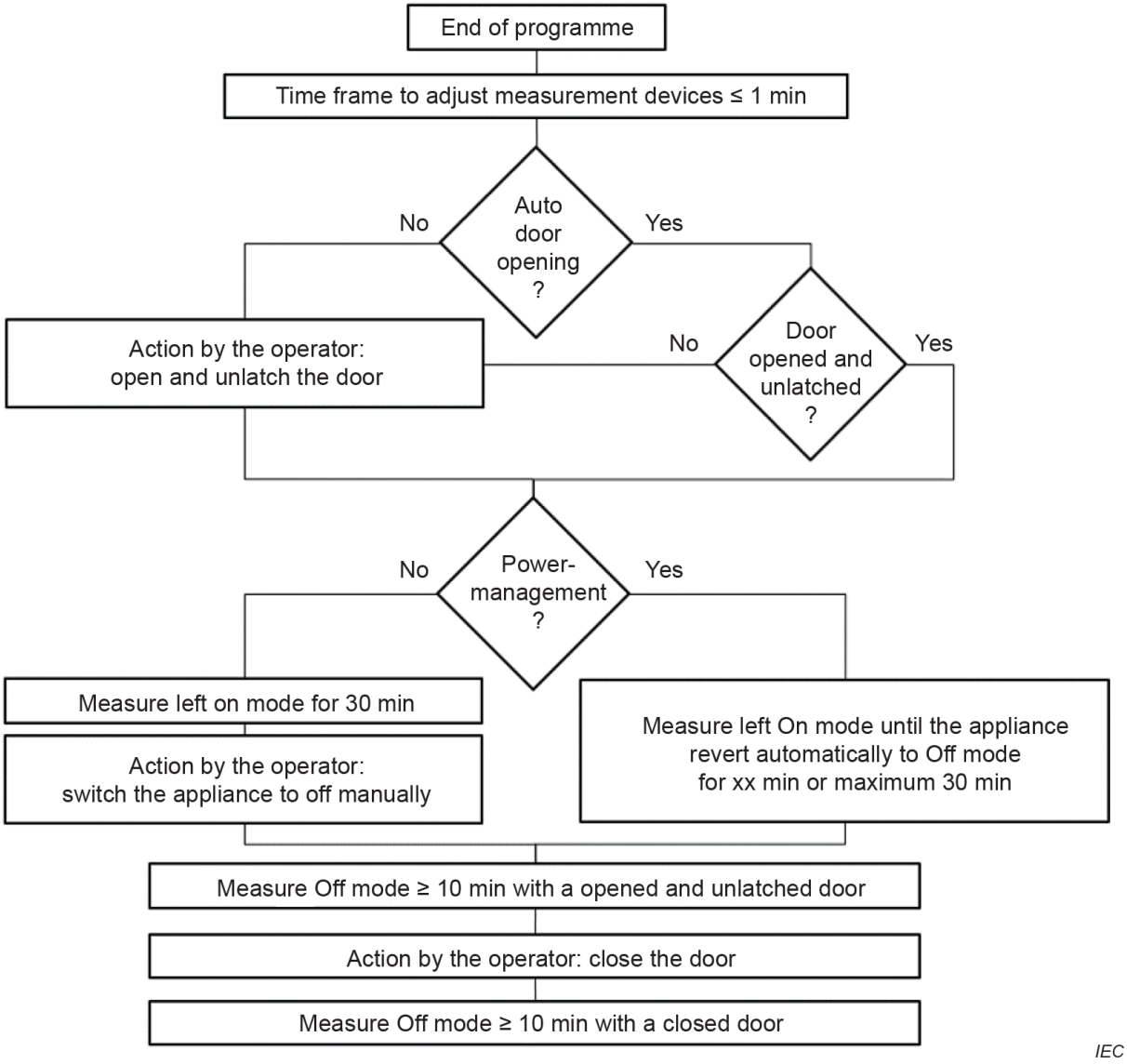
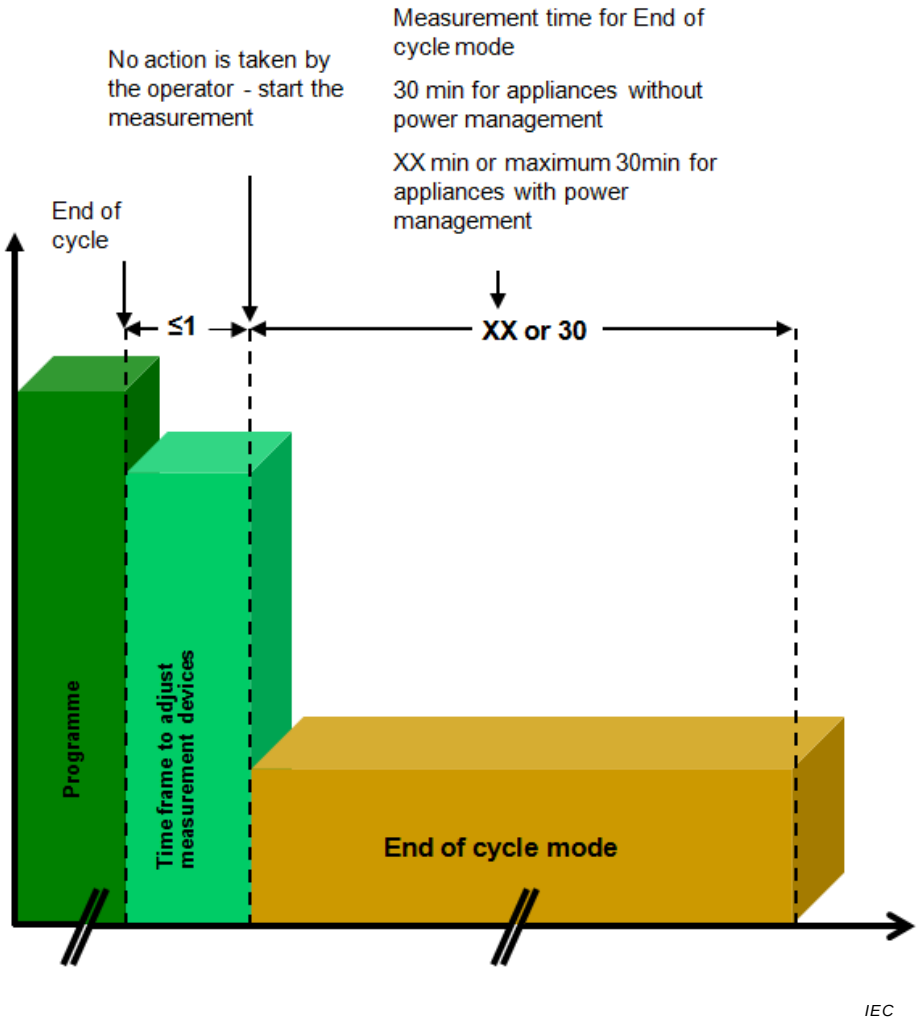


