
International Standard



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Surface active agents — Detergents for domestic machine dishwashing — Guide for comparative testing of performance

Agents de surface — Détergents pour le lavage de la vaisselle en machine — Principes directeurs pour des essais comparatifs d'évaluation de performance

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

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It has been approved by the member bodies of the following countries:

Australia	Iran	South Africa, Rep. of
Austria	Italy	Spain
Belgium	Japan	Switzerland
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The member body of the following country expressed disapproval of the document on technical grounds:

Hungary

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Surface active agents — Detergents for domestic machine dishwashing — Guide for comparative testing of performance

0 Introduction

In order to test the comparative performance of detergents and rinse agents used in a number of domestic dishwashing machines, it is necessary to consider several related and several apparently unrelated variables. The particular variables and their importance will vary between regions and countries depending on

- the variety of soil, consequent on varied dietary habits;
- the materials used in making kitchen utensils, tableware and cutlery;
- water quality and limitations in the available choice of dishwashing machines.

Recognizing the importance and value to users of comparative test information derived from similarly based test methods, this International Standard lays down the criteria to be considered in designing tests and assessing results. One of the primary criteria, which affect all consumers, is the effective removal of a wide variety of soils from all kinds of domestic utensils soiled by foods and drinks, with the least possible damage to utensils and to washing equipment. Another important criterion is the appearance of the cleaned utensils, such as, absence of spotting and filming

Although toxicological and ecological properties are extremely important for products widely used in the home, their assessment is beyond the scope of this International Standard.

This International Standard shows how to devise satisfactory comparative test methods despite the possible choices between the dishwashing machines.

1 Scope

This International Standard establishes guidelines for carrying out comparative tests on machine dishwashing products solid or liquid, in an attempt to reflect realistically the performance of products likely to be used by consumers.

It lists and defines the performance characteristics considered; it gives details of the variables to be taken into account, indicates their significance and provides a basis for designing adequate comparative test methods.

2 Field of application

This International Standard applies both to dishwashing machine detergents and to rinsing agents; the latter are added optionally by the user to the final rinse water to improve draining and so improve appearance, particularly under some conditions, e.g. hard water.

Domestic machine dishwashing is understood to include machine washing of all domestic utensils used for food storage, preparation, cooking, eating and drinking.

It does not apply to industrial dishwashing products.

3 References

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

ISO 862, *Surface active agents — Vocabulary.*

4 Definitions

4.1 detergent for domestic machine dishwashing: A detergent¹⁾ in powder, granular or liquid form, manufactured for use in domestic dishwashing machines.

4.2 rinsing agent for domestic machine dishwashing: A product which is formulated to improve the drying effect and the appearance of articles cleaned by means of domestic dishwashing machines. It may be in liquid form (to be added to the final rinse) or in solid bar form (to be placed and left in the dishwasher during successive washings).

1) See the definition in ISO 862.

5 General

Performance testing shall be carried out on products available (or being introduced) in the country concerned. The test machine dishwashing process, together with the selection of utensils and other variables, shall be influenced by current consumer practice in that country and the model of dishwashing machine used.

Sampling of solid and liquid products shall be carried out following the procedures specified in ISO 607.

This International Standard covers the principal considerations for assessing products for machine dishwashing, namely:

- a) the performance characteristics (see clause 6);
- b) the soiled articles required for assessing these characteristics (see clause 7);
- c) the washing processes (see clause 8).

In dealing with the load of soiled articles and the washing process, a number of primary and secondary variables is listed.

Methods of appraisal of performance characteristics and the way in which results of tests shall be reported and interpreted and also information on the physical characteristics of the product are also covered.

6 Performance characteristics

6.1 General

No single assessment will predict the overall performance of a machine dishwashing product; hence, a series of assessments is necessary in order to evaluate various aspects and provide a qualitative judgement of the overall performance.

These aspects of the overall performance are first classified and then the method of assessment is detailed in clause 9.

6.2 Classification of overall performance characteristics

The overall performance of the washing product can be classified according to several separate criteria the relative magnitude of which is influenced by the detergent and rinsing agent employed, rather than by the type of dishwashing machine. The following criteria may play a role in this assessment.

6.2.1 Final appearance of the articles

This criterion covers soil removal, redeposition, the removal of stains and dried or burnt cooking residues and the absence of spots and films.

The characteristics mentioned above are very difficult to evaluate in only one wash, differences usually being too variable to allow any meaningful assessment. Several repeated experiments are necessary to obtain a clear picture of the effects on soil removal, redeposition, etc.

6.2.2 Drying efficiency

This criterion is influenced by the machine operation, water temperature, the composition and shape of the articles and their position in the machine and the use of rinsing agents. The effects of rinsing agents on draining and hence drying and appearance can be compared.

