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Electric dishwashers for commercial use — Test methods for measuring the performance

bsi.

National foreword

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Elektrische Geschirrspüler für den gewerblichen Gebrauch - Messverfahren für Gebrauchseigenschaften

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European foreword

This document (EN 50593:2017) has been prepared by CLC/TC 59X “Performance of household and similar electrical appliances”.

The following dates are fixed:

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1 Scope

This European Standard applies for manually loaded undercounter one-tank and one-tank hood type electrically heated dishwashing machines for washing plates, dishes, glassware, cutlery and similar articles.

These machines are used in commercial kitchens, such as restaurants, canteens, hospitals and in businesses such as bakeries, butcher shops, etc.

This European Standard does not apply to commercial dishwashers with transport systems (flight-type and rack conveyor dishwashers) and utensil washers.

This European Standard does not apply to undercounter water-change dishwashers.

This European Standard does not apply to appliances designed exclusively for industrial purposes.

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

The characteristics are measured by washing plates.

This European Standard does not address safety requirements.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for the application 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.

EN 10088 (all parts), *Stainless steels*

3 Terms and definitions

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

NOTE The following definitions are related to the appliance.

3.1
commercial dishwasher
electric dishwasher which is specially designed for use in commercial environment and which cleans and rinses dishes, glasses, cutlery, and, in some cases, cooking utensils by chemical, mechanical, thermal and electrical treatment

Note 1 to entry: Commercial dishwashers evaluated with a specific drying operation at the end of the programme should be declared as such in the test report.

3.1.1
under counter one tank dishwasher
manually loaded, programmable, undercounter front loader with one detergent-circulating zone and a fresh water rinse

Note 1 to entry: The washware is cleaned using a detergent solution that is regenerated. The technical equipment is geared to the performance that is required in the specific application.

3.1.2
hood-type dishwasher
manually loaded, programmable, hood-type, pass-through machine with typically one detergent-circulating zone and a fresh water rinse

3.2
operation
event that occurs during the dishwasher programme such as cleaning and rinsing

3.3
programme
series of operations which are pre-defined within the dishwasher and which are declared by the manufacturer as suitable for cleaning certain washware

3.4
cycle
complete cleaning process, as defined by the programme selected, consisting of a series of operations (washing, rinsing, drying etc.) and including any operations that occur after the completion of the programme

Note 1 to entry: Examples of **operations** that may occur after the completion of the **programme** are refilling of the boiler, heating, pumps, fans, etc.

3.5
programme time
time which is measured from the initiation of the programme (excluding any user programmed delay) until an end of programme indicator is showing the end of the programme

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

3.6
cycle time
time which is measured from the initiation of the programme (excluding any user programmed delay) until all activity ceases (i.e. the end of the cycle)

3.7
automatic dispenser
device activated automatically which injects or dispenses detergent or rinse agent one or more times into the dishwasher at predetermined points in the dishwasher cycle

3.8
ready-to-use mode
mode after which the dishwasher has been filled with water, the water has been heated (ready for operation) and the machine is ready to start the cycle as indicated in the instructions for use

3.9
rack
removable support for holding washware in the dishwasher

3.10
energy consuming element
electrical consumer (e.g. heaters, fans, pumps, etc.) in the dishwasher

Note 1 to entry: The control system is not considered as an energy consuming element.

3.11
washware
materials and utensils that come into contact with foodstuffs and re-usable crates/containers which are cleaned in a commercial dishwasher

Note 1 to entry: Examples of washware are plates, crockery, cutlery, kitchen equipment, glasses, pots, containers, crates and trays made of materials such as porcelain, plastic, glass, stainless steel and silver as well as coated materials.

3.12
treating agents
chemical products used to clean or rinse, as rinse aids or descalers, when treating washware in dishwashers

3.12.1
detergent
chemical product used to remove soiling from washware and which counteracts resoiling from the detergent solution

3.12.2
detergent solution
water mixed with detergent in the detergent circulation tank

3.12.3
rinse aid
chemical agent added to the water in the final rinsing operation which decreases the interfacial tension of the rinse aid solution

Note 1 to entry: It improves the drying effect and the reduction of water marks.

3.12.4
rinse aid solution
fresh water mixed with rinse aid used for fresh water rinsing

3.13
pre-cleaning
removal of loose waste and leftover food on the washware and emptying of hollow vessels

Note 1 to entry: Pre-cleaning is generally implemented by pushing the residue into waste containers and – if possible – by rinsing the washware with water. Pre-cleaning reduces the soiling of the dishwasher and improves the cleaning result.

3.14
ballast soil
artificial soil for testing certain machine characteristics

3.15
fresh water rinsing
washing process after cleaning during which the washware is sprayed with a rinse aid solution to remove residues of detergent solution, dissolved and undissolved dirt particles

3.16
drying
process in which the moisture drips, vaporises or evaporates from the surface of the washware

3.17
cleaning
removal of soiling

3.18
re-soiling
soiling of the washware e.g. on the rear side of the washware by the cleaning process which causes a deterioration of the cleaning result

3.19
contact time
time during which the detergent solution is in contact with the washware

3.20
cleaning process
process including at least one washing process and one fresh water rinsing process

3.21
operating time
period during which the dishwasher is operational

3.22
spray system
sum of all pipelines, jets and spray pipes required to circulate and spray detergent and rinse aid solutions

3.23
water softener
device which reduces the hardness of water

3.24
start-up time
time needed for the initial fill

3.25
initial fill
first water filling process between activation of the machine and reaching the ready-to-use mode

4 List of measurements

The performance and consumption characteristics are determined as follows:

— cleaning and resoiling performance test according to Clause 6;

— energy, water consumption and time measurement according to Clause 7.

Rinsing performance measurement is under consideration.

5 General conditions for measurements

5.1 General

The dishwasher manufacturer's instructions regarding installation and use of the commercial dishwasher shall be followed, except if they stand in conflict. In this case this standard shall prevail.

The cleaning and resoiling performance test according to Clause 6 and the energy and water consumption and time measurement according to Clause 7 are done together.

Note: deactivate the automatic start for appliances with automatic start cycle when the door/hood is closed.

All testing shall be performed on the same machine.

Before commencing measurements, the commercial dishwasher shall be checked to ensure that it is operating properly.

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

For all tests, the appliance shall be free-standing in the room without any excess coverage other than originally equipped. All protective surface cover foils shall be removed.

5.2 Conditioning of the machine under test and sequence of test procedures

Before conducting the performance tests, the dishwasher shall be initially filled and dosed with reference detergent (specified in 5.7) and reference rinse aid (specified in 5.8). No additional cycles shall be carried out on the machine under test between the consecutive steps of the following procedures. All parts of the machine shall be inspected and any residues shall be removed.

