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Responsible committee: CPL/59/1 Dishwashers and washing machines

Interested committees:

Title: BS EN IEC 60436 Electric dishwashers for household use - Methods for measuring the performance

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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UK Vote

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx

1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex **(e.g. 3.1)**	Paragraph/Figure/ Table/Note	**Type of comment**	**Commend (justification for change) by the MB**	**Proposed change by the MB**	**Secretariat observations on each comment submitted**
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

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59A/261/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER: **IEC 60436 ED5**	
DATE OF CIRCULATION: **2024-04-05**	CLOSING DATE FOR VOTING: **2024-06-28**
SUPERSEDES DOCUMENTS: **59A/256/RR**	

IEC SC 59A : ELECTRIC DISHWASHERS

SECRETARIAT: China	SECRETARY: Ms Fang XU
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.

FUNCTIONS CONCERNED:

☐ EMC ☒ ENVIRONMENT ☒ QUALITY ASSURANCE ☐ SAFETY

☒ SUBMITTED FOR CENELEC PARALLEL VOTING **Attention IEC-CENELEC parallel voting** The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting. The CENELEC members are invited to vote through the CENELEC online voting system.	☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING

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Recipients of this document are invited to submit, with their comments, notification of any relevant “In Some Countries” clauses to be included should this proposal proceed. Recipients are reminded that the CDV stage is the final stage for submitting ISC clauses. (SEE AC/22/2007 OR NEW GUIDANCE DOC).

TITLE:

Electric dishwashers for household use - Methods for measuring the performance

PROPOSED STABILITY DATE: 2027

NOTE FROM TC/SC OFFICERS:

Dear National Committee members,

This new edition of IEC 60436 constitutes a major update in testing the performance of dishwashers.

For the past three years working and advisory groups of SC59A have been working pro-actively towards improving crucial aspects of the test procedure, resulting in the most consumer and market relevant as well as accurate test methods for electric dishwashers to date.

All new elements of the test procedures are not only aiming to ensure precise measurements but also balancing test

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SC59A welcomes feedback on the proposed standard and is looking forward to further advance it with your support.

Yours sincerely,

Krzysztof Wozny, Convenor MT2

Jane Xu, Secretary SC59A

Paul Richter, Chair SC59A

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

Electric dishwashers for household use - Methods for measuring the performance

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60436 has been prepared by subcommittee 59A: Electric dishwashers, of IEC technical committee 59: Performance of household electrical appliances.

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

10) Implementation of a new reference machine, which better reflects modern dishwasher energy and water saving technologies. Its ability to function as a reference machine for the cleaning assessment was assessed in a Round Robin Test.

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11) Implementation of the new reference detergent type E, which better reflects market detergents formulations. It includes upgraded enzymes and a lower content of silicates to reduce the alkalinity which simplifies the world wide transportation by avoiding dangerous goods labelling and therefore improves the usage all over the world.
12) Implementation of an alignment factor for the cleaning performance assessment as proposed in a scientific study done by a university to align test results of the previous version to the new version of this standard with the new reference system described above.
13) Introduction of replacements and alternatives for the pan and knives as the production of the current ones was stopped.
14) Improvement of the room temperature control due to a temperature measurement inside the dishwasher directly prior to the start of the test programme.
15) Update of the weight of different load items and the specified ranges to anneal the requirements in the standard to the actual weight of the items.
16) Introduction of an updated method to assess low power modes providing a step-by-step measurement description and including new modes e.g. network standby which are of increased importance for dishwasher offering additional services via internet connection. Additionally, reactions to different interactions with the appliance can be assessed in a better way and learnings of Round Robin Test are included.
17) The inclusion of additional method for dishwasher testing which allows the assessment of variations of dishwasher units from one model.
18) New requirements for the loading and handling instructions for tests institutes.
19) Implementation of testing methodology for multicompartment dishwashers
20) Improvement of ballast soil preparation process in Annex V

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

The committee has decided that the contents of the base publication and its amendment will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

NOTE: **The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.**

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INTRODUCTION

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

- Discussion began in fourth quarter of 2021 during one of the web conferences of Maintenance Team 2.
- A first working draft was developed and discussed during the Qingdao China meeting in September 2023.
- It was decided by SC 59A to proceed directly to CDV, skipping CD stage, due to urgency of implementation of the new detergent (3.1.23) E. This urgency is caused by production termination of enzymes used for detergent (3.1.23) D composition.
- Implementation of new reference system, the new reference detergent (3.1.23) and the new reference machine (3.1.6) , is done based on data coming from Round Robin Test conducted in 2022-2023.
- 19 web conferences and 1 F2F meeting of MT2 took place to develop CDV document.

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Electric dishwashers for household use - Methods for measuring the performance

1 Scope

This International Standard applies to electric dishwasher (3.1.1) 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 dishwasher (3.1.1) for household and similar use and to describe the standard methods of measuring these characteristics.

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

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. 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 62301:2011, *Household electrical appliances - Measurement of standby power*

IEC TS 63350, *Household electric appliances - Specification of the properties of a digital system for measuring the performance*

IEC 63474, *Electrical and electronic household and office equipment - Measurement of networked standby power consumption of edge equipment*

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

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

3 Terms, definitions and symbols

3.1 Terms and definitions

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

3.1.1

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dishwasher
machine that cleans, rinses and dries **tableware** (3.1.9) by chemical, mechanical, thermal, and electric means

Note 1 to entry:A **dishwasher** (3.1.1) can have a specific drying **operation** (3.1.13) at the end of the **programme** (3.1.14) .

Note 2 to entry:Different **dishwasher** (3.1.1) types are designated by manufacturers e.g. free-standing, built-in or integrated.