6.2.3 Resistance of the articles to the wash process

This criterion covers chemical and physical damage, including the effect on the colour of decorations, the tarnishing of metals and the changes in optical properties of glass-type surfaces.

Certain characteristics which reflect the possible damage caused to articles by the washing products will require extensive wash trials. Although, for example, tarnishing of aluminium can be assessed after 5 to 10 washes, the fading of decorations may need up to several hundred washes. This is a very lengthy and labour-intensive operation. Ideally, soils should be present, as they can influence the damage characteristics. It is however difficult to include soil in a test and it is therefore frequently omitted in practice.

Damage can be caused by other factors, such as abrasion or stresses caused by the physical effects of the washing process. A distinction should therefore be made between physical and chemical damage.

6.2.4 Effect on washing equipment

This criterion covers any interaction between the product and the washing machine.

Corrosion of the dishwashing machine is of importance to the consumer and new machines or new parts should be used to assess this effect.

7 Load of soiled articles

7.1 General

In tests, it is preferable to use normally soiled articles provided by families or canteens. Loads of soiled articles similar in size and composition shall be used for each replicate and, because of the variety of articles and soils, numerous replicates of each test article are needed to obtain statistically meaningful results. While short-time storage of dirty articles should be considered normal, it should not be longer than part of a day. Moreover, the nature of soiling and the storage conditions (e.g., relative humidity and temperature) will be major variables.

Soiling by normal use can be simulated in the laboratory by controlled application to utensils of the foods which are common in the country. If artificial soils are used, the conditions under which the soil is applied to the articles, and interaction between the soil and the articles, have an effect on the test results and should therefore be standardized. Particular difficulty may be encountered in simulating "burn on" during cooking. 7.4 lists the variables which should be controlled when preparing and using soiled articles. It may also be used as a guide for the preparation of comparable loads of artificially soiled articles when naturally soiled articles are not available.

7.4 Load of soiled articles – Variables

Main variables	Secondary variables	Essential conditions for the test	Comments
Soils	Type and composition	Food ingredients and food preparations used for soiling shall represent those commonly used in the country or area in which the products are to be used, e.g. fats and oils, proteins, carbohydrates, soiled food residues and tannins from tea, coffee and wine; lipstick, fruit stains and burnt or baked-on foods, etc.	Several individual soils may be applied to the same substrate, but they should be applied in separate areas.
	Physical state	Use solid, liquid and pasty soils. For reproducibility, it is recommended that the soil components be identical and characterized by their physical and chemical properties, if possible.	Ideally, soils should be stable and should be uniformly applied and aged prior to washing to give a valid comparison.
Substrate (tableware, cutlery and kitchen utensils)	Type of article and material of construction	Include a variety of different substrates. Use the commonest type of kitchen utensils, tableware and cutlery in the country, made of the most commonly used construction materials, e.g. porcelain, glass, ceramic, metal, plastics, PTFE, etc, but soft and/or porous materials (wood, stoneware) should not be part of the evaluation.	It is essential that the surface of the article used shall not be modified during the successive washings of a series of tests. In particular, scratching and other physico-chemical modifications of the surface should be avoided.
	Nature of surface	Article loads for comparative testing should be comparable as far as the nature of the surface is concerned, e.g. porous (stoneware), non-porous (porcelain, earthenware), hydrophilic (wood), hydrophobic (plastics).	For this reason, porous plates are not to be used for this type of test. Use of wood substrates is not recommended.
Preparation of the soiled articles	Amount of soil	The amount of soil applied on each article should be carefully measured and should realistically represent naturally soiled articles.	If soiled articles have to be stored for a certain time before use, the duration of storage should be controlled and the storage conditions (e.g. temperature and relative humidity) kept constant.
	Application of the soils to the substrate	Apply soils evenly and reproducibly to clean articles. When soils are applied in the molten state (e.g. certain cooking fats), the temperature at which the soil is applied to the articles and the temperature at which the soil is solidified, shall be controlled.	In practice, this is a major variable.

7.2 Single-wash and multiple-wash assessments

Single-wash evaluations may be made on test articles which have been previously used, provided that they have been thoroughly cleaned before re-use and that the surface or finish has not been damaged. The single-wash technique, by definition, will not show cumulative product effects. It also will not necessarily indicate the true relative performance of products.

To evaluate cumulative effects, such as tarnishing of metals, the build up of stains (e.g. coffee, tea), effect on glaze, etc., it will be necessary to use a repeat-wash technique whereby the articles being tested are soiled, washed, stored, and this cycle repeated a number of times. In this case, statistically, each run of a number of repeat washes is only one experiment. Thus, this technique is lengthy and costly. On the other hand, it is the method which is closest to practical consumer experience.

7.3 Unsoiled articles

Unsoiled articles can be used to assess aspects of soil redeposition or damage. For this purpose, repeated washes, in the presence of soiled loads are required. It should be noted that soil redeposition is normally mainly influenced by the machine itself rather than the detergent used.