5.3 Power supply

In every case the appliance is supplied at 230 V or 400 V and 50 Hz.

The tolerance on power supply shall be ± 1 % for voltage and ± 1 % for frequency.

The voltage and frequency shall be measured and recorded during the test.

5.4 Test programme

The programme to be tested shall be the one which cleans normally soiled washware (standard cleaning cycle).

The manufacturer shall declare the programme to be used for testing.

5.5 Ambient conditions

The following ambient conditions shall be maintained throughout the measurements.

—	ambient temperature of the room:	**(23 ± 2)**	°C;
—	relative humidity:	**(55 ± 5)**	% rH;
—	air velocity max:	**1**	m/s.

The limit value for the air velocity shall only apply to the room area where the drying of the soiled plates is carried out (see 6.2.3).

The ambient temperature and the relative humidity shall be measured and recorded during the test.

5.6 Water supply

5.6.1 General

The actual water temperature and pressure maintained during the tests shall be measured and recorded. The maintained water hardness shall be measured.

5.6.2 Water supply – Temperature

The temperature of the supply water shall be (15 ± 2) °C.

5.6.3 Hardness

If the dishwasher is fitted with an integrated water softening unit, it shall be deactivated (set to soft water supply). During testing, soft water with a water hardness of < 3°dH or a total hardness of (Ca^{2+} + Mg^{2+}) < 0,54 mmol/l shall be used.

NOTE Procedures to reach a defined hardness of water are described in e.g. EN 60734.

5.6.4 Water Pressure

The flow pressure of the water supply shall be set to 240 kPa and shall be maintained within the range ± 20 kPa.

If it is not possible to maintain the pressure within this range a flow rate of (15 ± 2) l/min shall be maintained.

5.7 Detergent

For the tests solely the reference detergent, shall be used (see A.1).

The concentration shall be (3 ± 0,3) g/l for the tests.

The amount of detergent shall be calculated by the given concentration and the measured water consumption of the previous operation.

The detergent shall be added by hand directly into the wash chamber.

Detergent from the same batch shall be used for the dishwasher under test.

The detergent manufacturer's specifications regarding storage and handling shall be observed.

5.8 Rinse aid

For the tests solely the reference rinse aid shall be used (see A.2).

The dosing is done according to manufacturer's instruction

The concentration shall be set according the manufacturer's instruction.

Rinse aid from the same batch shall be used for the dishwasher under test.

The rinse aid manufacturer's specifications regarding storage and handling shall be observed.

5.9 Load

The load is a rack for the appliance under test defined in A.4.

The rack is loaded in accordance with the manufacturer's instructions. The washware used for the test purpose are defined in A.4.

Only washware with no visible damage on the surface, e.g. scratches or similar damages, and free of any residues shall be used.

5.10 Temperature measurement

The temperature shall be measured every second and recorded during the cycle and reported.

The last rack used in the conditioning cycles with ballast soil (7.2.4) is equipped with a temperature probe (Accuracy ± 2K) positioned in the centre of the upper surface of stainless steel support fixed on the holder (see A.6), exact position first row on the left hand side in the front of the rack.

6 Cleaning and resoiling performance test

6.1 Purpose and general description

The purpose of this test is to evaluate the cleaning and resoiling performance and is performed together with the energy and water consumption and time measurement, as described under 7.2.4.

The procedure consists of the removal of the test soiling, applied in the form of 33 soil dots per plate. After dot application the plates are air-dried under ambient conditions as defined under 5.5.

To evaluate performance degradation during continuous operation, particles according to 6.2.2.3 are added directly into the wash tank before the machine cycle starts. For statistical plausibility, in total five cycles shall be done in the preconditioned dishwasher using the described cleaning solution and standard dishwasher manufacturer settings. The plates are evaluated by visual inspection at the end of the procedure. The number of not completely removed soil dots, as well as the number of remaining sesame seed particles on the plates, are counted and statistically analysed as described in the following procedure.

In case more than one rack is cleaned in one cycle, parameters referring to the number of racks involved shall be considered accordingly.

6.2 Description of the cleaning performance test procedure

6.2.1 Preparation

6.2.1.1 Basic cleaning of plates (if new plates are used, follow procedure 6.2.1.2)

Before each test, all plates need to be pre-treated with the basic cleaning procedure. Plates are pre-soaked using the basic cleaning detergent (see A.3) with a dosage of 300 g ± 5 % per 10 l of fresh water at a temperature of 50 °C to 65 °C. The plates shall be pre-soaked for at least 20 min followed by manual pre-scrapping, if needed, so that the soil or other residues are completely removed from the plate surface. In order to ensure a complete removal of the basic detergent after basic plate cleaning, all plates shall be rinsed with fresh water and washed in a dishwasher for two cycles. Only demineralized water (no chemicals) shall be used for the dishwasher.

After basic cleaning, the plates need to be completely air-dried and cooled down to ambient temperature.

An alternative procedure can be applied if the same result is obtained (see 6.2.3).

Only completely dry plates at ambient conditions shall be used for the test.

6.2.1.2 Basic cleaning of new plates

If new plates are used for the test, the following procedure shall be applied: The basic cleaning detergent (see A.3) with a dosage of 300 g ± 5 % per 10l tank volume shall be used. The detergent is directly added into the wash tank. The new plates shall then be washed for 10 subsequent cycles in the dishwasher with a wash temperature of 60 °C to 65°C and a rinse temperature of 80 °C to 85 °C. Load the rack with new plates, put it into the dishwasher and start the subsequent cycles. When the 10 cycles are finished, drain the dishwasher and refill it with fresh demineralized water. In order to remove any detergent residues, the dishwasher shall then be run for one complete cycle with a cycle time ≥ 180 s without the use of any chemicals.

6.2.1.3 Dishwasher

The dishwasher shall be preconditioned according to the standard measuring procedure as described in 7.2.4.

