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Surface active agents — Detergents for washing fabrics — Guide for comparative testing of performance

Agents de surface — Détergents pour le lavage du linge — Guide 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	India	Switzerland
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0 INTRODUCTION

The methods of assessing performance of detergents for washing fabrics depend on many variables which are linked together in a complex way. This is why it has been considered necessary to lay down a guide concerning the drawing up and application of comparative test methods.

This guide has been drawn up in the full recognition that no single test, or series of tests, carried out in a laboratory will be able to define completely the limits of product performance for the numerous different washing products on the market today. The position is all the more complex when the many different national washing habits and soils, and the wide variety of textiles, are taken into account.

Soil is composed of a variety of substances such as fats, proteins, pigments and other coloured particles which exhibit quite different adhesive properties on the fabric. The chemical composition of the fibre, the textile structure and the finish will also greatly influence soil adhesion to the fabric. It is therefore very important, in comparative testing, to understand that differences in the degree of soil removal may be observed if the soiled material is unfinished or resin-finished cotton, shrink-resistant wool, nylon, polyester, or polyacrylic fabric and if the fabrics are loosely or closely knit or woven, are light or heavy, or have a smooth or rough surface.

In addition to the aspects relating directly to cleaning, a good detergent should have other properties in order to ensure good acceptance and to present no danger. In particular, it should not attack either the fabric (materials, dyes, finishes) being washed or the washing machines, and it should retain its properties during long periods of storage.

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

Despite these complexities, it should be possible for a given country or group of countries to devise satisfactory comparative test methods.

1 SCOPE

This International Standard constitutes a guide for carrying out comparative tests of fabric washing products in such a way as to realistically reflect the performance of the products likely to be used by consumers.

It gives details of the variables to be considered, indicating the significance and importance of each of these variables, and provides a basis for the drawing up of adequate comparative test methods which will give a valid estimation of the performance of a fabric washing product when two or more products are compared during the same series of tests.

2 FIELD OF APPLICATION

This International Standard applies to all products sold for use in domestic washing machines.

In general, it does not apply to industrial washing products or to other specialized products.

3 REFERENCES

ISO 607, *Surface active agents — Detergents — Methods of sample division.*[1]

ISO 2267, *Surface active agents — Verification of certain effects of laundering — Preparation and use of unsoiled cotton control cloth.*

ISO 3758, *Textiles — Care labelling code.*[2]

ISO 4312, *Surface active agents — Verification of certain effects of laundering — Methods of analysis and test for unsoiled cotton control cloth.*[2]

4 GENERAL

When the products to be compared are recommended for several laundry conditions, they shall be examined under these varied conditions according to the manufacturer's directions in order to obtain a true assessment of their value; conversely, a product shall not be tested under conditions for which it has not been recommended.

1) In preparation. (Revision of ISO/R 607.)

2) At present at the stage of draft.

The choice of the products and the characteristics which the testing laboratory will examine has a strong influence on the design of the experiment, including the washing process, the selection of the fabric load and other variables. The performance testing shall be carried out on products readily available in the particular country. Knowledge of the formulation of the products is unnecessary as it is not, in general, possible to predict the performance of a product on the basis of the formulation alone.

Sampling of the products shall be performed following the procedure specified in ISO 607.

This International Standard contains four clauses covering the principal considerations in fabric washing product assessment. These considerations are

the characteristics of the fabric to be assessed;

the fabric loads required for this assessment;

the washing processes to be employed;

the most significant aspect of the physical characteristics of the product.

In the clauses dealing with fabric load, washing process and physical characteristics, a number of variables and secondary variables are listed. For each secondary variable, a limited number of recommendations are given for a test method which is designed to compare two or more products, together with the reasons behind these recommendations and possible interactions with other variables.

5 CHOICE OF PERFORMANCE CHARACTERISTICS TO BE ASSESSED

5.1 General comments

There is no single assessment that will give the overall performance of a fabric washing product.

In order to assess cleaning or redeposition, it is recommended that naturally soiled fabrics, as referred to in clause 6, be used.

A series of assessments is necessary in order to evaluate the various aspects of the end results of performance tests.

These aspects of the end results are classified below and the method of appraisal is detailed in clause 8.