Fig. k.1-Measurement Procedure for Low Power Modes(Left on mode and off mode)


Measurement time for End of cycle mode
30 min for appliances without power management
XX min or maximum 30min for appliances with power management
No action is taken by the operator - start the measurement
End of cycle
≤1
XX or 30
Programme
Timeframe to adjust measurement devices
End of cycle mode
IEC

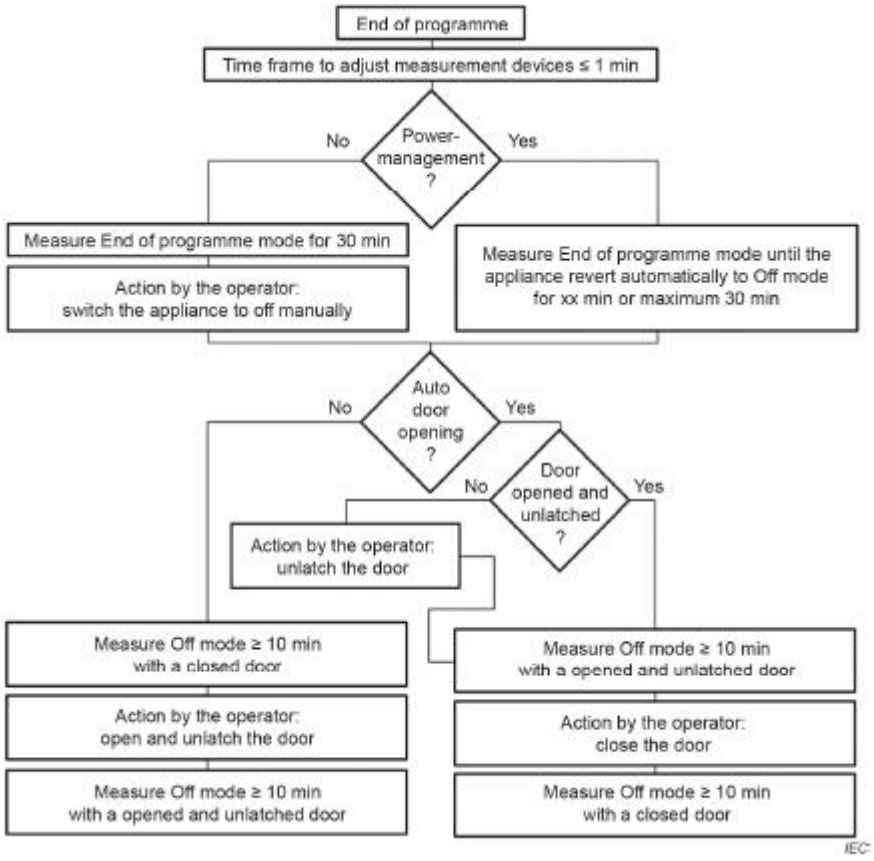


Fig. K.2 Measurement Procedure for Low Power Mode (end of programme mode and off mode)

The low-power modes are determined in different positions of the dishwasher door, which are defined as followed:

– closed door;

– opened and unlatched door – the required door position is described in Figure K.3.