6.2.1.4 Template for dot application

Dimensions in millimetres

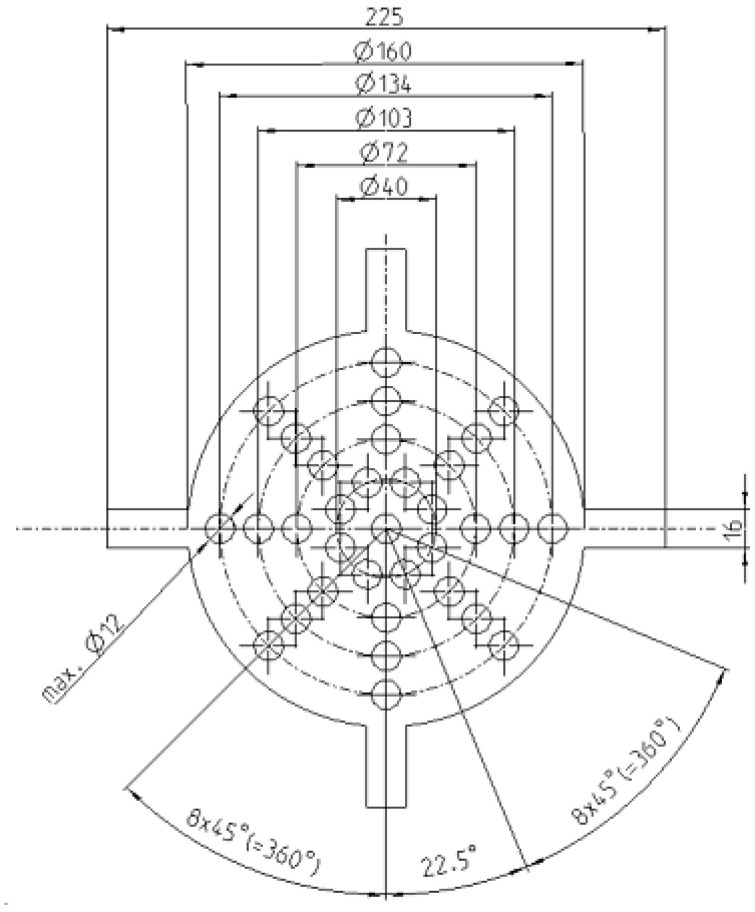

Figure 1 — Template with dot test pattern

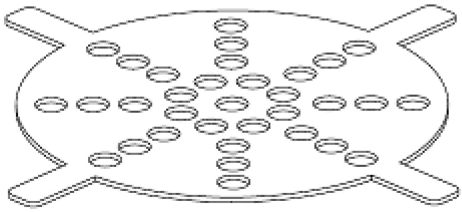

Figure 2 — Template — 3D view

The thickness of the template should be between 1 mm and 3 mm.

The maximum diameter of the holes shall be 12 mm.

Recommended materials are stainless steel or rubber. A centralized position of the template on the plate shall be ensured.

In case a stiff material is used for the template, the flaps shall be bent upwards to allow the template to hover max 5 mm above the surface of the plate. The template shall not come in contact with the test-soil. One template should be sufficient for the preparation of all plates.

6.2.1.5 Pipette/dispenser used for dot application

For application of the dots to the plate surface a repeater pipette with the required accuracy shall be used (see A.5).

6.2.2 Formulation of test soil

6.2.2.1 Ingredients

290 g cow milk (3,5 % fat, pasteurized, homogenized)

0,2 g Nigrosin (CAS-number 101357–32–8) (C.I. 50420)

80 g white and yellow egg mixed

80 g Sugar (fine grade, EU-quality 1)

210 g wheat flour for pastry with 0,5 % mineral content in dry form (Germany: Type 405, A: Type 480, Switzerland: “Weissmehl”, Italy: Tipo 00)

Use eggs of good quality with a mass of 50 g to 65 g (covered by class M of European eggs labelling) at ambient condition. The eggs shall be at least 7 days old, but not having passed their best before or use-by date. The eggs shall be kept refrigerated until use. At least 3 eggs shall be used for the whisked egg.

The egg white and the egg yolk are mixed with a stick blender for 10 s in a bowl.

Any U.H.T.milk with 3,5 % fat content may be used. U.H.T. milk shall have a “use-by” or expiry date of at least 1,5 months from the date of the test. U.H.T milk shall be refrigerated after opening and shall be used within 2 days of opening.

6.2.2.2 Formulation

The coarse Nigrosin kernels are ground in a chemical mortar to a fine powder.

180 g of cow milk is filled into an 800 ml beaker.

The milk shall be added with a temperature of 6 °C to 8 °C.

The ingredients 0,2 g Nigrosin, 80 g sugar, 80 g egg and 210 g wheat flour are added to the 180 g cow milk.

Blend together with a stick blender for 2 min. After completion, 110 g additional cow milk is added. The mixture is manually stirred with a whisk or spatula to suspend residual ingredients from the beaker walls. Afterwards the mixture is blended for another 2 min and set aside for 30 min to remove air enclosures.

The created test soiling can be used for a maximum of 3 h. If the test soiling is not used for a while, plastic foil shall be used as a cover to minimize film build-up due to dehydration. If a thin film exists, it can be mixed under to rehydrate the film fragments.

Figure 3 — Coarse Nigrosin kernels are ground in a chemical mortar

Figure 4 — Mixed test soil

6.2.2.3 Particles

To each rack 10 g of white sesame seeds (see A.7) are added directly into the machine chamber / top of the wash tank.

The sesame seeds are added immediately before the insertion of the rack containing the soiled plates. The sesame seeds are prepared by sieving, using an upper mesh size of 2 mm and a lower mesh size of 1 mm.

6.2.3 Application of test soil

The application and the drying process shall occur at ambient conditions as defined in 5.5. The test soiling dots are applied on the front side of the plates only.

Centre the template in the middle of the plate. Use the repeater pipette to apply the 33 dots in the middle of the given areas. Each dot shall have a weight between 0,024 g and 0,030 g, corresponding to an average volume of about 25 µl. The total soil amount per plate shall be 0,9 g ± 0,1 g. The soiling of one rack shall be completed within 20 min. After the 20 min of soiling, the 2 h drying time starts.

After application, the plates shall be stored in their serving orientation to dry, not covered or stacked.

At the end of the 2 h drying period, the dots have dehydrated to dot sizes of 6,75 mm ± 1,00 mm. A soiled plate is shown in Figure 5.

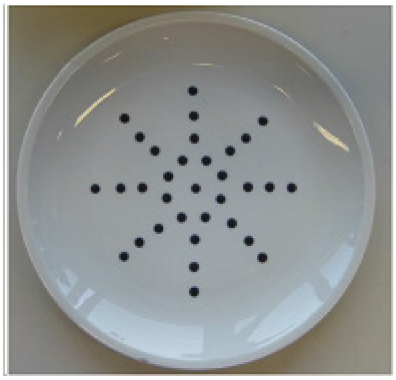

Figure 5 — Plate with 33 dots after drying

If the specified sizes of the dots are not reached, the basic cleaning process of the plate surface was not successful and thus there are still remaining residues on the plate surface, or other parameters were not in range. This leads to altered cleaning performance behaviour and therefore shall be avoided.

In total 5 racks with soiled plates shall be prepared in series as described in Figure 6. At the end of the 2 h drying time, the first rack is ready for the cleaning and resoiling performance test, which is combined with the energy and water consumption and time measurement . The test sequence defined under 7.2.4 and shown in the flow chart in Annex B shall be followed. To each machine cycle 10 g of sesame seeds are added directly into the machine chamber / top of the wash tank before a new rack is loaded.