5.2 Classification of end results of performance tests

The (overall) performance of the washing product may be classified according to several separate criteria :

a) *Fabric appearance*

This criterion covers soil removal, redeposition, brightening, stain removal and overall whiteness.

b) *Fabric feel*

This criterion is influenced by the fabric, its construction, the drying methods used, the type and quantity of product, water hardness, deposition and the washing machine.

c) *Fabric stability*

This criterion covers chemical and physical damage, including the effect on the colour or the finish of the fabric, the dimensional stability and the physical strength of the fabric.

d) *Effect on washing and drying equipment*

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

5.3 Difficulties of assessment of the performance

Except perhaps for stain removal, all the characteristics mentioned under criterion 5.2a) are very difficult to estimate after only one wash, differences usually being too small and too variable to allow any meaningful assessment. For this reason, several wash cycles are necessary to obtain a clear picture of the effect of redeposition, partial removal of dirt and fading of colours.

An assessment may be made either by using similar articles from a large number of family bundles (see 6.2.1) or preferably by repeated wash and wear cycles (generally at least ten) on the same articles (see 6.2.2), stopping the experiment when the differences between the products are stable, at the required confidence level.

The removal of stains derived from natural soils, artificially applied to test pieces, may be estimated after each wash and averaged across all the washes.

Certain characteristics which reflect the possible damage caused to the articles by the washing products will require at least twenty-five washes and sometimes up to fifty washes. This is a very lengthy operation. In addition, it is very difficult to differentiate between the damage caused by the detergent itself and the damage caused by other factors, such as abrasion or stresses of the physical effects of the washing process.

The effect on colours is also difficult to estimate because of the extreme variety of dyes. Assessment should separate what is due to the detergent itself and what is due to the actual stability of the dye in the washing environment (temperature effect, bleeding, dye transfer). Soil (mainly perspiration) may also influence the dye resistance. The assessment should include a control whereby articles of the same colour are washed in plain water at the same temperature to determine the inherent dye stability of the fabrics and to determine the effect of the products being tested on colours which are fast in water alone.

The amount of residue retained on the cloth depends on the performance of the washing machine (rinsing and spinning) as well as on the efficiency of the washing product. The amount alone is not sufficient to describe

the results. Depending on the nature of the deposition, the resulting damage may be a certain harshness of the article or a yellowing of the fabric which affects the overall appearance. The harmful effects of deposition on equipment and, in particular, on washing machines are also of importance to the consumer. New machines or new parts should be used when the effect of deposition on equipment is to be assessed.

6 FABRIC LOAD

6.1 General comments

It is generally recognized and accepted that normally soiled fabrics should be used for comparative testing of detergents. Standard soiled and artificially stained fabric has been used by detergent technologists for many years in rigorous tests to establish important aspects of detergent formulations. For example, artificially stained fabric may be useful for determining the optimum level of bleaching agent.

Several other selected tests exist in the literature, but no individual tests nor any combination of these tests may be considered to relate satisfactorily to the performance of a product under actual conditions. For this assessment, soiled fabric from a domestic source shall be used.

The composition of a household load varies from country to country, but there are certain articles which are common to most loads. The degree and source of soiling will also vary from household to household, so that a sufficiently large selection of soiled fabrics should be used to even out soil differences between loads over the period of test.

Artificially stained or unsoiled test cloths for examining specific ingredients or special product effects (rather than overall performance) may be included with naturally soiled loads.

The detailed composition of the load will depend on several factors, such as

- the capacity of the machine used in the experiment;
- the cycle of the machine to be used;
- the characteristics to be assessed;
- the experimental process envisaged which determines the type of load and the number of replications.

6.2 Naturally soiled fabrics

Naturally soiled fabrics are the essential component of the load and shall be used to assess most performance aspects, such as cleaning (soil removal), stain removal and overall appearance. The characteristics may be assessed from two different points of view :

a) the influence of the detergent after a single wash (after one wash of many family bundles);

b) the effect of the detergent after several wash and wear cycles (after ten or more washes of the same articles).

These will give different answers since some effects appear only after several washes. Only the multi wash and wear procedure will truly reflect the overall performance of the detergent, and this procedure should always be used for the complete assessment of products.