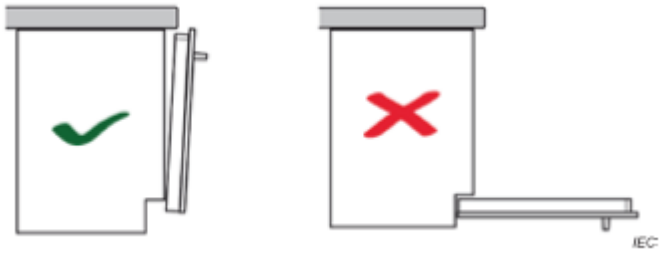


Fig. K.3 Required door position in the case of opened and unlatched door (left picture)

NOTE— Some dishwashers have self-closing doors and a block insert can be necessary in order to keep it open.

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 programme the door of the dishwasher is opened and unlatched (as described in Figure K.3) 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.

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 within 30 min after end of programme, the left-on mode duration is determined in accordance with Clause K.2 and shall be reported

At the completion of any cycle programme, the door of the dishwasher is opened and unlatched (as described in Figure K.3) 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 PROGRAMME MODE POWER

At the completion of any programme 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 programme has been completed. The procedure is explained in Figure K.2.

For machines without power management (where end of programme mode persists for an indefinite period), the measurement of end of programme mode shall be determined over a period of 30 min. In this case the end of programme 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 programme 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 programme 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 programme mode shall be determined over the actual duration. In this case the end of programme mode power and the end of cycle mode duration are reported.
The power consumption of end of programme mode is the average of the measured data.

K.5 DETERMINATION OF END OF PROGRAMME MODE DURATION

If a test machine is equipped with a power management system to revert the machine automatically to off mode within 30 min after the end of the programme, the end-of-cycle mode duration is determined in accordance with Clause K.4 and shall be reported.

At the completion of any programme 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 programme 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 power is measured after the determination of left-on mode or end of programme mode as explained in Figure K.1 or K.2 with a closed and also with an opened and unlatched door, as explained in Figure K.3. 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, the off mode shall be determined in two conditions: closed, and opened/unlatched door..

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

K.6.1 *After left-on mode (Figure K.1), the off mode shall be determined over a period of*
• not less than 10 min with opened and unlatched door, and

• not less than 10 min with closed door; in some cases, user intervention can reactivate the dishwasher, and in such a case, the measurement shall start after the dishwasher automatically reverts to the off mode.
The higher value shall be reported.

K.6.2 *After end of programme mode (Figure K.2):*
– If off mode is reached with an opened and unlatched door:
• the door stays undisturbed, measure off mode for not less than 10 min,
• then close the door and measure off mode for not less than 10min; in some cases, user intervention can reactivate the dishwasher, and in such a case, the measurement shall start after the dishwasher automatically reverts to the off mode.
– Or if off mode is reached with a closed door:
• the door stays undisturbed, measure off mode for not less than 10 min,
• then open and unlatch the door and measure off mode not less than 10min; in some cases, user intervention can reactivate the dishwasher, and in such a case, the measurement shall start after the dishwasher automatically reverts to the off mode.
The higher value shall be reported.
Opening or closing the door by the operator can reactivate the dishwasher to perform auxiliary functions, such as display information or operate the interior light. Should this occur, additional waiting time is needed for the dishwasher to revert to off mode.

K.7 DETERMINATION OF DELAY START MODE POWER

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 programme 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)
(*clause* 6.4.6.1,6.4.7.1, 6.4.3.1)
SUPPLIERS OF TEST MATERIALS

Information on suppliers of test materials is available on the IEC website and will be continually updated. This information can be accessed via SC 59A supporting documents on the IEC website: www.iec.ch/sc59a/supportingdocuments. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the suppliers named.

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 *MResults*

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

- Cleaning scores (include Table 4 or equivalent).
- Drying scores (include Record four scores for each pot excluding pot handles:

– inner bottom;
– inner wall;
– outer surfaces;
– all pot surfaces .