A water meter complying with 7.2.1 shall be installed in the feed line of the dishwasher in order to measure the water consumption.

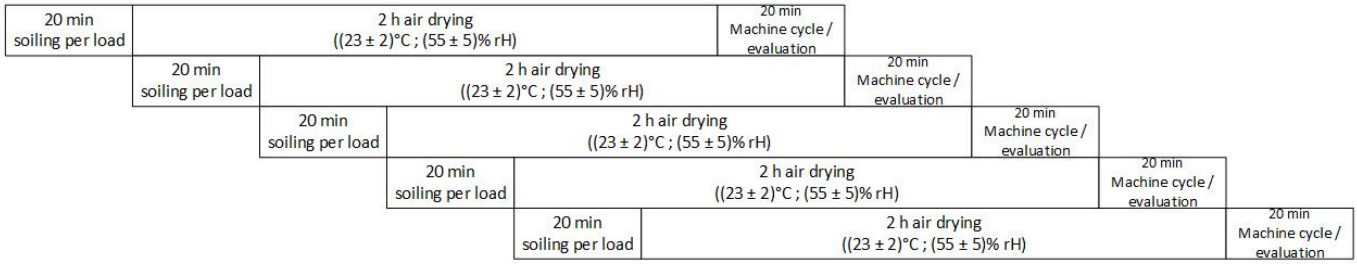

Figure 6 — Time schedule for test procedure

In order to calculate average cleaning results, each test consists of five repetitions. The water volume refilled by the machine during the cycle shall be measured in order to compensate for tank water discharge. According to this volume, after each cycle the detergent (3 g/l) is manually added in order to ensure a constant detergent concentration.

6.3 Evaluation

6.3.1 General

After each cycle, the rack containing the plates is immediately removed from the machine. After the plates are dried, all plates are visually inspected for remaining dot soil residues and sesame seed particles. The remaining dots and particles per plate are counted.

A remaining dot is counted if there are any traces visible after the cycle. Any remaining sesame seed particles or fractions thereof are counted.

The evaluation time per plate is 10 s.

For the evaluation, the light conditions shall be as follows:

— colour temperature of 3 500 K to 4 500 K (“daylight” or “cool white” lamp);

— intensity of illumination measured at the position of evaluation shall be 1 000 lx to 1 500 lx.

For dot evaluation purposes, only the front side of the plate is considered.

For the evaluation of sesame seed particles both the front and rear side of the plate are considered.

The found total numbers of sesame seed particles from both sides of the plate are added.

See “Evaluation sheet for cleaning performance calculation” in 8.2.

6.3.2 Calculation of performance results

For statistical plausibility, the average results of the five cycles are considered to generate the final result.

The cleaning performance is calculated using the following Formula (1):

$$\chi_{clean} = 100 - \frac{total\ number\ of\ remaining\ dots}{total\ number\ of\ applied\ dots} \cdot 100 \text{ in } \% \quad (1)$$

The resoiling performance is calculated using the following Formula (2):

$$x_{res} = \frac{\text{total number of particles found}}{\text{total number of evaluated plates}} \quad (2)$$

7 Energy, water consumption and time measurement

7.1 General information

The purpose of this measurement is to determine the electrical energy and water quantity as used by the dishwasher for filling, running and the required time for completion of a particular programme which is used for measuring the cleaning performance.

Furthermore, the **start-up time** and the electrical power of the **ready-to-use mode** are measured.

All test sequences are visualized in the flow chart in Annex B.

In case more than one rack is cleaned in one cycle, parameters referring to the number of racks involved, shall be considered accordingly.

7.2 Measurement method

7.2.1 General

Energy consumption is measured in kWh to three decimal places, water consumption in litres to one decimal place and time in seconds.

The energy and water consumption is measured in total for 5 cycles. The total value is then divided by 5 (see 7.2.4).

The programme and cycle time is measured for each cycle (see 7.2.4) and the arithmetical mean of the values shall be calculated.

7.2.2 Preparation

The dishwasher is cleaned by running one normal cleaning cycle as defined for the performance test, but without load.

Then it is emptied as described in the instruction manual and cooled down to ambient temperature (see 5.5) with the hood/door open for at least 12 h.

The fill level of the dishwasher boiler is at the same height as after the standard draining process (see instruction manual of the manufacturer). All parts of the machine shall be inspected and any residues shall be thoroughly removed.

The appropriate racks and plates according to 5.9 are provided.

Before each test procedure, the required amount of racks shall be prepared.

All plates and racks shall be dry and at ambient temperature (see 5.5).

7.2.3 Initial fill and Start-up time

Start recording.

Switch on the dishwasher and wait until it has reached the ready-to-use mode and all energy consuming elements are inactive.

Open door / hood and keep it open for 30 s to load the machine according to 5.9. Close the door / hood and start one cycle immediately.

Wait until all energy consuming elements are inactive.

Stop recording.

The start-up time (T_S) shall be measured from switching on the dishwasher until it has reached the ready-to-use mode and all energy consuming elements are inactive.

The energy (E_F) and water consumption (V_F) are measured from switching on the dishwasher until one cycle is finished and all energy consuming elements are inactive.

The energy (E_S) and water (V_S) consumption for the initial fill process is calculated by subtracting the average consumption of one cycle (E_C resp. V_C) calculated according to 7.2.4.

$$Es = EF - EC \quad (3)$$

$$Vs = VF - VC \quad (4)$$

7.2.4 Energy, water consumption and programme/cycle time

This test is done together with the cleaning and resoiling performance test (Clause 6).

The machine shall be conditioned according to 5.2.

The machine is in ready-to-use mode.

For temperature conditioning of the entire machine and for turbidity conditioning in the wash tank, three racks loaded with plates shall be washed consecutively.To each conditioning cycle a defined quantity of ballast soil shall be added into the centre of the wash chamber of the dishwasher before the filter (if available). The ballast soil needs to be added before the cycle is started.

For each plate to be tested 0,9 g of test soiling shall be added.

For each rack to be tested 10 g of sesame seeds shall be added.

Both test soiling and sesame seeds are described in 6.2.2.

Note: For example, if the rack is loaded with 18 plates, 18*0,9 g = 16,2 g test soil and 10 g sesame seeds shall be added into the wash chamber for each conditioning cycle.

Load the machine, close the door / hood and start the first programme cycle.

After the machine is indicating the end of the programme, wait until all energy consuming elements are inactive.

Open door / hood and keep it open for 30 s to unload and load again with the next rack and add detergent and ballast soil.

Close door / hood and start the next conditioning cycle immediately.

The load for the 3rd conditioning cycle shall be equipped with a temperature probe according to 5.10.

After the 3rd conditioning cycle unload the machine and close the door / hood.