3.1.2
free-standing dishwasher
dishwasher (3.1.1) which is intended to be installed without an enclosing structure

3.1.3
built-in dishwasher
dishwasher (3.1.1) which is intended to be installed inside an enclosing structure such as a kitchen cupboard

3.1.4
integrated dishwasher
built-in dishwasher (3.1.3) which is designed to have a board fitted to the **dishwasher** (3.1.1) door

3.1.5
test machine
dishwasher (3.1.1) under test

3.1.6
reference machine
dishwasher (3.1.1) used to standardise cleaning and drying performance measurements

Note 1 to entry:Two **reference machine** (3.1.6) are specified for use in this standard (see Annex I and Annex W).

3.1.7
test run
single **programme** (3.1.14) performance assessment

3.1.8
test series
set of **test run** (3.1.7) which are collectively used to assess the performance

3.1.9
tableware
dishware, glassware, cutlery and **serving pieces** (3.1.11) used according to this standard to test a **dishwasher** (3.1.1)

3.1.10
place setting
set of **tableware** (3.1.9) for the use by one person, not including **serving pieces** (3.1.11)

Note 1 to entry:A **place setting** (3.1.10) is comprised of different items used for breakfast and lunch (type A); and dessert and dinner (type B).

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3.1.11
serving pieces
set of items for preparation and serving of food which can include pot and pan, serving bowls, serving cutlery and a platter

3.1.12
rated dishwasher capacity
whole number of **place setting** (3.1.10) together with the **serving pieces** (3.1.11) which can be cleaned and dried in one **cycle** (3.1.15) when loaded in accordance with the manufacturer's instructions

Note 1 to entry:The **rated dishwasher capacity** (3.1.12) is declared by the manufacturer and expressed as a number of **place setting** (3.1.10) .

3.1.13
operation
each event that occurs during the **dishwasher** (3.1.1) **programme** (3.1.14) such as cleaning, rinsing or drying

3.1.14
programme
series of **operation** (3.1.13) which are pre-defined within the **dishwasher** (3.1.1) 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** (3.1.14) indicator signals the end of the **programme** (3.1.14) and the user has access to the load.

3.1.15
cycle
complete cleaning, rinsing, and drying process, as defined by the **programme** (3.1.14) selected, consisting of a series of **operation** (3.1.13) until **all activity ceases** (3.1.39)

Note 1 to entry:The **cycle** (3.1.15) can be equal to or last longer than the **programme** (3.1.14) .

3.1.16
cycle time
length of time beginning with the initiation of the **cycle** (3.1.15) (of the selected **programme** (3.1.14)), excluding any user programmed delay, until **all activity ceases** (3.1.39)

3.1.17
programme time
length of time beginning with the initiation of the **programme** (3.1.14) , excluding any user-programmed delay, until an end of **programme** (3.1.14) indicator is activated and the user has access to the load

Note 1 to entry:If there is no end of **programme** (3.1.14) indicator, the **programme time** (3.1.17) is equal to the **cycle time** (3.1.16) .

3.1.18
automatic dispenser
device activated automatically which injects or dispenses **detergent** (3.1.23) or **rinse aid** (3.1.24) , one or more times into the **dishwasher** (3.1.1) at predetermined points in the **dishwasher** (3.1.1) **cycle** (3.1.15)

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3.1.19
non-automatic dispenser
device, usually a fixed cup or cavity on the **dishwasher** (3.1.1) door, cover, or **rack** (3.1.22) , which deposits a previously measured amount of **detergent** (3.1.23) or **rinse aid** (3.1.24) , into the **dishwasher** (3.1.1)

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** (3.1.20)

3.1.22
rack
support for holding dishware, cutlery, and/or glassware in the **dishwasher** (3.1.1)

3.1.23
detergent
cleaning agent for use in **dishwasher** (3.1.1) to aid in the removal of food soils by chemical means

Note 1 to entry:A reference **detergent** (3.1.23) 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** (3.1.13) to improve the drying effect and reduce water marks

Note 1 to entry:A reference **rinse aid** (3.1.24) is specified for use in this standard (see 5.8).

3.1.25
void

3.1.26
left-on mode
mode that begins as soon as the **dishwasher** (3.1.1) door has been opened and/or unlatched by the user after the completion of the **programme** (3.1.14) , 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** (3.1.27) .

Note 2 to entry:This mode can persist indefinitely or can be of limited duration if the **dishwasher** (3.1.1) is equipped with a **power management system** (3.1.34) .

3.1.27
off mode
condition in which the test **dishwasher** (3.1.1) is connected to the mains and is not providing any function

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Note 1 to entry:The following shall also be considered as **off mode** (3.1.27) :
a) conditions providing only an indication of **off mode** (3.1.27) ;
b) conditions providing only functionalities intended to ensure electromagnetic compatibility

3.1.28
network (3.1.28)
communication infrastructure with a topology of links, an architecture, including the physical components, organizational principles, communication procedures and formats (protocols)

3.1.29
standby mode
condition where the test **dishwasher** (3.1.1) is connected to the mains and provides only the following functions, which may persist for an indefinite time:
(a) reactivation function, or reactivation function and a mere indication of enabled reactivation function; and/or
(b) reactivation function through a connection to a
network (3.1.28)
(3.1.28) ; and/or
(c) information or status display; and/or
(d) detection function for emergency measures

3.1.30
standby mode in condition of networked standby
condition of networked standby means a condition where the household **dishwasher** (3.1.1) is connected to the mains and provides only the reactivation function through a connection to a
network (3.1.28)
(3.1.28) , which may persist for an indefinite time

Note 1 to entry:This mode is only applicable to **dishwasher** (3.1.1) that provide a connection function to a
network (3.1.28)
(3.1.28) .