Water found on the top side of the pot's rim is scored on the inner wall. Water found on the bottom side of the pot's rim is scored on the outer surface. Do not include the pot handles in the evaluation and do not include any area of water which bridges both a pot handle and the pot

- **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)
(clause 5.1.3)
TEST ENCLOSURE FOR BUILT-IN AND INTEGRATED DISHWASHERS

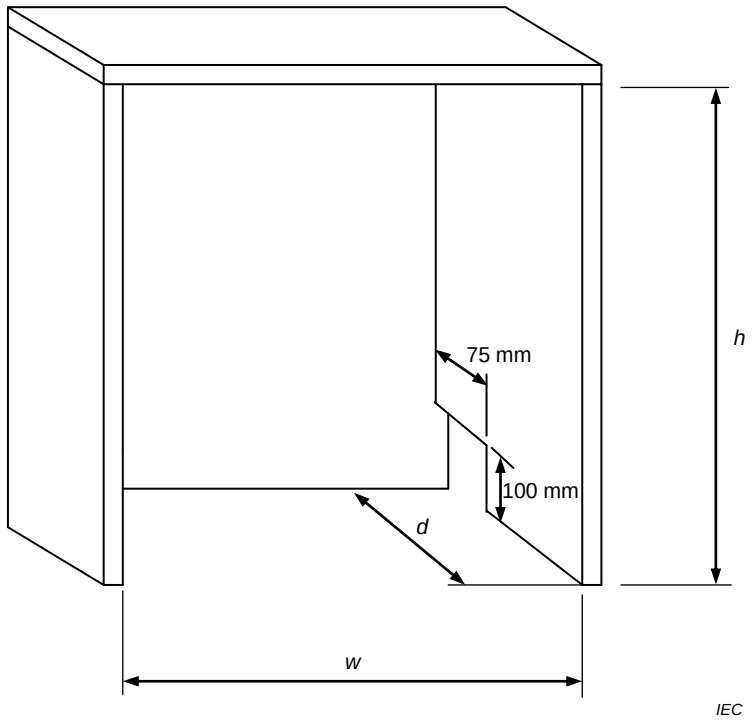
Figure N 1 shows a test enclosure for built-in and integrated dishwashers.

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 – 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) within one week.

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). 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.

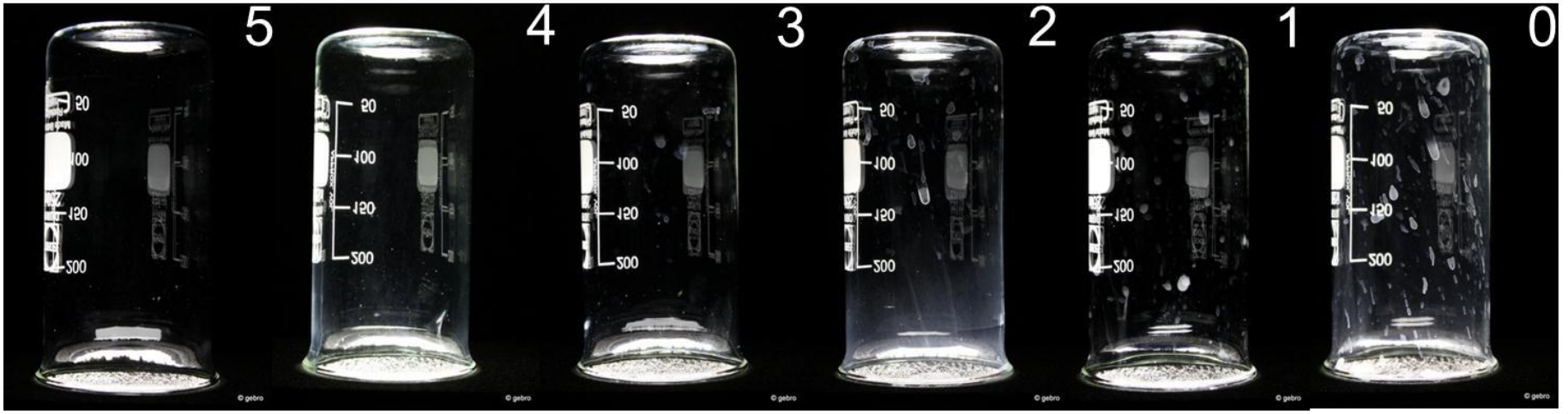
Use the photo catalogue (Figure Q.2) to assess the spots on the glasses.
The evaluation of the tableware shall be done using a light box with standardised conditions. The light box should be rectangular and open to the front with a black inside surface (Figure Q.1). It should be large enough to hold 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.

IEC

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.



IEC

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*

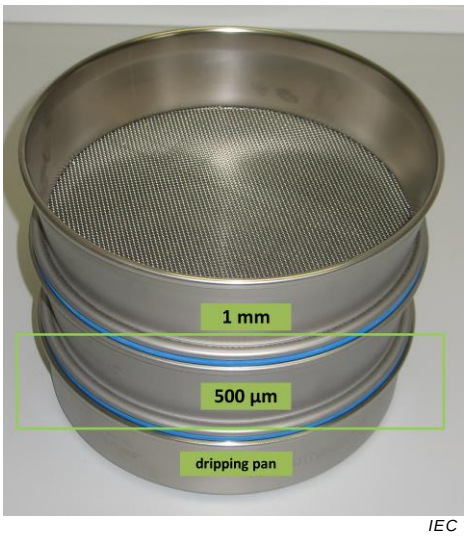
Natural caffeinated coffee shall be used. Coffee grounds should be purchased in the already ground condition and not ground by the laboratory. Dry, not brewed, coffee grounds are prepared and applied.