Wait until the dishwasher is in the ready-to-use mode and all energy consuming elements are inactive.

The energy, water consumption and programme/cycle time measurement combined with the cleaning and resoiling performance test shall now be started within 15 min.

5 cycles loaded with racks with soiled plates shall be washed. For each rack 10g of sesame seeds according to 6.2.2.3 shall be added into the centre of the wash chamber of the dishwasher before the filter (if available).

Start recording.

Open door / hood and keep it open for 30 s to load the machine with a rack with soiled plates.

Close the door / hood and start the programme cycle immediately.

After the machine is indicating the end of the programme, wait until all energy consuming elements are inactive.

Open door / hood and keep it open for 30 s to unload the machine.

Close door / hood until the next rack containing soiled plates according to 6.2.3 is ready for use.

Open door / hood and keep it open for 30 s to load the next rack and add detergent.

Close door / hood and start the next programme cycle immediately.

After the 5th programme cycle, when the machine is indicating the end of the wash cycle, wait until all energy consuming elements are inactive.

Open door / hood and keep it open for 30 s to unload the machine.

Close the door / hood.

Stop recording 20 min after the start of 5th cycle.

Now the total water consumption (V_T) and the total energy consumption (E_T) of 5 cycles and each individual programme/cycle time (T_{PR1} until T_{PR5} and T_{C1} until T_{C5}) shall be reported.

The total energy consumption (E_T) is then divided by 5 to determine the energy consumption per cycle (E_C)

$$E_C = E_T \ / \ 5 \tag{5}$$

The water consumption (V_T) is then divided by 5 to determine the water consumption per cycle V_C.

$$V_C = V_T \ / \ 5 \tag{6}$$

The energy (E_P) and water (V_P) consumption per plate shall be calculated by dividing E_C and V_C by the number of plates per rack:

$$E_P = E_C \ / \ \text{plates per rack} \tag{7}$$

$$V_P = V_C \ / \ \text{plates per rack} \tag{8}$$

The programme time (T_{PR}) is calculated as follows:

$$T_{PR} = \left(T_{PR1} + \ T_{PR2} + \ T_{PR3} + \ T_{PR4} + \ T_{PR5}\right) / \ 5 \tag{9}$$

The cycle time (T_C) is calculated as follows:

$$T_C = (T_{C1} + T_{C2} + T_{C3} + T_{C4} + T_{C5}) \ / \ 5 \tag{10}$$

7.2.5 Power consumption – Ready-to-use mode

The machine shall be conditioned according to 5.2.

Load the machine according to 5.9, close the door / hood and start one cycle.

Keep door/hood closed and wait until all energy consuming elements are inactive.

Start the power consumption measurement (E_U) over the period of time (T_U).The measurement shall be carried out for at least 3 h.

Data shall be recorded at regular intervals of 5 s.

At the end of the min. 3 h, open door / hood and keep it open for 30 s to unload and again load the machine. Start a programme cycle immediately. After the machine is indicating the end of the programme, wait until all energy consuming elements are inactive.

Stop recording data.

The ready-to-use mode power consumption (E_{RTU}) is calculated by subtracting the average power consumption of one cycle (E_C) evaluated according to 7.2.4.

$$E_{RTU} = E_U - E_C \text{ in kWh} \quad (11)$$

The ready-to-use mode time (T_{RTU}) is calculated by subtracting the average cycle time (T_C) as evaluated according to 7.2.4.

$$T_{RTU} = T_U - T_C \text{ in s} \quad (12)$$

The power of the ready-to-use mode is calculated as follows:

$$P_U = \left(E_{RTU} x 3600\right) / T_{RTU} \text{ in kW} \quad (13)$$

8 Data to be reported

8.1 Laboratory and test data

Company / address:	
Test Person:	
Date:	
Room temperature [°C]:	
Air humidity [%]	
Water hardness [mmol/l]:	
Water temperature [°C]	
Water pressure [kPa]	
Detergent, Type:	Batch number:
Rinse Agent, Type:	Batch number:

Dishwasher data

Manufacturer / provider:	
Model name:	
Serial number:	
Supply Voltage [V, Hz]	
P_{max} [kW]	
I_{max} [A]	
Programme used:	
Tank temperature manufacturer's setting	
Boiler temperature manufacturer's setting	
Features	
Detergent solution concentration [g/l]	
Rinse aid solution concentration [g/l]	

Measured data

Energy consumption for initial fill (E_S)		kWh
Water consumption for initial fill (V_S)		l
Start-up time (T_S)		s
Number of plates per rack		
Cleaning performance (x_{clean})		%
Resoiling performance (x_{res})		
Energy consumption per cycle (E_C)		kWh
Water consumption per cycle (V_C)		l
Energy consumption per plate (E_P)		kWh
Water consumption per plate (V_P)		l
Average programme time (T_{PR})		s
Average cycle time (T_C)		s
Power ready-to-use mode (P_U)		kW

8.2 Evaluation sheet for cleaning performance calculation

		rack 1		rack 2		rack 3		rack 4		rack 5	
plate surface		front	front and rear	front	front and rear	front	front and rear	front	front and rear	front	front and rear
amount of		remaining dots	particles found	remaining dots	particles found	remaining dots	particles found	remaining dots	particles found	remaining dots	particles found
plate	1										
	2										
	3										
	4										
	5										
	6										
	7										
	8										
	9										
	10										
	11										
	12										
	13										
	14										
	15										
	16										
	17										
	18										
quantity											

In Figure 7 an example is shown of remaining dots and particles.

On that plate, 14 dots and 4 sesame seed particles are still visible after the finished machine cycle.