In both cases, the load shall include articles in common use in average families. Typical are sheets, pillow cases, shirts, vests or undershirts, tea-towels, terry-towels, etc. The nature of the textile will determine the washing (programme) cycle to be used. For ease of grading whiteness and soil removal, white articles are preferred. When coloured articles are used to test colour fastness or to measure removal of stains on coloured fabrics by colourless liquid, they should not be washed with white loads because dye transfer may interfere with measurements to be made on white fabrics.

6.2.1 *Single wash assessment*

This method requires a large supply of family bundles. Loads are prepared by selecting from these bundles identical articles of about equal soil level and type (assessed visually). These selected articles will be used for grading after each load has been washed in a detergent. Other test pieces may be added as desired and the loads made up to normal mass by a mixture of articles drawn from the same family bundles. Care shall be taken to balance the loads as much as possible for article type, dimensions, and the nature and level of soil, and to use a sufficient number of loads to ensure that the results have the required statistical significance.

The main limitations of this method are the unknown history of soils and stains on the fabrics, no measurement of cumulative effects and, unless individual articles are cut in half, no reliable comparisons of soil/stain removal performance between detergents.

6.2.2 *Multi wash and wear assessment*

The only way to take into account the cumulative effects of washing in a detergent is to use the wash and wear procedure, whereby articles are worn or used, washed, graded and then the cycle is repeated. It is necessary to identify from wash to wash the articles to be treated with each particular product. The advantages of this technique are the following :

a) it can start with new articles, which eliminates the risk that previous usage will influence the results;

b) there is no need to separate family bundles into a number of identical articles; new articles may be provided as required by the experiment;

c) the load is well defined and reproducible from wash to wash; it consists mainly of test articles with only a small addition from family bundles to make it up to the normal mass; [a number of families sufficient to give statistically significant results (if possible, ten or more) should be included.]

The major disadvantages of this technique are the time and cost of the test. Experience has shown that it takes a minimum of ten successive wash and wear cycles for the results to begin to stabilize. On the other hand, this is the only method known to date to determine realistic differences between products. The one-wash technique will never, by definition, show the cumulative effects and, in most cases, will only measure large differences between products.

The table in 6.5 gives some proposals for the use of naturally soiled loads.

6.3 Standard soiled and artificially stained test pieces

Standard soiled and artificially stained test pieces are only of value in obtaining additional information on some performance aspects.

Experience has shown that standard soiled test pieces, when used to appraise most characteristics such as soil removal or overall appearance after the wash, do not give results that correspond to naturally soiled articles. The reason is that standard soils are limited to a small number of substances, while natural soils are very complex. Standard soils are applied at much higher levels and by a much greater variety of processes (for example from solvents) than are natural soils; in many cases, carbon black is the major component, although it is rarely a significant factor in natural soil; results vary considerably with different types of standard soiled fabrics; ageing decreases soil removal from a given batch of soiled cloth. However, some correlation is found with certain simple characteristics of the washing process, such as load size, rate of mechanical agitation, or water temperature.

The table in 6.6 gives an example of the use of artifically stained test pieces. An evaluation of the stain-removal properties of a detergent should include the variety of stains most often found on articles in a particular country (food stains vary greatly from country to country).

The nature of the test pieces should correspond to the load under investigation. For instance, when testing the bleaching efficiency on synthetic fibres, stains should be applied on pieces made of the appropriate textiles, and again, the stains should be appropriate to the particular country.

6.4 Unsoiled test pieces

Unsoiled test pieces may be used to assess aspects of soil redeposition, dye transfer, fabric damage, deposition and fluorescent effects. For this purpose, repeated washes, together with naturally soiled articles are required.

The table in 6.6 gives examples of unsoiled test pieces for the appraisal of various characteristics.

The unsoiled test pieces are specified in ISO 2267, and the methods of analysis and test in ISO 4312.

One of the limitations of this assessment is the absence of the wear effects such as soil, stress, and light.