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.

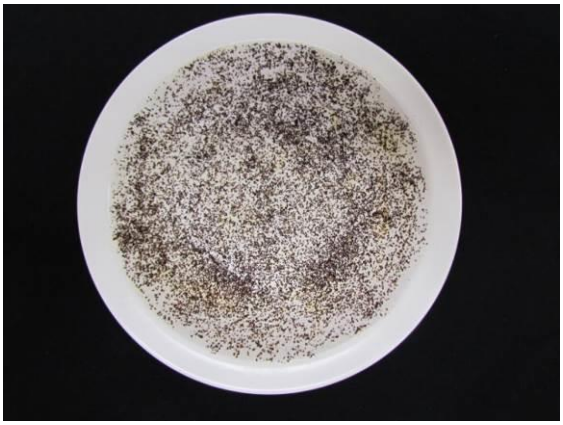
To gain the required sieve fraction, an analytical test sieve with a mesh size of 1 mm and a dripping pan is additionally required.

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:



IEC

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.3.3.4 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

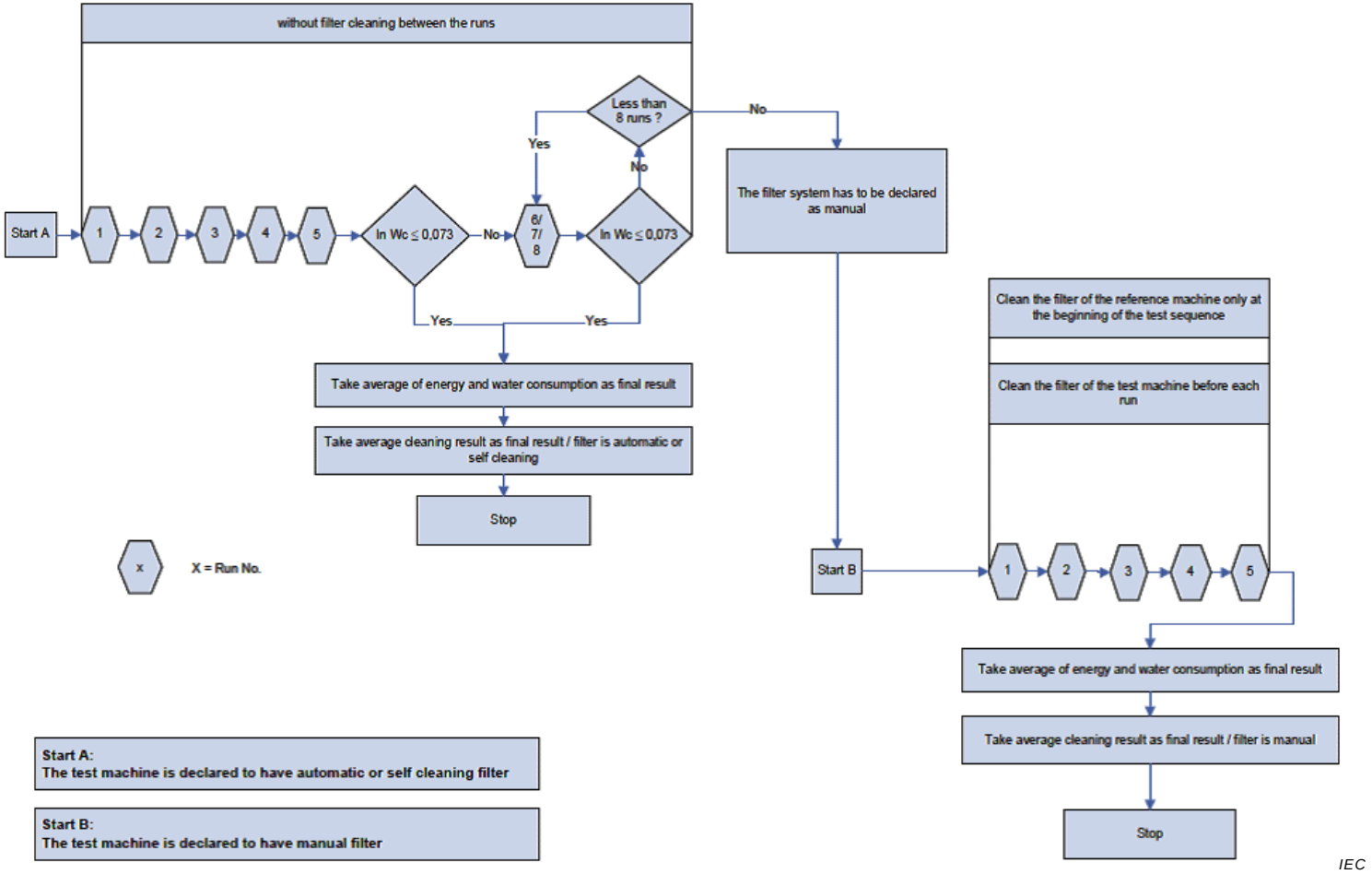
Table R.3 – Soil Application Quantities for Different Rated Dishwasher Capacities