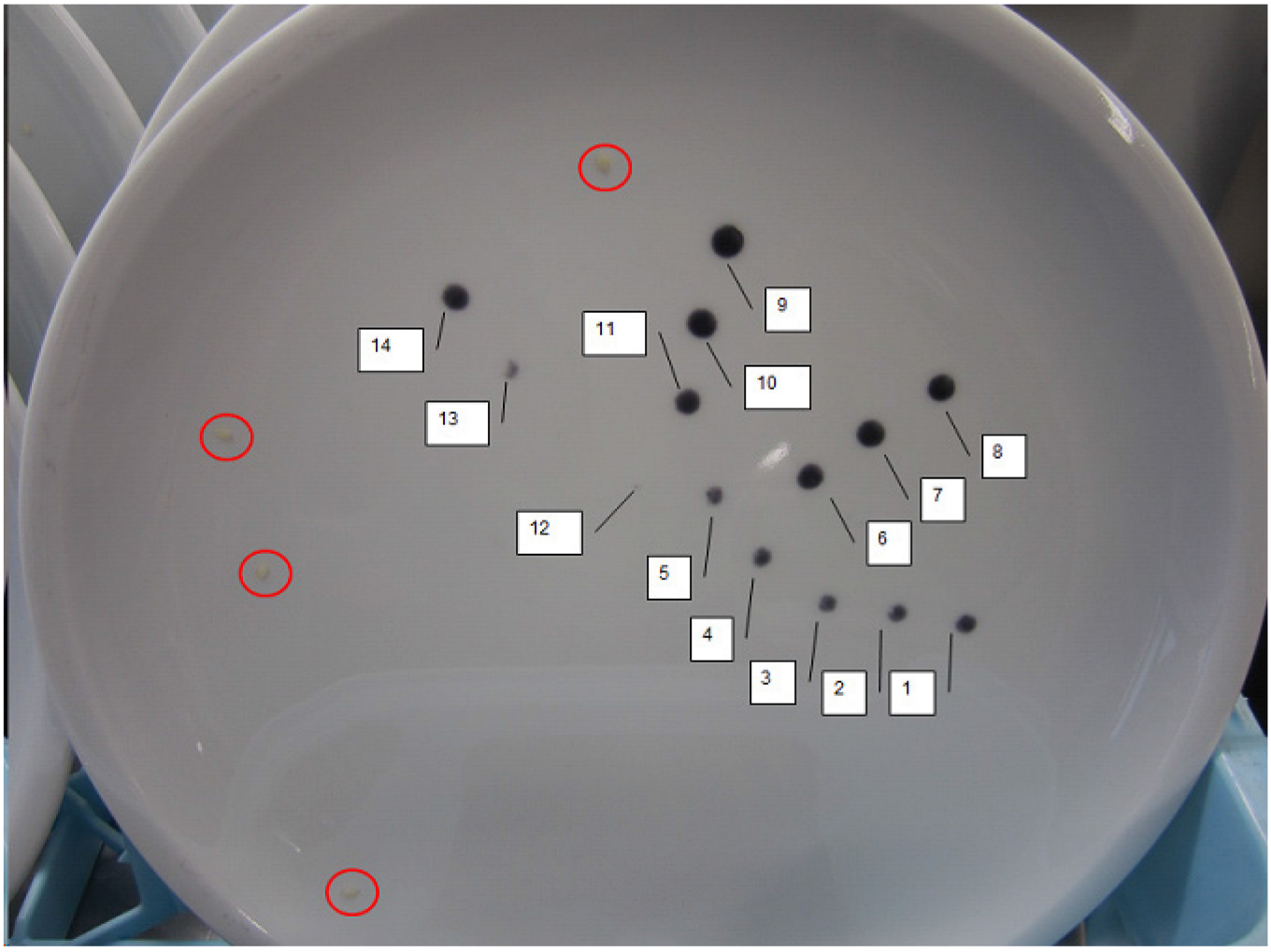

Figure 7 — Evaluation example

Annex A
(normative)

Test materials for laboratories

A.1 Reference Detergent

The detergent is prepared according to the formula specified in Table A.1.

While stirring the fully demineralized water, the potassium tripolyphosphate solution and the potassium hydroxide are added. Finally, the sodium silicate is also added while stirring, and thoroughly mixed. After one or two days, a deposit precipitates out of the initially clear solution. This sediment is removed by decanting.

Table A.1 — Detergent

Raw material	Percentage of mass [%]	Quantity for 1 kg
Fully demineralized water	21,6	216,0 g
Potassium tripolyphosphate solution, 50 % (percentage of mass)	20,0	200,0 g
Potassium hydroxide, 45 % (percentage of mass)	35,5	335,0 g
Sodium silicate, material quantity proportion r (SiO_2/Na_2O) = 3,41 to 3,51; mass of solid is approximately 35 %	22,9	229,0 g
Total	100,0	1 000,0 g

NOTE Density of reference detergent: 1,35g/ml.

302633 DIN Testreiniger REGSM (5l)[1]

20 000 951 DIN Detergent REGSM (12kg)[2]

A.2 Reference rinse aid

The rinse aid is prepared according to the formula specified in Table A.2.

While stirring the fully demineralized water, the crystalline citric acid is added and fully dissolved.

Subsequently, the two following liquid raw materials are added while continuously stirring.

---

1 DIN Testreiniger REGSM (5l) is the tradename of a product supplied by Chemische Fabrik Dr. Weigert GmbH and Co.KG. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CENELEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

2 DIN Detergent REGSM (12kg) is the tradename of a product supplied by Winterhalter Gastronom GmbH. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CENELEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

Table A.2 — Rinse aid

Raw material	Percentage of mass [%]	Quantity for 1 kg
Fully demineralized water	70,0	700,0 g
Citric acid, monohydrate, crystalline	5,0	50,0 g
Niotensid, fatty alcohol C12/C14 + 5 EO + 4 PO	20,0	200,0 g
Sodium cumenesulfonate 40 % (percentage of mass)	5,0	50,0 g
Total	100,0	1 000,0 g

302833 DIN Testklarspüler KEGSM (5 l)[3]

20 000 952 DIN Rinse Aid KEGSM (10 l)[4]

A.3 Basic cleaning detergent

The basic cleaning detergent is prepared according to the formula specified in Table A.3.

All ingredients are thoroughly mixed.

Table A.3 — Basic cleaning detergent

Raw material	Percentage of mass [%]	Quantity for 1 kg
Sodium hydroxide	30,0	300,0 g
Pentasodium tripolyphosphate	30,0	300,0 g
Sodium percarbonate	20,0	200,0 g
Disodium metasilicate	20,0	200,0 g
Total	100,0	1 000,0 g

Etolit Geschirrblitz[5]

A.4 Load

If the dishwasher is supplied with a rack, this rack shall be used for the test.

In case no rack is supplied with the dishwasher, an available standard rack shall be used

In case of dishwashers with rack dimensions of 500 mm x 500 mm the racks shall be loaded with 18 plates and for dishwashers with rack size of 400 mm x 400 mm the racks shall be loaded with 10 plates.

The plates are porcelain plates.

---

[3] DIN Testklarspüler KEGSM (5 l) is the tradename of a product supplied by Chemische Fabrik Dr. Weigert GmbH and Co.KG. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CENELEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

[4] DIN Rinse Aid KEGSM (10 l) is the tradename of a product supplied by Winterhalter Gastronom GmbH. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CENELEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

[5] Etolit Geschirrblitz is the tradename of a product supplied by Etol-Werk Eberhard Tripp GmbH and Co. OHG. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CENELEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

Plate flat coupe diameter 240mm, Item Nr. 9051224[6].

It is recommended to place paper between the plates to stack them without scratching.

A.5 Test pipette/dispenser

EXAMPLE Pipette VWR.