6.5 Variables for naturally soiled loads

Main variables	Secondary variables	Essential conditions for the test	Reasons and interactions
Family bundles of unknown history (6.2.1).	Large number of families to give cross-section of equally soiled bundles	Light and heavily soiled articles are eliminated to balance the soil between the loads.	Loads for each detergent should contain equal amounts of soil. A large number of bundles is necessary for statistical purposes.
	Smaller number of families with similar soiled articles	Similar articles are cut in half to compare two detergents.	The sectioned articles ensure equal soiling between loads.
Family bundles with new articles (6.2.2)	Each family to give articles consisting of sheets, pillow-cases, shirts, vests or under-shirts, tea-towels and terry-towels.	Sufficient new articles to make up equal loads of matched fabrics for each detergent.	To even out soiling, each family supplies two loads to compare two detergents.
	Each family should supply a limited range of new articles.	Terry-towels, tea-towels, shirts and pillow-cases are essential articles in certain countries. The remainder of the load may consist of miscellaneous articles from the family bundles.	Each family should supply a minimum of two articles to compare two detergents. Terry-towels provide human soils and stains; tea-towels provide food soils and stains.

NOTES

1 Naturally soiled fabrics may be made from cotton or synthetic fibres, according to the assessment of the detergent to be made.

2 Naturally soiled loads should include those fabrics most commonly used as laundry items in the country for which the testing is intended, unless fabric types are among the variables being evaluated.

6.6 Variables for artificially stained and unsoiled test pieces

Different test pieces for	Test piece variables	Essential conditions for the test	Reasons and interactions
Stain removal	Range of textiles with stains normally found in homes in a given country.	Most common stains applied to the textile types corresponding to the cycle and load under study. Artificial stains may be added.	To be representative, most stains peculiar to the country should be included. The textile type plays a prime rôle in the case of soil removal, as does the washing cycle.
Deposition	Unsoiled white or black test pieces.	Include enough white or black textile pieces at the beginning of the test so that some sample pieces may be removed at desired intervals, while others will remain to the completion of the test. A minimum of twenty-five washes may be required.	Deposition due to the deposit of salts from hard water and residues depends on washing conditions and the type of textile.
Redeposition of soil	Unsoiled white test pieces	Include enough white textile pieces at the beginning of the test so that some sample pieces may be removed at desired intervals, while others will remain to the completion of the test. A minimum of twenty-five washes may be required.	Redeposition of soil depends on the washing conditions and the type of textile.
Colour fastness	Range of coloured textiles found in a given country	Colour types shall correspond to the current usage for the textile considered.	
Fabric feel	Unsoiled knitted or terry-towel pieces.	Pieces of the textile type under test shall be dried according to normal practice in the country. Avoid ironing and too frequent handling.	Fabric feel (softness) is strongly influenced by drying, ironing conditions and the amount of handling.
Fabric damage	Unsoiled test pieces	Standard pieces of the textile type under test and finished garments. At least twenty-five and sometimes up to fifty washes are necessary to assess a small effect.	If possible, use pieces which allow separate measurement of physical and chemical damage. It is difficult to separate the effect of the detergent from the effect of the other variables (wearing, machine).

7 WASHING PROCESS

7.1 General comments

The washing process shall correspond to the current practices in the country for which testing is intended. Two main categories of wash are to be considered, namely the hand wash and the machine wash.

For practical reasons, this guide is limited to the machine wash. Most variables for a machine wash will also apply when describing a hand wash. Some products are not compatible with certain types of washing machine and should only be tested in either the hand wash or in an appropriate machine.

The experiment should be run in the type or types of machine which are most common in the country for which testing is intended. Where automatic machines do exist and are compatible with the products under test, they should be preferred, even though they may not be the most widespread. Automatic machines make the operation easier and ensure a better reproducibility. 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.) may distort completely the product comparison.

The variables governing the washing conditions may be divided into several categories :

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

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

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

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

The variables given in 7.2 are not necessarily independent. Their levels depend on the type of load to be washed. Generally, a manufacturer will state, on the packet of a washing product, the types of load he claims it can wash and will give some indications on how to wash these loads. Most often, these indications correspond to washing cycles and washing conditions specified on the ISO care code label (see ISO 3758). A product should not be tested under conditions other than those recommended. If a product is recommended for a washing process which differs from that normally used in the country, it should be tested following the recommended procedure. It would not be logical for instance, to test in the main wash a product which is recommended for pre-wash only.

If it is current practice in a country to carry out separate bleaching (chlorination treatment), this shall be considered as one of the washing process variables.