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)
(*clause* 7.3.4)
FLOW CHART–EVALUATION OF FILTER SYSTEMS



ANNEX T
(normative)
(*clause* 8.1.1)
INSTRUMENTATION AND ACCURACY

Instruments used for this International Standard shall comply with the specifications set out in 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 programme mode power	W	Measurement instrumentation for off mode, left on mode, and end of programme mode power are described in IEC 62301.		

ANNEX U
(informative)
(*clause* 3.2.4, 8.1.2)
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 $(\sum (t_{Ci} \, x \, Q_{Ci})) / \sum Q_{Ci}$; (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:

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

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.

Annex V

(informative)

Testing intermittently recurring functions

V.1 GENERAL

Clause 8 describes how water and energy consumption and programme time shall be measured with the quantities relating to intermittently recurring functions excluded. This annex describes how water and energy consumption and programme time shall be measured when quantities relating to intermittently recurring functions (including softener regeneration) are to be included as described in 5.10.3 (ii).

In every case, the test series shall begin with 5 to 8 test runs as described in Clauses 6 to 8.The data from these test runs shall be used to determine cleaning performance, drying performance, and sump filter type (automatic or self-cleaning or manual).

It is possible that these initial 5 to 8 test runs could generate sufficient data for water and energy consumption and programme time to cover all the intermittently recurring functions of interest. In this case, no further testing will be necessary, and the data can be evaluated as described in V.3.

If additional test runs are necessary to generate the data needed to cover all the intermittently recurring functions of interest, then the test series shall be extended as described in V.2. The data shall then be evaluated as described in V.3.

V.2 TEST SERIES DESIGN

This clause applies when the test series needs to be extended so that it includes enough runs where each of the intermittently recurring functions occur in addition to runs where no intermittently recurring functions occur. The number of replicate runs needed for each function should normally be at least three, but can be higher or lower, depending on the statistical significance required in the final output and other factors, such as the number of replicate samples being tested in parallel. The test report shall include an explanation for the basis of the particular test design chosen.

When the number of replicate runs has been decided, an extension to the test series can be designed, which will deliver all the data needed to cover all the intermittently recurring functions of interest. Data provided by the manufacturer can be of help in predicting when specific intermittently recurring functions are likely to occur, and thus, how many runs will be needed overall.

The extension to the test series shall consist of either or both of the following two types of cycle:

• trigger cycles – test runs in which the intermittently recurring function of interest takes place;

• preparatory cycles – cycles which are used to bring the dishwasher to the condition inwhich the trigger cycle will occur on the subsequent test run.

Figure V.1 illustrates how a test series is designed.

For trigger cycles, the following rules apply:
• the dishwasher shall be allowed to cool to ambient conditions prior to the start of the cycle;
• the sump filter shall be cleaned before every test run;
• the dishwasher shall be loaded with a full clean standard load and ballast soil as described in Clause V.4;
• detergent, rinse aid and salt shall be used as specified in 5.7, 5.8 and 5.9;
• the reference machine does not need to be run in parallel with these cycles;
• data from these cycles shall not be used for assessing cleaning performance or drying performance;
• data from these cycles shall be reported and be used in the evaluation in Clause V.3.

For preparatory cycles, the following rules apply:
• the dishwasher does not need to be allowed to cool to ambient conditions prior to the start of the cycle;
• the sump filter shall be cleaned before every test run;
• the dishwasher shall be loaded with a full clean standard load and ballast soil as described in Clause V.4;
• detergent, rinse aid and salt shall be used as specified in 5.7, 5.8 and 5.9;
• the reference machine does not need to be run in parallel with these cycles;
• data from these cycles shall be reported but it shall not be used in any evaluation.

In all other respects, the procedures given in Clauses 1 to 5 shall be followed for both trigger cycles and preparatory cycles.

Details of all preparatory cycles and trigger cycles shall be described in the test report using the format given in Table V.2.

The design of the test series extension selected to address intermittently recurring functions shall be described in the test report.

The information provided by the manufacturer concerning intermittently recurring functions on which the test series extension is based shall also be included in the test report.

Data recorded for water and energy consumption and programme time for each trigger cycle shall be evaluated in accordance with Clause V.3.

V.3 Method of Evaluation

V.3.1 General

This method of evaluation applies only in cases where the test series design includes intermittently recurring functions.