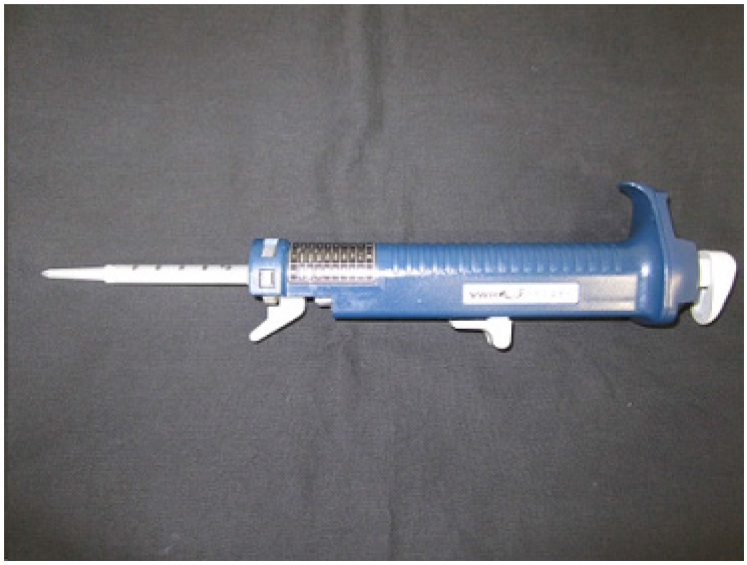

Figure A.1 — Pipette (VWR order no. VWRI613-0964)[7]

Figure A.2 — VWR Dispenser tip 1,25ml (VWR order no. 613-1002)[8]

The pipette shall be suitable for a dosing volume of 25 µl.

---

6 Plate flat coupe diameter 240mm, Item Nr. 9051224is the tradename of a product supplied by Schönwald. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CENELEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

7 VWR order no. VWRI613-0964 is the tradename of a product supplied by VWR International GmbH. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CENELEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

8 VWR order no. 613-1002 is the tradename of a product supplied by VWR International GmbH. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CENELEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

A.6 Stainless steel holder and support[9]

Dimensions in millimetres.

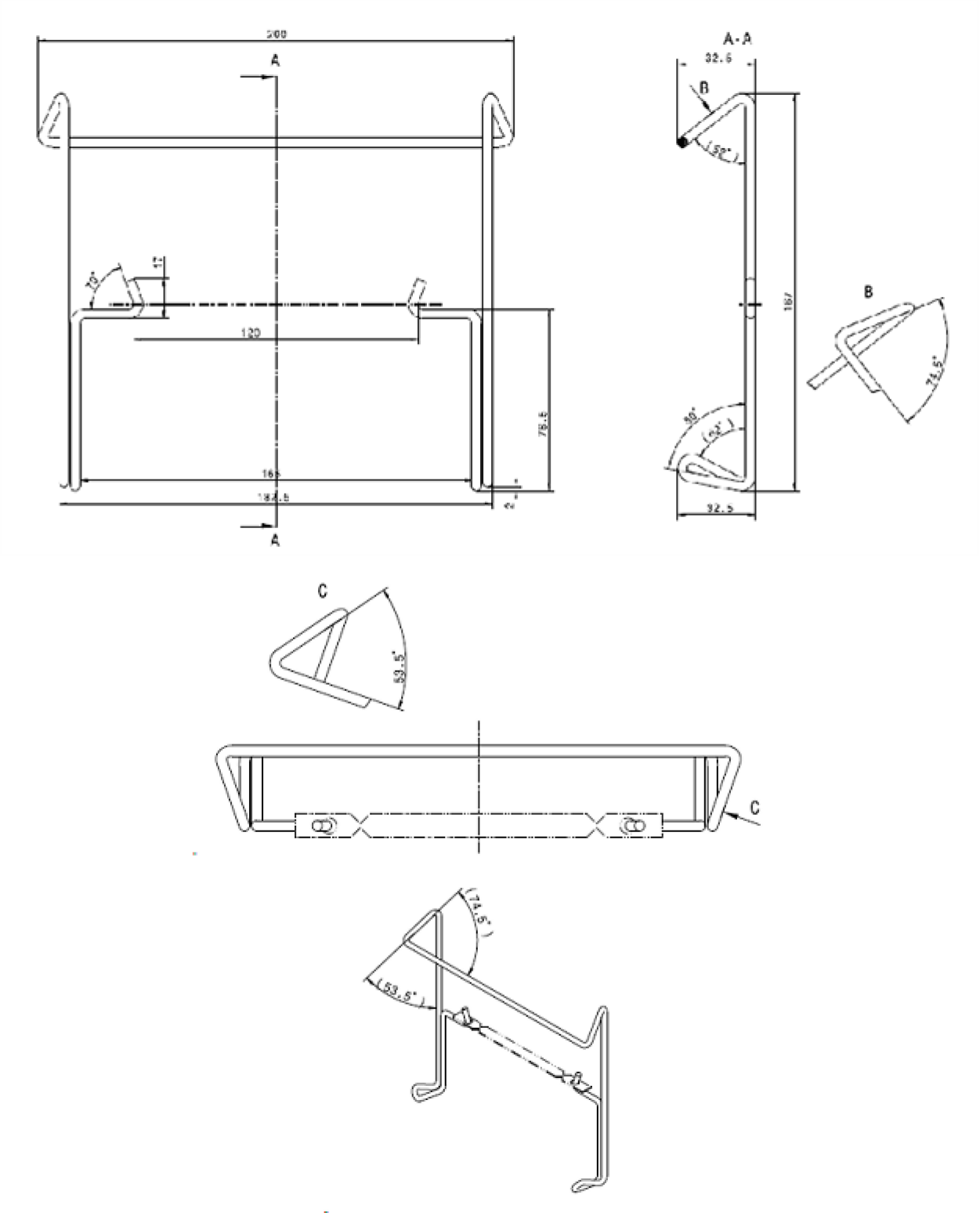

Figure A.3 — Holder for stainless steel support

9 Stainless steel holder and support are examples of products supplied by Milchwirtschaftliches Institut Dr. Huefner. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CENELEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

The stainless steel support as shown in Figure A.4 is made of the following stainless steel material:

Austenitic steel, material no. 1.4301 as specified in EN 10088 (all parts).

Dimensions in millimetres.