The application of heat and pressure in ironing may fix deposits of salts and residues and unremoved or redeposited soil and hence those articles which are ironed in practice, together with relevant test pieces, shall also be ironed after each wash cycle in testing. Care shall be taken to ensure that there is due control of the temperature, pressure and time so that practical ironing conditions are reproduced, otherwise unrealistic results may be obtained.

7.2 Washing process variables

Main variables	Secondary variables	Essential conditions for the test	Reasons and interactions
Washing machine	Type	The common type in the country for which the testing is intended An automatic model is preferred, if available.	In Europe, horizontal drum type (top or front loading) In the U.S.A., vertical top-loading agitator type An automatic machine improves reproducibility.
	Installation	The machines shall be installed according to the manufacturer's specifications.	
	Number of machines	If one machine is used, its precise action shall be checked during the different operations both before and during the experiments. If several machines are used, they shall be of the same model and their precise action shall be checked.	See general comments.
Cycles	Water volume[1]	*Automatic* Normally programmed by the machine manufacturer for each cycle *Non-automatic* For non-automatic and non-programmed machines, the recommendations given by the manufacturer shall be followed.	The consumer shall follow the instructions concerning the machine and will be able to control this variable.
	Time Temperature[2] Rinse Spin	In general, use the cycle corresponding to the load to be tested. If a product requires a specific cycle, it shall be tested under these specified conditions. When a pre-wash is common practice, it shall be included in the cycle. For non-automatic machines, follow the instructions	The consumer shall choose the cycle based either on the machine or fabric manufacturer's recommendations or on those of the detergent manufacturer. A pre-wash or soak may change the performance of the products.
Load size	Machine type Cycle	Follow the machine manufacturer's recommendations for the particular cycle.	Too large a load for a machine may obscure product differences.

1) Fluctuations in water pressure may affect water volume in automatic washing machines and hence may also affect test results. Therefore, the water volume provided by the selected machine settings should be measured initially and care should be taken to maintain this volume throughout the test.

2) In some situations, the water temperatures for washing and rinsing may be determined by the machine cycle used for testing. If water temperatures may be freely selected, two or more wash temperatures should be used, since different types of washing products may not respond in the same manner in different temperature ranges.

Main variables	Secondary variables	Essential conditions for the test	Reasons and interactions
Water	Hardness	If only one water hardness is to be tested, use the average water hardness for the country. Preferably, use three water hardnesses, one at a lower, one at the average and one at a higher level of the hardness range for the country. Check the stability of the water hardness. 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. Hardness may vary from day to day and even within one day. Artificially prepared hard water may be necessary to eliminate the danger of trace metal contamination and hardness variations.
Water	Initial temperature	The initial temperature shall be constant within ± 3 °C.	The initial temperature often influences the length of the cycle or the final temperature.
Detergent	Sampling	The amount for each wash shall be prepared in advance, using standard sampling procedures.	Unless care is taken in preparing for sampling, some segregation may occur during product storage and handling.
	Addition	If the method of addition is not programmed, follow the instructions. Programmed by the machine manufacturer for each cycle.	The consumer shall follow the machine or fabric manufacturer's instructions. The consumer does not always control this variable.
	Amount	Preferably, follow the detergent manufacturer's recommendation for the cycle and type of load investigated. Under-dosage may also be investigated. Equal cost amounts may also be investigated, if the cost as supplied can be established with accuracy.	Recommended dosage is the manufacturer's responsibility, as is the product formula and density. Under-dosage frequently occurs in practice and may reveal important product differences. For products sold on the basis of cost advantage.
Additive products (bleaching agent, soak and presoak products, softening agent etc.)	Amount	The manufacturer's recommendations shall be followed.	In certain countries, the use of a separate bleaching agent (chlorine) is normal practice.
	Addition	The method and periods of introduction may also be investigated according to the customs in the country.	The periods of addition may greatly modify the product performance and have an influence on all the results.
Additional operations	Drying	Ideally, use the drying method which is most common in the country if reproducibility can be assured. If not, use a tumbler dryer.	The action of the air and the sun may have a different effect on articles washed in different products.