3.1.31
delay start mode
condition where the user has selected a specified delay to the beginning of the selected **programme** (3.1.14)

Note 1 to entry:This mode is only applicable to **dishwasher** (3.1.1) that provide a delay start function for the user.

3.1.32
void

3.1.33
left-on mode duration
time from the start of **left-on mode** (3.1.26) until the **dishwasher** (3.1.1) reverts automatically to **off mode** (3.1.27)

Note 1 to entry:This time span is only applicable to **dishwasher** (3.1.1) equipped with **power management system** (3.1.34) .

3.1.34

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power management system
system within the **dishwasher** (3.1.1) which allows it to revert automatically to **off mode** (3.1.27) or **standby mode** (3.1.29) after the completion of the **programme** (3.1.14)

3.1.35
refrigerated
storage of foods at a temperature of (4 ± 3) °C

3.1.36
freeze
storage of foods at a temperature of (−18 ± 3) °C

3.1.37
automatic or self-cleaning filter
filter system which does not require frequent cleaning by the user

3.1.38
manual filter
filter system which requires cleaning by the user after each **cycle** (3.1.15)

3.1.39
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.

3.1.40
intermittently recurring function
function that occurs during some, but not all, series of **operation** (3.1.13) of a specific **programme** (3.1.14) (or **programme** (3.1.14)) and that is directly related to water-softening **operation** (3.1.13) , water-reuse **operation** (3.1.13) or similar **operation** (3.1.13) and that alters water consumption, energy consumption and/or **programme time** (3.1.17)

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*

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

N	the total number of scores for all items;
n	the number of combined cleaning and drying test run (3.1.7) ;
s_z	the total number of scores per item number;
$D_{R,z}$	the sum of drying scores of the reference machine (3.1.6) ;
$D_{T,z}$	the sum of drying scores of the test machine (3.1.5) ;
$D_{R,i}$	the average drying score for one test run (3.1.7) of the reference machine (3.1.6) ;
$D_{T,i}$	the average drying score for one test run (3.1.7) of the test machine (3.1.5) ;
$D_{R,t}$	the target drying score of the reference machine (3.1.6) ;
$ln\ P_{D,i}$	the logarithm of the drying performance index for one test run (3.1.7) of the test machine (3.1.5) ;
$ln\ P_D$	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 (3.1.8) .

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 run (3.1.7) ;
s_z	the total number of scores per item number;
$C_{R,z}$	the sum of cleaning scores of the reference machine (3.1.6) ;
$C_{T,z}$	the sum of cleaning scores of the test machine (3.1.5) ;
$C_{R,i}$	the average cleaning score for one test run (3.1.7) of the reference machine (3.1.6) ;
$C_{T,i}$	the average cleaning score for one test run (3.1.7) of the test machine (3.1.5) ;
$ln\ P_{c,i}$	the logarithm of the cleaning performance index for one test run (3.1.7) of the test machine (3.1.5) ;
$ln\ P_c$	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 (3.1.8) .
AF1	Alignment factor 1 for cleaning index:
AF2	Alignment factor 2 for cleaning index:

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

E_e	the electrical energy;
E_h	the hot water energy;
E_c	the cold water correction energy;
t_h	the volume-weighted average inlet temperature of all hot water;
t_{hi}	the temperature of each increment of hot water supplied to the test machine (3.1.5) ;
Q_{hi}	the volume of each increment of hot water supplied to the test machine (3.1.5) ;
Q_h	the volume of hot water supplied to the test machine (3.1.5) ;
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 (3.1.5) 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 (3.1.5) which is subsequently heated by the internal heater of the machine;
Q_c	the volume of the cold water supplied to the test machine (3.1.5) .
$E_{Regional\text{-}e}$	the estimated energy consumption for the dishwasher (3.1.1) for a cold water supply temperature of t_{nr};
$E_{IEC15\ °C\text{-}m}$	the measured energy for the dishwasher (3.1.1) in accordance with 8.2.2 with a cold water supply temperature of 15 °C;
t_{nr}	the nominal non-standard cold water temperature for the region;
Q_a	the cold water volume of all cold fills that occur in heated operation (3.1.13) ;
Q_b	the cold water volume of all cold fills for non-heated operation (3.1.13) , excluding any cold fills that occur after the last heated operation (3.1.13) ;
$E_{IEC15\ °C\text{-}e}$	the estimated energy for the dishwasher (3.1.1) with a cold water supply temperature of 15 °C;
$E_{Regional\text{-}m}$	the measured energy consumption for the dishwasher (3.1.1) 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 Clause 7;

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- energy consumption, water consumption and programme time (3.1.17) according to Clause 8;
- airborne acoustical noise according to Clause 9;
- additional aspects of energy consumption of dishwasher (3.1.1) (low power modes) according to Annex K.

5 General conditions for measurements

5.1 General

5.1.1 General information

The dishwasher (3.1.1) manufacturer's instructions regarding installation and use of the dishwasher (3.1.1) 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 (3.1.5) , including installation instructions, detergent (3.1.23) amounts, rinse aid (3.1.24) settings, water softener (3.1.20) settings (if applicable), filter type, loading schemes and any other information relevant to identifying intermittently recurring function (3.1.40) that may influence product consumption and performance (if applicable).

Performance tests according to this standard are generally carried out on a new machine, with a reference machine (3.1.6) running parallel with the test machine (3.1.5) (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 (3.1.6) shall be in accordance with the description given in Annex I or Annex W.

The reference machine (3.1.6) shall always be installed as a free-standing dishwasher (3.1.2) machine independent of the type of test machine (3.1.5) .