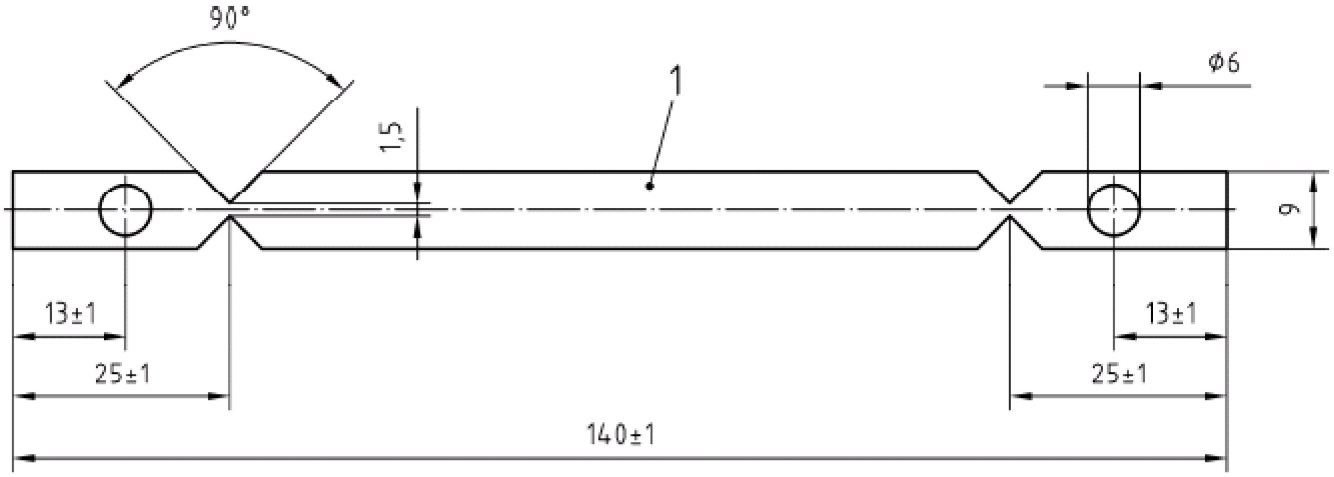

Figure A.4 — Stainless steel support

The temperature probe is fixed on the support as shown in Figure A.5.

Dimensions in millimetres.

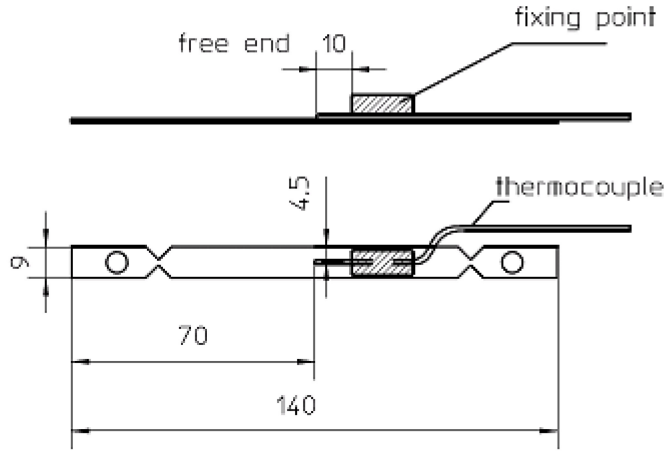

Figure A.5 — Temperature probe positioning

A.7 Sesame seeds

Possible product for sesame seeds: Sesame natur[10].

Sizes between 1 mm and 2 mm

With shell

White color

Not roasted

[10] Sesame natur is the tradename of a product supplied by Schapfenmühle. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CENELEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

Annex B
(informative)

Flowchart – Test sequence

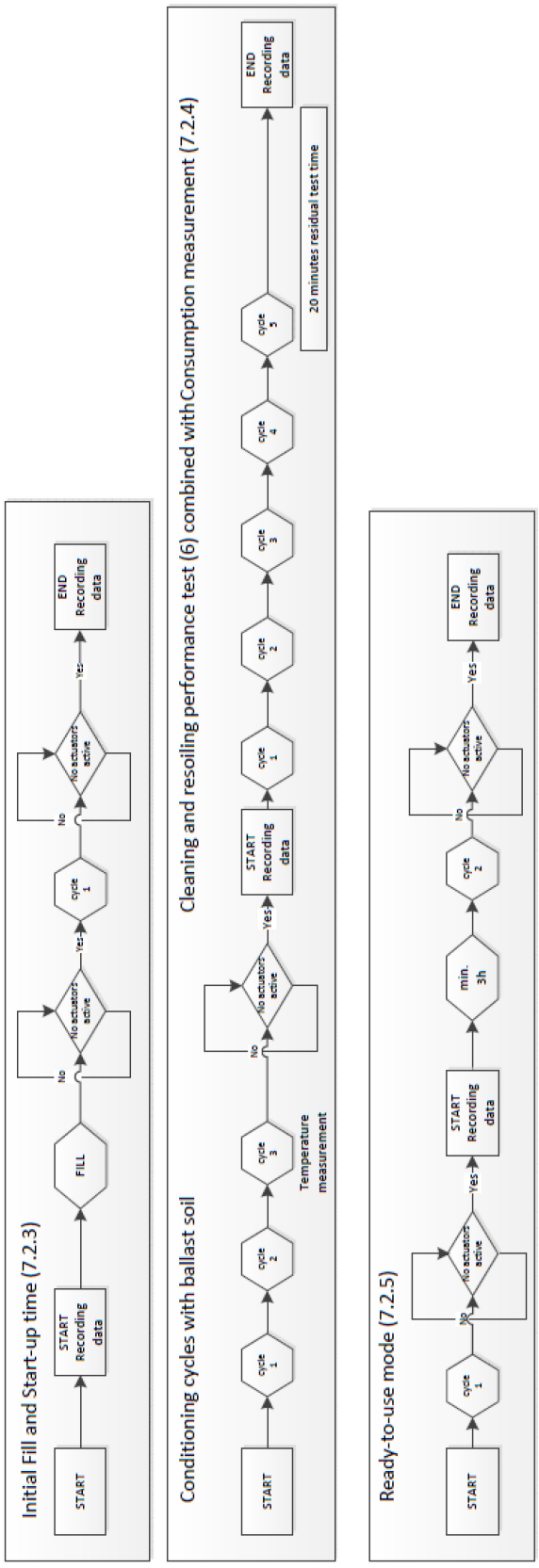

Figure B.1— Flowchart for test sequence

Bibliography

[1] EN 1672-2, *Food processing machinery — Basic concepts — Part 2: Hygiene requirements*

[2] EN 60335-1, *Household and similar electrical appliances — Safety — Part 1: General requirements (IEC 60335-1)*

[3] EN 60335-2-58, *Household and similar electrical appliances - Safety - Part 2-58: Particular requirements for commercial electric dishwashing machines*

[4] EN 60734, *Household electrical appliances - Performance - Water for testing*

[5] EN 62053-21, *Electricity metering equipment (a.c.) - Particular requirements - Part 21: Static meters for active energy (classes 1 and 2)*

[6] DIN SPEC 10534, *Food hygiene — Commercial dishwashing — Hygiene requirements, testing*[11]

[11] Text in German and English; Germ reduction performance

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