Only data generated from testing in accordance with Clause 8 and from trigger cycles (in accordance with Annex V) shall be used for evaluation.

Using the energy consumption, the water consumption, and programme time generated from test runs and trigger runs in accordance with Clause 8 and Clause V.2, calculate the arithmetic mean of the measured values for each operating mode included in the test series. The mean values for each of the operating modes tested shall then be combined in a weighted mean. The weighting of the mean shall be based on the frequency of each individual operating mode.

For example, if the dishwasher is tested in 2 operating modes:
– operating mode 1 "with regeneration",
– and operating mode 2 "without regeneration",
and the frequency of regeneration is once in 3 cycles, then the weighted mean consumption is 2 × the mean consumption "without regeneration" plus 1 × the mean consumption "with regeneration" divided by 3.

Specific guidance is provided in V.3.2 to V.3.5.

V.3.2 Energy consumption

The weighted mean energy consumption and total energy consumption for each test run, trigger run, and each preparatory cycle shall be reported.

The weighted mean energy consumption shall be calculated from the energy consumption *E*e and the energy of the supplied hot water *E*h (if any) for every whole test run and trigger run as described in V.3.1 and reported.

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.

V.3.3 Hot water energy

Hot water energy shall be calculated in accordance with 8.2.3.

V.3.4 Water consumption

Total water consumption shall be reported for each test run and trigger run and each preparatory cycle.

The weighted mean water consumption shall be calculated from every whole test run and every trigger run as described in V.3.1 and reported.

V.3.5 Time
Programme time shall be measured from the initiation of the 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 ends when all activity ceases.

Total programme time shall be reported for each test run, trigger run and each preparatory cycle.

The weighted mean programme time shall be calculated from the programme time for every whole test run and trigger run, as described in V.3.1, and reported.

V.4 Ballast soil

V.4.1 Dose
Ballast soil shall be added to trigger test runs and preparatory cycles in the following quantities:
• rated dishwasher capacity of 10 or more place settings: 100 g;
• rated dishwasher capacity of less than 10 place settings: 60 g.

V.4.2 Preparation
Ballast soil shall be prepared using the items described in 6.3 as follows.

Add 150 g of oat flakes and 2 250 g of milk to 750 g boiling water. Stir and boil this mixture for 10 min.

Mix in 1 780 g egg yolk, 2 670 g of minced spinach, 890 g of margarine and 1 630 g of minced meat and simmer for 20 min, stirring regularly.

If necessary, top the mixture up to 10 kg using boiling water.

Pour appropriate portions of the mixture (see V.4.1) into plastic cups.

V.4.3 Storage
Store the cups of ballast soil at −18 °C for up to 12 months.

V.4.4 Application
Allow the cup of ballast soil to reach ambient temperature in accordance with 5.5.

Make two holes approximately 8 mm diameter in the wall of the cup, level with the top of the ballast soil. Place the cup of ballast soil upright as close as possible to the centre of the highest rack intended for supporting crockery in the dishwasher. If necessary, standard load items may be removed to create sufficient space for the cup.

NOTE— It is intended that the ballast soil cup will only release the ballast soil slowly as water from the dishwasher runs through the holes in the side. This should ensure that some soil persists beyond the end of any pre-wash operation into the main wash. Having the holes in the cup wall at the same level as the top of the ballast soil mixture means that the cup will not act to store process water from the dishwasher and should not therefore affect the consumption of water in the cycle.