The same reference machine (3.1.6) shall be used for entire test series (3.1.8) .

Before commencing a test series (3.1.8) , the **reference** machine and the test machine (3.1.5) shall be checked to ensure that they are operating properly.

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

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

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

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

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

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5.1.2 Free standing dishwasher (3.1.1)

dishwasher (3.1.1) shall be tested as free-standing dishwasher (3.1.2) except where they are designated as **built-in** or **integrated** (refer to 5.1.3). dishwasher (3.1.1) that can be installed as either free-standing dishwasher (3.1.2) or **built-in/integrated** shall be tested as free-standing dishwasher (3.1.2) .

5.1.3 Built-in and integrated dishwasher (3.1.4)

dishwasher (3.1.1) 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 (3.1.5)

Before conducting performance tests on a new dishwasher (3.1.1) , it shall be operated for at least three cycle (3.1.15) , using a programme (3.1.14) suitable for normally or heavily soiled tableware (3.1.9) , with reference detergent (3.1.23) (specified in 5.7) and with reference rinse aid (3.1.24) (specified in 5.8), to remove manufacturing residue; a clean load or no load may be used.

NOTE: Any cycle (3.1.15) or operation (3.1.13) 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 cycle (3.1.15) shall be carried out on the test machine (3.1.5) 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 (3.1.7) or on separate test run (3.1.7) . The determination of energy consumption, water consumption and programme time (3.1.17) (Clause 8) shall be done concurrently with the combined cleaning and drying performance test (Clause 6 and Clause 7).

Manufacturers or suppliers may have information on the design and operation (3.1.13) of their dishwasher (3.1.1) which would allow an equivalent determination of the drying performance using an alternate method, for example, with unsoiled tableware (3.1.9) 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 (3.1.8) the **reference** machine and the test machine (3.1.5) shall be cleaned by operating for at least two cycle (3.1.15) in the test programme (3.1.14) with reference detergent (3.1.23) (specified in 5.7). Prior to starting a new test series (3.1.8) , 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 (3.1.1) , particular attention should be paid to accumulations in locations such as filters, sump, spray arms, door seals and rack (3.1.22) rails

If recommended by the manufacturer, adjust the water softener (3.1.20) and add salt as per 5.9.

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5.3 Electricity supply for machines

5.3.1 Electricity supply for test machine (3.1.5)

5.3.1.1 Voltage

The test voltage shall be set at the rated voltage of the test machine (3.1.5) 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 (3.1.5) 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 (3.1.6)

5.3.2.1 Voltage

The supply voltage shall be set at 230 V AC and maintained within ±1 % 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 (3.1.14)

The programme (3.1.14) to be tested for noise and performance measurements is typically the one recommended by the manufacturer for a normally soiled load.

Additional programme (3.1.14) may then be tested.

NOTE: In some countries the manufacturer has to declare the programme (3.1.14) to be used for the purpose of energy labelling (which may not be for a normally soiled load). In some countries the programme (3.1.14) is legislated and the rules for compliance have to be followed.

The same programme (3.1.14) shall be used for measuring the combined cleaning and drying performance according to Clause 6 and Clause 7; the energy consumption, water consumption and programme time (3.1.17) according to Clause 8; and the noise according to Clause 9, if tested.

The name of the programme (3.1.14) tested shall be reported.

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5.5 Ambient conditions

The following ambient conditions shall be maintained throughout the whole process described in Clause 6 and Clause 7. The conditions shall be reported.

- Ambient temperature of the room: (23 ± 2) °C
- Relative humidity: (55 ± 10) %

The temperature inside the reference machine (3.1.6) and test machine (3.1.5) with the tableware (3.1.9) items loaded shall be measured and recorded at a frequency of at least once per 10 seconds directly before the programme (3.1.14) start for a period of 5 min with a closed door. The temperature sensor shall be located at one of the front corners of the lowest available rack (3.1.22) . The programme (3.1.14) shall not be started until the temperature inside the machine is within the limit defined for ambient temperature of the room for the 5 min period. The minimum and maximum result during the 5 min shall be reported.

Record the temperature inside the machine for the whole run.

5.6 Water

5.6.1 General

5.6 describes the characteristics of the water supply to be connected to the dishwasher (3.1.1) 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.
- 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.

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For dishwasher (3.1.1) 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 (3.1.1) shall not exceed 250 ml. For dishwasher (3.1.1) 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 (3.1.1) 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 (3.1.1) , 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 dishwasher (3.1.1) that include a water supply line, or shall not exceed 400 ml for dishwasher (3.1.1) that do not include a water supply line.

The water supply system shall be configured so that throughout the programme (3.1.14) the measured temperature of all water entering the dishwasher (3.1.1) is within the specified tolerance.

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.

5.6.5 Additional water quality parameters

Metal ions, such as iron, copper, and manganese can impact cleaning performance by influencing the bleaching intensity. Also the chloride content of water for testing may be of relevance for testing dishwasher (3.1.1) . Therefore, it is recommended to not exceed following limits (see IEC 60734:2012 subclause 5.2, Table 3):

- Iron (Fe) < 0.1 mg/l
- Copper (Cu) < 0.05 mg/l
- Manganese (Mn) < 0.05 mg/l
- Chloride (Cl) < 4.5 mmol/l

Regularly, and at least every six months (e.g. in conjunction with specification check of the reference machine (3.1.6)), a check of the additional water quality parameters shall be undertaken. The measured metal ion and chloride content shall be reported.

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NOTE: Laboratories, in which the water for testing is exceeding any of the critical thresholds, should take corrective actions to minimize the impact on cleaning performance. The technical committee preparing this international standard is considering making above limits mandatory in the future.