Main variables	Secondary variables	Essential conditions for the test	Reasons and interactions
	Ironing	Follow the instructions on the fabric care label for the temperature of ironing.	Articles which are ironed in practice, together with relevant test pieces, should be ironed in order to fix deposits of salts and residues and unremoved or redeposited soil. Ironing is necessary for some articles in order to give them an identical surface appearance before grading. The method of ironing may have a great influence on all the results.

8 METHODS OF APPRAISAL

8.1 Visual assessment

For the major characteristics corresponding to the consumer's appraisal, visual assessment is the only way to obtain satisfactory results.

In certain areas the human eye is more sensitive than any instrument and is more able to detect residual soils or stains (for example to combine size, shade and intensity). Owing to the great variety of residual soils, absolute scales for reference cannot be established and, as the human eye is not reliable for objective assessment, the only method is to use a grading system based on paired comparisons. The results obtained with one product are compared with the results obtained with all the other products. A balanced experiment is designed to minimize the total number of paired comparisons which should be carried out.

This visual assessment requires a carefully selected panel of expert judges representing consumers' judgement. This panel is most important to ensure the quality of the grading. The conditions under which the panel work are also subject to a number of rules to facilitate the grading and avoid bias.

This system of paired comparisons gives a preference grading and therefore corresponds to the consumer's appraisal, which is the objective of product assessment. Interpretation is rather easy as it gives directly, for the characteristics being assessed, a preference grading based on articles which have been examined in a realistic way.

Paired comparison may also be used to assess fabric feel or creasing of fabrics which have been treated to make them permanently crease-resistant or fabrics made from chemical fibres, as no instrument is available to assess this variable.

8.2 Use of optical and physical instruments

For the assessment of certain characteristics (for example stain removal, brightening, tensile strength), when artificially stained or unsoiled test pieces have been used during the experiments, measurements by means of instruments may be made. Normal statistical techniques may then be used to obtain a mean result and the confidence limits, but the interpretation of such results in terms of consumers' preference is difficult and great care shall be taken when drawing conclusions from them.

The table in 8.3 gives a list of the major variables and suggests the type of appraisal to be made.

8.3 Assessment of variables

The opinion of the panel in relation to the relative importance of these variables shall be biased according to the preferences of the consumer.

Variables	Type of measurement	Comments
Soil removal	Panel judgement	The light sources used to check the fabrics shall be standardized and shall not vary from one measurement to another or during a measurement. Non-fluorescent light to eliminate brightening effects
Stain removal		
— natural stains	Panel judgement	
— artificial stains	Instrument	
Visual whiteness		Normal light, including ultra-violet hue effects are evaluated simultaneously.
— normal articles	Panel judgement	
— test pieces	Instrument	Fluorescence and whiteness measurements
Redeposition	Panel judgement	In most cases, the human eye can differentiate between redeposition and possible dye transfer.
— test pieces	Instrument	
Overall appearance — normal articles	Panel judgements under various light sources	Requires a large number of judges to balance individual opinion on the relative significance of the various components (soil removal, redeposition, etc.).
Fabric feel	Panel judgement	
Fabric damage — test pieces	Instrument	The degree of polymerization or the fluidity index of the cellulose and the tensile strength give an estimate of the chemical and physical damage.
Fabric colour — test pieces	Panel judgement	The panel may estimate the degree of the change, if any.
	Instrument	The instrument may follow the colour change from wash to wash.
Fabric deposition — test pieces	Instrument (chemical analysis) Panel judgement	Deposition (amount and nature) helps one to assess residues and fabric feel.

9 PHYSICAL CHARACTERISTICS

9.1 General comments

The physical characteristics of the detergent depend on its chemical composition and its manufacturing process. Detergent products having similar chemical compositions may nevertheless have different physical characteristics and consequently different properties from the point of view of performance; for example, the speed at which it dissolves may have an effect on the performance of the product. Thus, it is obvious that the chemical composition alone cannot predict product performance.

The physical properties of a detergent usually change during its life and alter during shipment and storage.

Obviously, it is the manufacturer's responsibility to keep the physical characteristics of the detergent as constant as possible throughout its life but, in order to be fair, if it is intended to compare certain physical characteristics of different detergent samples, this shall be done on samples of approximately the same age, stored under the same conditions.

A washing powder may be characterized according to different physical variables. These variables are not of equal importance in terms of product performance. Some concern aesthetic aspects only, and some concern the ease of use but do not have a direct influence on the product performance. Others affect more specifically the efficiency of the washing operations.