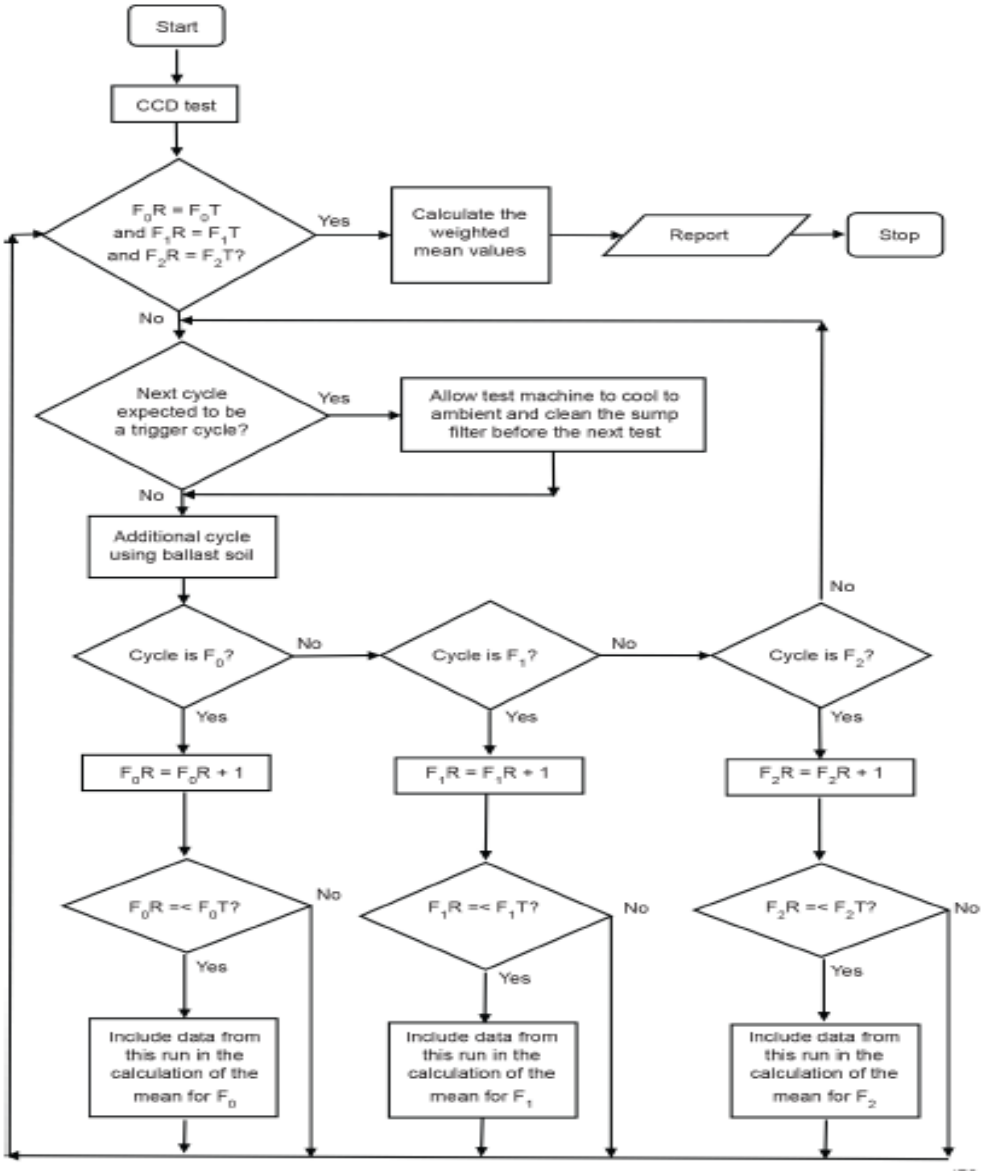


Fig. V.1 – Flow Chart Showing the General Test Design for Assessing Intermittently Recurring Functions

The following describes a test on a dishwasher which has a water softener and normally reuses the water from the final rinse but empties the storage tank for cleaning once every 5 runs.

The test objective is to determine consumption data for two intermittently recurring functions: F1 which is water softener regeneration, and F2 which is water tank cleaning.

Consumption data for when no intermittently recurring function occurs (F0) is also to be determined.

Let the total number of test runs to be carried out when intermittently recurring function F1 occurs be F1T.

Let the total number of test runs to be carried out when intermittently recurring function F2 occurs be F2T.

Let the total number of test runs to be carried out when no intermittently recurring function (F0) occurs be F0T.

F1T, F2T & F0T should be decided before the test series begins. They may be set by a regulator. They could be decided according to a required level of consistency.

In the flow chart in Figure V.1, the number of test runs completed for each intermittently recurring function is indicated by the symbols F1R, F2R and F0R.

The flow chart illustrates the process by which additional test runs are carried out to generate sufficient data to calculated weighted average values for the consumption data which include the impact of intermittently recurring functions.

The flow chart is a generalised example. It can be modified to accommodate fewer or extra intermittently recurring functions, as required.

Table V.1 – Intermittently Recurring Function Data Provided by the Manufacturer /Supplier

Test machine identification:				
Programme setting:				
Intermittently recurring function:	**Function 1**	**Function 2**	**Function 3**	**Example**
Name and general description of function				Water softener regeneration. Restores the softening function of the water softener.
Conditions under which the function normally occurs				When the dishwasher is set for use with water having a hardness of 2,5 mmol/l, regeneration takes place once for every 50 litres of water used. The regeneration event begins 60 minutes after the start of the programme and lasts for 12 minutes.
Declared impact on water consumption				Regeneration uses 5,4 litre.
Declared impact on programme duration				Regeneration increases programme duration by 12 minutes.
Declared impact on energy consumption				Regeneration does not increase energy consumption by more than 0,01 kWh.

Table V.2 – Record of Preparatory and Trigger Cycles Carried out Before and / or between Test Cycles

Laboratory identification						
Test/project reference						
Test dishwasher identification:						
Test run	Units	1	2	3	4	5
Test run type (T = Trigger, P = Preparatory)	T / P					
Date of test run	yy/mm/dd					
Time at start of test run	hh:mm					
Time at end of test run	hh:mm					
Energy consumption	kWh					
Water consumption	l					
Programme duration	min					