5.7 Detergent

The reference detergent (3.1.23) E, as described in Annex E, from the same batch shall be used in the **reference** and test machine (3.1.5) throughout the whole test series (3.1.8) . The quantity of detergent (3.1.23) for one test run (3.1.7) shall be as recommended by the manufacturer, including the dosage of detergent (3.1.23) in different cycle (3.1.15) steps (e.g. main wash or pre-wash), but not more than

$$-8g + 0.5g per place setting loaded for dishwashers with a capacity of \geq 8 place setting -8g + 0.7g per place setting loaded for dishwashers with a capacity of < 8 place settings.$$

(1)

The total amount of detergent (3.1.23) stated above shall be used if no recommendation is given by the manufacturer.

The manufacturers recommendation regarding the dosage of detergent (3.1.23) in different cycle (3.1.15) steps e.g., main wash or pre-wash can be followed if the maximum amount is not exceeded.

The quantity of detergent (3.1.23) used during the tests shall be reported.

Refer to I.3.2 or W.3.2 for the amount of detergent (3.1.23) used in the reference machine (3.1.6) .

The detergent (3.1.23) shall be placed in the dishwasher (3.1.1) immediately prior to starting the programme (3.1.14) in the locations specified by the manufacturer. If a **dispenser** is fitted, some or all of the detergent (3.1.23) 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 (3.1.23) . In the absence of manufacturer's recommendations, the total amount of detergent (3.1.23) shall be placed in the main compartment of the **dispenser.**

Before use the detergent (3.1.23) shall be homogenized in accordance with ISO 607 (refer to Annex L for suitable equipment). This guarantees an even distribution of the detergent (3.1.23) components in the produced samples. The homogenisation process shall be documented in the test report.

The detergent (3.1.23) shall be stored in a waterproof container in quantities of no more than 1 kg at temperatures between 1° and 25° C. After first opening of the container it shall be stored tightly closed at ambient temperature of (23 ± 2) °C and relative humidity not exceeding 65%. It shall be used within six months after production date.

5.8 Rinse aid

The rinse aid (3.1.24) Formula "III", as described in Annex E, shall be used.

For dishwasher (3.1.1) with an adjustable automatic dispenser (3.1.18) , 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 (3.1.24) .

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

For machines without automatic dispenser (3.1.18) , the rinse aid (3.1.24) shall be added manually, if so recommended by the manufacturer and in accordance with their instructions.

5.9 Salt

If the dishwasher (3.1.1) is equipped with a water softener (3.1.20) that requires salt, fill the salt reservoir in accordance with the manufacturer's instructions. For specification of the salt, see Annex E.

For dishwasher (3.1.1) with an adjustable water softener (3.1.20) , 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 function (3.1.40) that relate to the programme (3.1.14) selected for testing. This data shall include details of changes to energy consumption, water consumption and programme (3.1.14) duration that are caused by each intermittently recurring function (3.1.40) . The data shall also include a description of the conditions that trigger each intermittently recurring function (3.1.40) . An example of a format for describing intermittently recurring function (3.1.40) is shown in Table V.1.

If no data is provided by the manufacturer or supplier, intermittently recurring function (3.1.40) may take place during valid test cycle (3.1.15) 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 function (3.1.40) 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 function (3.1.40) on reproducibility and the validity of test results

When a dishwasher (3.1.1) is tested over a test series (3.1.8) of 5 to 8 test run (3.1.7) , intermittently recurring function (3.1.40) may cause the results to be different to the true long-term average. For example, if the dishwasher (3.1.1) regenerates its softener every 3 cycle (3.1.15) and uses a significant amount of water to regenerate, the average water consumption for the test series (3.1.8) would be higher if two regeneration (3.1.21) occurred than if only one occurred in the test series (3.1.8) . 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.

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5.10.3 Treatment of intermittently recurring function (3.1.40)

For dishwasher (3.1.1) with intermittently recurring function (3.1.40) , testing can be conducted according to one of the following two options:

i) Excluding consumption data from test run (3.1.7) where the intermittently recurring function (3.1.40) 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 (3.1.40) (s).

ii) Extending the test series (3.1.8) as necessary to include a suitable number of test run (3.1.7) where the intermittently recurring function (3.1.40) does not take place and a suitable number of test run (3.1.7) where intermittently recurring function (3.1.40) does take place. From such a test series (3.1.8) , 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 (3.1.40) (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 setting (3.1.10) and serving pieces (3.1.11) .

The tests are carried out in parallel with either the reference machine (3.1.6) specified in Annex I or Annex W; under conditions described in Clause 5. The **reference** machine and the test machine (3.1.5) 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 (3.1.9) 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 machine (3.1.6) and the test machine (3.1.5) 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).

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6.2 Load

6.2.1 Composition of the test load

The test load shall comprise specific numbers of each tableware (3.1.9) item according to the rated capacity of the test machine (3.1.5) as described in Annex A. The physical condition of the tableware (3.1.9) items shall meet the description in Annex A.

Alternative items in the test load shall be the same in the reference machine (3.1.6) and the test machine (3.1.5) .

6.2.2 Requirements for pre-conditioning of new tableware (3.1.9)

New tableware (3.1.9) items shall be pre-conditioned by washing them for three cycle (3.1.15) using detergent (3.1.23) (specified in 5.7) and rinse aid (3.1.24) (specified in 5.8). Use a dishwasher (3.1.1) , other than the test machine (3.1.5) or the reference machine (3.1.6) (s), with a programme (3.1.14) suitable for normally or heavily soiled tableware (3.1.9) .