8 Washing process

8.1 General

The washing process shall correspond to practices current in the country in which the products are to be used. The experiment shall be carried out in the type or types of machines that are most common in the country.

When, for practical reasons, several machines are used simultaneously, it is necessary to check their precise action during the various operations both before and during the test. A difference between machines of the same model (for example, volume, heating power, etc.) can completely distort the product comparison. A statistically designed randomization of the runs over the available machines is necessary.

The pattern of loading is extremely important. The water streams are diverted by the load and performance variations may be encountered unless the way of loading is carefully controlled.

The loading should comply with the machine manufacturer's recommendation. Guidance can generally be obtained from the instruction booklets, but more detailed photographs are advisable to aid the laboratory technicians who have to load the machines.

In the dishwashing process two products, detergents and rinsing agents, are often used. The detergents should be compared with or without rinsing agents, according to the custom in the country. Rinsing agents should not be used without a detergent.

Variables governing the washing conditions can be divided into several categories:

- a) variables which are generally imposed by the washing machine (water volume, agitation, speed of heating, final temperature);

- b) variables which are left to the user (choice of programme, amount of detergent, soil load, load pattern and size);

- c) variables due to external conditions (water hardness, inlet water temperature, water pressure);

- d) variables which occur during additional operations run after the wash itself (drying).

These variables, further detailed in 8.3, are not necessarily independent. Generally, the instruction on a dishwashing product will state the relationship between product usage, water hardness and soil load. A product should be tested under combinations of conditions which conform to the product label recommendations.

8.2 Long-term effects

For a comparison of the long-term effects, such as damage to glassware and metals, the same wash processes as for performance assessments shall be used. The test should be started with new articles. Articles, especially glasses, may vary considerably in their sensitivity to the wash process, even when obtained from the same production batch.

To obtain meaningful results, enough replicate samples of the same batch should be used to ensure a low standard deviation. Experience indicates that a minimum of 7 specimens of each article (from the same batch) are necessary.

When repeat washes are carried out, the articles shall be dried between washes in the machine. Care should be taken that the articles cool down to room temperature before the next cycle is started. As already stated in 6.2, a considerable number of washes may be necessary before the changes become sufficiently evident for a clear comparison.

Because damage can be caused by the mechanical/physical effects of the washing operation itself, the inclusion of a "waterblank", i.e. no detergent, is helpful as a reference benchmark in the observation of chemical effects when assessing long-term damage.

8.3 Washing process — Variables

Main variables	Secondary variables	Essential conditions for the test	Comments
Washing machine	Type	Use the common model(s) in the country in which the products are to be used.	
	Installation	The machine should be installed according to the manufacturer's specifications.	
	Water softener	The water softener, if present, should be regenerated according to the machine manufacturer's instructions.	
	Number of machines	When several machines are used, they should be of the same model and their precise action should be checked during the different operations both before and during the experiments.	See 8.1.
Loading the machine	Place of each article	Load according to the manufacturer's instructions. The exact place of each article should be defined. Cutlery should be divided among the basket compartments. Different metals shall not be mixed in a single compartment nor placed so that they will touch a dissimilar metal in an adjoining compartment. Unsoiled articles, if present, should not be concentrated in one place, but be distributed evenly within the machine.	To avoid contact corrosion Redeposition is very much location dependent.
	Location of each article	The location should comply with the machine manufacturer's instructions. In all cases, the soiled surface shall face the water jets.	Locating marks on the articles may help the technicians.
Cycles	Water volume	As programmed by the machine manufacturer for each cycle. The water pressure should be constant and within the limits specified by the machine manufacturer.	The consumer does not control this variable. Variations in water volume may occur with pressure variations.
	Time/temperature	In general, use the cycle corresponding to the load to be tested, based either on the machine manufacturer's or the detergent manufacturer's recommendations.	
	Spray pressure	If the spray pressure can be adjusted by the consumer, select the recommended pressure for the corresponding load.	
	Pre-wash	When a pre-wash is common practice, it shall be included in the cycle.	
Water	Hardness	When a machine with a built-in water softener is used, then normal tap water will suffice. In the absence of a built-in water softener, if only one water hardness is to be tested, use the average water hardness for the country. Preferably use 3 water hardnesses, one below, one at, and one higher than the average for the country. Check the stability of the water hardness and pH. The Ca/Mg ratio shall be indicated if artificially prepared hard water is used.	Performance may vary greatly according to the hardness of the water. When the built-in water softener is used, its consistent operation should be checked. Hardness and pH may vary from day to day and even during one day. Artificially prepared hard water may be necessary to eliminate the possibility of trace metal contamination and of variation in hardness.
	Initial temperature	The initial inlet water temperature shall be constant within ± 3 °C.	The initial temperature often influences the length of the cycle and the final temperature, and greatly influences performance if the machine has no built-in heater.