In addition, the extreme importance of certain physical variables shall not be neglected when sampling a detergent for comparative testing as well as for an analytical determination.

The physical properties may be divided into a number of variables which affect performance and other variables which affect the choice of the consumer. The former are fully covered (see 9.2) as defined in clause 1, while the latter are simply noted (see 9.3).

9.2 Variables affecting the results

Variables	Sub-variables	Essential conditions for the test	Reasons and interactions
Density	Fresh	Packages will be handled in the same way before measurement.	The density alters during shipment and therefore the amount of detergent assessed by volume varies.
	After shipment and storage	The same package size will be used for the comparisons. The same measuring method and apparatus shall be used for the comparisons	The density may vary from size to size, depending on handling. Density values vary with the measuring method and the apparatus.
Homogeneity	Fresh After shipment and storage	Use a standardized sampling procedure.	Shipment conditions may give rise to segregation. Homogeneity shall be examined only on samples similarly handled.
Solubility	Rate Absence of insolubles	Solubility shall be examined under normal conditions of use, time and temperature, etc.	Solubility depends on several variables, namely : water hardness, temperature, time, agitation, detergent/water ratio, method of addition, particle size, density, homogeneity.
Dispensibility	Shape of dispenser Cleanliness of the dispenser Water pressure Water temperature Water flow rate Water flow time	In the case of a machine fitted with a dispenser, it shall be ensured that all the product leaves the dispenser.	Products may vary according to secondary factors. Bad dispenser design may distort the product performance. This is a dispenser fault and shall be indicated.
Sudsing properties	Level/amount Over-sudsing	This shall be measured during the normal conditions of actual cloth washing. The risk of over-sudsing shall be based on several experiments in order to be meaningful. Measurement of sudsing shall be carried out only with naturally soiled loads.	Sudsing is not necessarily an indication of good performance. Excessive sudsing adversely affects the performance of the product in drum-type machines. Several variables affect suds, principally temperature, amount of detergent, water hardness, and the amount of soil.

NOTE — The measurement of the density and the homogeneity should be carried out before the washing experiments begin. The other physical properties are best assessed during washing since the measurements must be carried out under realistic conditions in order to be meaningful.

9.3 Other variables

Colour, odour, particle size and appearance, absence of dust, hygroscopicity, caking properties, pourability properties.

While being essentially an accepted parameter, hygroscopicity may also have an effect on the properties of caking and pourability, which in turn may have an effect on the distribution of the product.

Hygroscopicity alone is often not significant as the package quality plays an important rôle. If this variable is measured, new unopened packages shall be used.

If some caking is found, it should be reported whether the product was broken up or used in a lumped state, this representing a consumer variable. If broken up, the ease of breaking the lumps should also be assessed and reported.

10 REPORT ON THE RESULTS AND INTERPRETATION

Although the final conclusion remains the responsibility of the laboratory running the experiment, the following recommendations may help in the preparation of an objective and significant table of results.

a) Each characteristic is independent and emphasizes a different aspect of the performance. There is no way of combining them into a single figure. In fact, each consumer may have a different opinion on which is most important, and reporting each characteristic separately may help him to make a choice.

b) The panel assessment generally gives directly the grading of products for the characteristic considered, but it does not give absolute values and does not allow products to be graded, for example, on some arbitrary "cleaning" scale.

On the other hand, instrumental measurements are generally made on standard soiled and artificially stained fabrics. As a result, the values so obtained do not represent reality. A product may remove 100 % of a natural stain in practice and only 25 % of a corresponding artificial stain. These absolute values are therefore generally theoretical and do not correspond directly to the needs of the consumer.

c) The report shall clearly describe in detail the experimental conditions of the test and give a description of the methods used.

d) The report shall include at least the mean value of each characteristic and/or the statistical parameter which determines the significant differences at a given confidence level.

It is essential to remember that a difference may be significant statistically, even though it may be too small to be noticed by the consumer. Conversely, bigger differences may not attain statistical significance if the error is too great (often because not enough repeated tests have been carried out).

e) In the case of the panel assessment by paired comparisons, there can be no mean value but products may be graded against each other or against a reference product.

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