6.2.3 Requirements for conditioning of tableware (3.1.9)

All tableware (3.1.9) items shall be clean, dry and conditioned prior to the test run (3.1.7) . In this case ‘clean’ means that an item would score 5 if assessed according to Clause 7 and ‘dry’ means that an item would score 2 if assessed according to Clause 7.

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

The tableware (3.1.9) items shall be conditioned in a dishwasher (3.1.1) using detergent (3.1.23) ; the type of detergent (3.1.23) specified in 5.7 is recommended but not required. The dishwasher (3.1.1) shall dispense rinse aid (3.1.24) (specified in 5.8) in the final operation (3.1.13) prior to the next test. Use a dishwasher (3.1.1) , other than the test machine (3.1.5) or the reference machine (3.1.6) , with a programme (3.1.14) which has a cleaning performance equal to or better than that of the reference machine (3.1.6) .

6.2.4 Requirements for re-conditioning tableware (3.1.9)

A film or scale may accumulate on the surface of the tableware (3.1.9) 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 (3.1.9) in a dishwasher (3.1.1) other than the test machine (3.1.5) or the **reference machine(s)**.
- Run a programme (3.1.14) in which the detergent (3.1.23) is substituted with 30 g anhydrous citric acid (for the supplier see Annex L) and rinse aid (3.1.24) specified in 5.8 is dispensed as normal. Use a programme (3.1.14) which has a cleaning performance equal to or better than that of the reference machine (3.1.6) .

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- Inspect and condition the tableware (3.1.9) 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 machine (3.1.5) , for one test series (3.1.8) , 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

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 (3.1.9) items shall be done within 12 consecutive hours, with prepared soils refrigerated (3.1.35) in air tight containers prior to usage except where specified otherwise.

Based on the number of place setting (3.1.10) , calculate the total weight of soil that will be needed (grams/item × number of tableware (3.1.9) 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.

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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 (3.1.9) 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 (3.1.35) 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 (3.1.35) 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.

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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, gently shake the milk for approximately 5 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 (3.1.35) 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 F.2.

During each cooking operation (3.1.13) 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 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.

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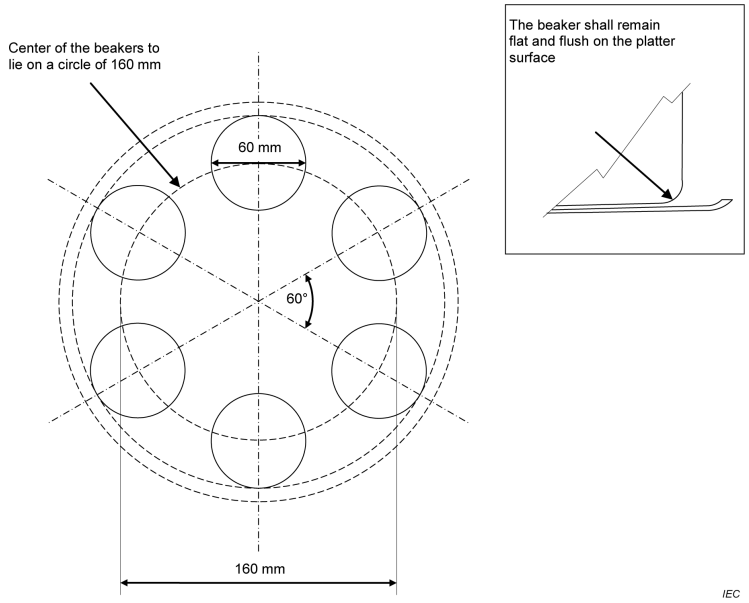


Figure 1 – Position of the glasses on the microwave turntable

6.4.3 Tea

6.4.3.1 General

Use tea with the following characteristics:

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

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

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

6.4.3.2 Preparation

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

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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: 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 (3.1.9) items into the thermal cabinet. Refer to Figure 2 for loading tableware (3.1.9) items.
- Close the doors and switch on the power of the thermal cabinet.
- This procedure shall be completed in 3 min.

The tableware (3.1.9) items shall remain in the thermal cabinet for a period of 1 h after the power of the thermal cabinet is switched back on. After this pre-drying period proceed as described in 6.5.2.

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

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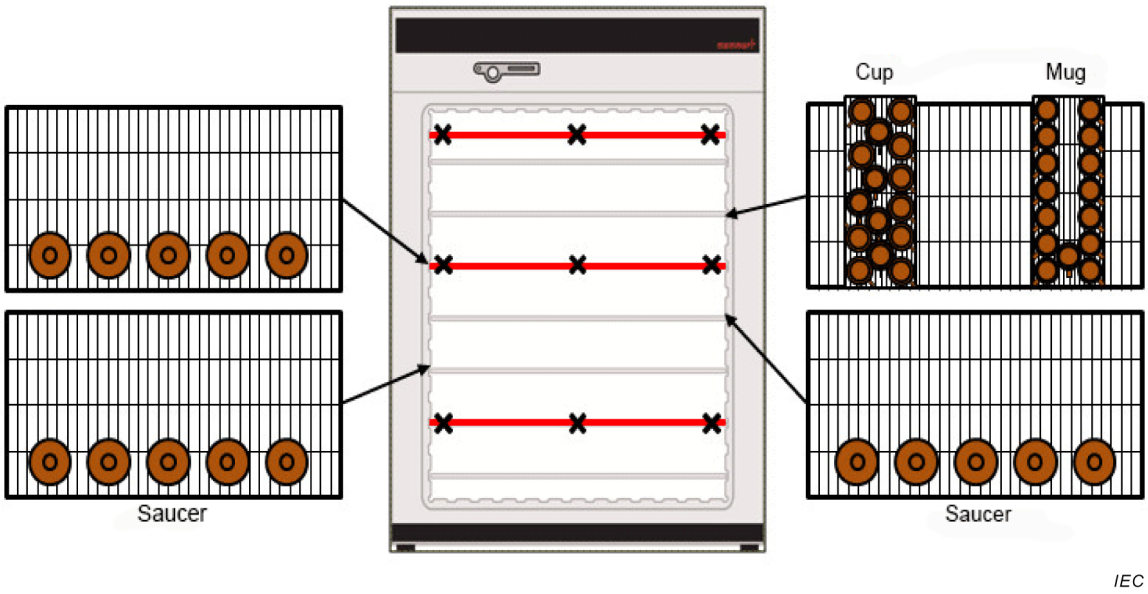


Figure 2 – The thermal cabinet for pre-drying of soiled cups, mugs and saucers

6.4.3.5 Pre-drying for air drying method

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

6.4.4 Minced meat

6.4.4.1 General

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

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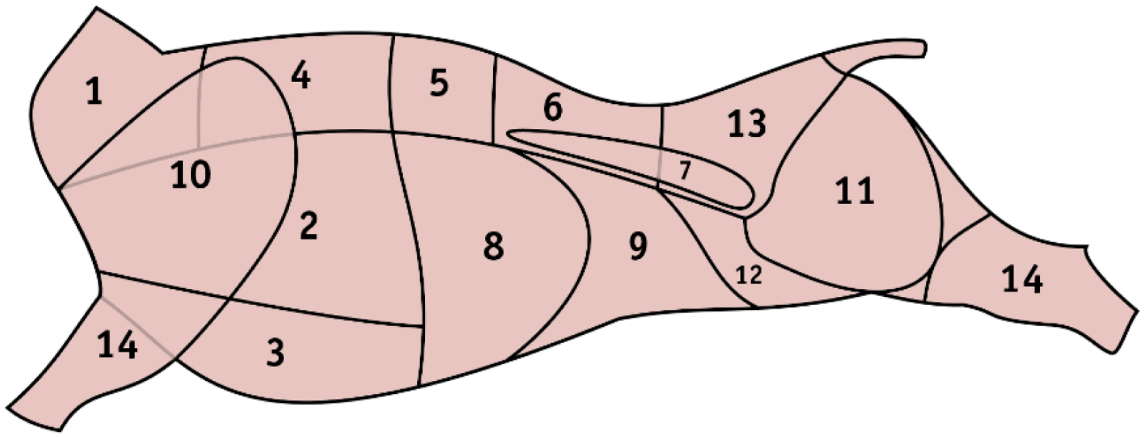


Figure 3 – Schematic view of the different beef pieces

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

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

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

6.4.4.2 Preparation and Storage

Mix 50 g of whisked whole egg (see 6.4.5) to every 150 g minced meat (see 6.4.4). Mix well and divide into 20 g, or multiple of 20 g, portions. Store the portions in watertight containers and freeze (3.1.36) . 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 pan with minced meat mixture.

- 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 pan.

- Method of soiling:

  Refer to 6.4.1 and use a plastic fork as an application tool.

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- 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 pan:

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

NOTE: Alternatives to single-use plastic forks are available. It is expected to use an alternative with soft and flexible prongs to minimize the risk of scratching of dish load items.

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 (3.1.35) until required. Eggs shall be at ambient temperature prior to use.

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

6.4.5.2 Preparation

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

6.4.5.3 Application

- Items to be soiled:

  Soil the melamine dessert plates, the dinner plates and the forks with egg yolk.

- Quantity of soil:

  Calculate the total amount of soil to be applied to all the items to be soiled for each item type

  A_t as follows:

$$A_t = N_t \times M_t \quad (2)$$

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

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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. 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.

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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 spoonbowl 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 (3.1.5) 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. The spinach shall be passed through the grinder once.

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.

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After mincing, the spinach may be freeze (3.1.36) -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.

NOTE: Alternatives to single-use plastic forks are available. It is expected to use an alternative with soft and flexible prongs to minimize the risk of scratching of dish load items.

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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 1: Unsaturated fats include trans fats.

NOTE 2: The proportions of each type of fatty acid refer to the fraction of the total fat content, not as a proportion of the total ingredients. For example, a margarine with a saturated fatty acids content of 18 % of the total ingredients in a product with a total fat content of 70 % of the total ingredients has a proportion of saturated fatty acids of 26 %, which is within the range of (33 ± 11) %.

6.4.8.2 Preparation and storage

The margarine shall be refrigerated (3.1.35) 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 (3.1.7) (6.6.1) and then place the melamine bowls into the machine.

6.5 Drying of the soiled tableware (3.1.9) items

6.5.1 General

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

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6.5.2 Oven drying method

All tableware (3.1.9) 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 setting (3.1.10) according to Figure 4. If necessary additional unsoiled tableware (3.1.9) items shall be included to ensure that the thermal cabinet is fully loaded.

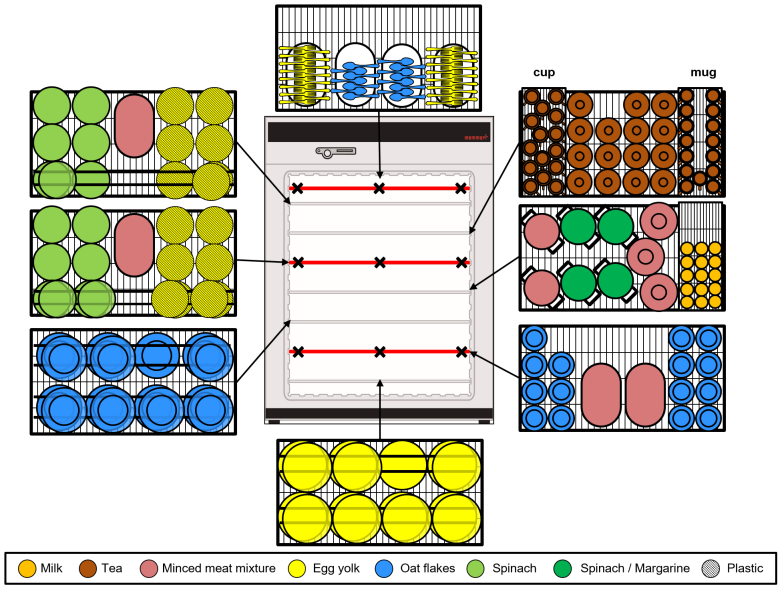


Figure 4 – The thermal cabinet with soiled load items (30 place setting (3.1.10))

NOTE 1: Different machines with different capacities require a different number of special items (pot and pan, 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 (3.1.9) 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 (3.1.9) items into the thermal cabinet according to Figure 4.
- Close the doors and switch on the power of the thermal cabinet.
- This procedure shall be completed in 10 min.

The tableware (3.1.9) 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 (3.1.9) 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 (3.1.1) rack (3.1.22) to cool, but the rack (3.1.22) shall remain outside the opened dishwasher (3.1.1) .

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Soiled tableware (3.1.9) 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. Subclause 5.1.1 requires that soils prepared at the same time and from the same batch are used for reference machine (3.1.6) and test machine (3.1.5) . The soiled tableware (3.1.9) shall not be stored in a dishwasher (3.1.1) .

NOTE 2: Storing the soiled tableware (3.1.9) in dishwasher (3.1.1) rack (3.1.22) on an open dishwasher (3.1.1) door is allowed.

NOTE 3: The opaque plastic cover is used to limit air circulation and avoid dust particles falling on the stored tableware (3.1.9) items.

6.5.3 Air drying method

All tableware (3.1.9) items soiled according to 6.4, except the melamine bowls, shall be dried according to the procedure described below.

All soiled tableware (3.1.9) 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 (3.1.9) 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 (3.1.1) rack (3.1.22) (see 6.6.1) with the rack (3.1.22) still in the dishwasher (3.1.1) – in this case, the dishwasher (3.1.1) door shall be open and the rack (3.1.22) pulled out; or
- loaded into the dishwasher (3.1.1) rack (3.1.22) (see 6.6.1) which have been placed on a level surface – in this case, a tray shall be placed under the rack (3.1.22) and any soil that falls into the tray shall be placed on the dishwasher (3.1.1) door before the programme (3.1.14) 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 (3.1.1) 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 rack (3.1.22) inside the **reference** machine and the test machine (3.1.5) 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 (3.1.1) shall be loaded in accordance with I.5 or W.5.

If the mugs, cups and saucers have been air dried, collect the remaining tea from them before placing these items in the dish rack (3.1.22) . Place the tea on the floor of the **reference** machine and the test machine (3.1.5) just before the start of the test **run**.

Any soil particles that fall from the load items while they are being placed in the dish rack (3.1.22) shall be placed on the internal surface of the door of the **reference** machine and the test machine (3.1.5) before it is closed prior to the start of the test **run**.

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6.6.2 Operating

During the performance tests, the starting of the machines can have to be staggered to ensure that there is enough time for a single assessor to assess the performance of each machine at the prescribed time after its programme (3.1.14) finishes. However, test machine (3.1.5) shall run at the same time as part of the reference machine (3.1.6) programme (3.1.14) .

Before the machines start, place the detergent (3.1.23) according to 5.7.

If the test machine (3.1.5) is identified as having a manual filter (3.1.38) system according to 7.3.3, perform five combined cleaning and drying test run (3.1.7) of the test programme (3.1.14) , cleaning the test machine (3.1.5) filters between the measurements.

If the test machine (3.1.5) is identified as having an **automatic** or **self-cleaning filter** system according to 7.3.4, perform 5 combined cleaning and drying test run (3.1.7) of the test programme (3.1.14) , without cleaning the dishwasher (3.1.1) filters between the measurements. If necessary, increase the number of combined cleaning and drying test run (3.1.7) 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 run (3.1.7) , all without cleaning the dishwasher (3.1.1) filters between measurements.

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

Continue to perform the combined cleaning and drying test until both ln W_C and ln W_D values are satisfied or eight test run (3.1.7) have been completed. These respective numbers of test run (3.1.7) s in the test series (3.1.8) may be different between the cleaning and drying evaluation.

The filter of the reference machine (3.1.6) shall only be cleaned prior to the start of a new test series (3.1.8) and not between successive test run (3.1.7) in a test series (3.1.8) .

Between two successive test run (3.1.7) in a test series (3.1.8) , machines shall be allowed to cool down until they meet the ambient temperature requirements of 5.5. The maximum time between successive test run (3.1.7) in a test series (3.1.8) shall not exceed 4 days.

At the completion of the test programme (3.1.14) , the door shall be left undisturbed until commencing the evaluation procedure according to 7.2.2.

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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 (3.1.7) the drying assessment of the test machine (3.1.5) , including the evaluation of the reference machine (3.1.6) , 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 (3.1.1) , with or without a separate cutlery rack (3.1.22) (not combined with any other rack (3.1.22)), 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 (3.1.9) 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 (3.1.11) or other parts of the cutlery are positioned in any rack (3.1.22) which is not designed exclusively for cutlery, their drying performance shall be evaluated with the other items of the rack (3.1.22) .

A partial or complete wet rim (not a drop or streak) around soil residue adhered to the surface of the tableware (3.1.9) 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 test run (3.1.7) .

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

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