इंटरनेट मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार"
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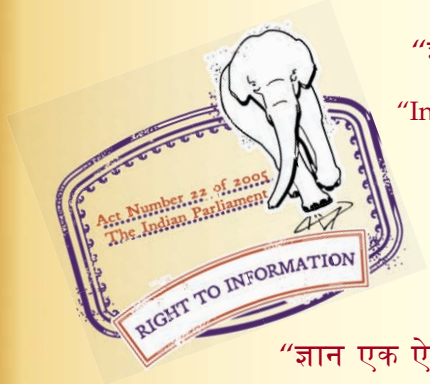
"The Right to Information, The Right to Live"

"पुराने को छोड नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS 14155 (1994): Domestic electric clothes washing machines for domestic use (Superceding IS 6390(Part 1):1983 and IS 6390 (Part 3): 1992 [ETD 32: Electrical Appliances]



"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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IS 14155 : 1994
[Superseding IS 6390 (Part 1) : 1983 and
IS 6390 (Part 3) : 1992]

भारतीय मानक

(Reaffirmed 2004)

कपड़े धोने की बिजली की घरेलू मशीनें — विशिष्टि

Indian Standard

DOMESTIC ELECTRIC CLOTHES WASHING MACHINES FOR HOUSEHOLD USE — SPECIFICATION

(First Reprint AUGUST 1996)

UDC 648·23 : 614·825

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

December 1994

Price Group 8

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Electrical Appliances Sectional Committee had been approved by the Electrotechnical Division Council.

This standard covers the general, safety and performance requirement of electric clothes washing machines, to water extracting machines and to washing and water-extracting machines, either with or without heating devices, for household use.

This standard shall supersede the following standards. The requirements of which have been incorporated in this standard:

IS 6390 (Part 1) : 1983 Domestic electric clothes washing machine : Part 1 Machines without tumbler dryers and spin extractors (*first revision*)

IS 6390 (Part 3) : 1992 Domestic electric clothes washing machines : Part 3 Requirements for spin extractions

As per the decision of the third meeting of Electrotechnical Division Council, separate standards on safety of domestic electric clothes washing machine and spin extractors have been brought out. In this composite standard instead of giving details of safety requirement, reference has been made to safety standard IS : 302-2-7 (1993) 'Safety requirement for household and similar electrical appliances : Part 2 Particular requirements, Section 7 Washing machine' and IS 302-2-4 (1993) 'Safety of household and similar electrical appliances : Part 2 Particular requirements, Section 4 Spin extractors'.

In this standard the performance characteristics and their method of tests have also been aligned with the corresponding IEC Publication.

While preparing this standard, assistance have been derived from IEC Publication 456 (1974) 'Methods of measuring the performance of electric clothes washing machines for household use'.

The use of artificially soiled textile materials, which was selected at this stage, solves the problems of reproducibility, but doubt has been expressed whether such a technique ensures sufficient correlation with practical use. It may still be possible, however, to find better artificial soils or combinations of such soils than those already included in this standard and in order to assist with the solution of the problem of producing a satisfactory artificial soil, practical experience with the methods of measurement prescribed is needed.

It is be hoped that such experience will be gained by the use of the present standard. With this in view, any laboratory which has obtained reliable experience in comparing the results of washing with different soiling techniques is invited to convey this information to Bureau of Indian Standards.

For the purpose of deciding whether a particular requirements of this standard is complied with, the final value, observed or calculated, expressing the results of a test, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be same as that of the specified value in this standard.

AMENDMENT NO. 1 OCTOBER 2011
TO
IS 14155 : 1994 DOMESTIC ELECTRIC CLOTHES WASHING MACHINES FOR HOUSEHOLD USE — SPECIFICATION

(*Page* 1, *clause* **1.1**, *first sentence*) — Substitute the following for the existing:

'This standard covers general, safety and performance requirements of domestic electric clothes washing machines including semi-automatic washing machines, water-extracting machines and washing and water-extracting machines, either with or without heating devices, for household use, their rated voltage not exceeding 250 V, ac single phase or dc.'

(*Page* 2, *clause* **3.2.12**) — Add the following new clause after this clause:

'**3.2.13** *Semi-automatic/manual washing machine*

A semi-automatic/manual washing machine is the machine which requires user intervention at one or more points during the programme to enable the machine to proceed to the next operation.'

(*Page* 5, *clause* **11.1.2**) — Substitute the following for the existing:

'**11.1.2** The removal of pigments of vegetable fat and spices, the specimen used being soiled with Indian curry.'

(*Page* 6, *clause* **11.2**, *first sentence*) — Substitute the following for the existing:

'The test is performed with square specimens measuring 150 ± 20 mm × 150 ± 20 mm cut from the fabric and carrying different types of standard artificial soiled and joined together in a strip with the different kinds of soil in the following order:

carbon black; mineral oil; Indian curry; chocolate and milk; and red wine.'

(*Page* 15, *Annex* B, *clause* **B-1.2**) — Substitute the following for the existing:

'**B-l.2** Specimen based on Indian curry enabling the removal of pigments of this common soiling due to pigments from vegetable oil and spices.'

(*Page* 15, *Annex* B, *clause* **B-3.1.2**) — Substitute the following for the existing:

'**B-3.1.2** *Composition of Soil Based on Indian Curry*

A stock solution of the following composition:

i)	Turmeric powder	:	1.0 g
ii)	Chilli powder	:	1.0 g
iii)	Common salt	:	1.0 g
iv)	Water	:	10.0 ml
v)	Refined cooking oil	:	90.0 ml'

B-3.1.2.1 *Preparation procedure*

'The soiling mixture for standard soiling of swatches of Indian curry is prepared by mixing the ingredients listed at **B-3.1.2**, in the quantities indicated. The stock solution is heated to fuming state (for about 5 min), cooled and used to prepare the solution for soiling of swatches. The water present in oil gets evaporated due to high temperature. Based on the above composition, 30 g/l solution is prepared by diluting requisite amount of cooled stock solution (30 g) in 1 litre carbon tetrachloride as a solvent. This mixture is applied through pad-dry process. The pad-dry operation is continued till required percentage reflectance value is attained.'

(*Page* 15, *Annex* B, *clause* **B-3.1.4**, *first sentence*) — Substitute the following for the existing:

'Composition of soil based on any Indian regular red wine.'

(ET 32)

Reprography Unit, BIS, New Delhi, India

Indian Standard

DOMESTIC ELECTRIC CLOTHES WASHING MACHINES FOR HOUSEHOLD USE — SPECIFICATION

1 SCOPE

1.1 This standard covers general, safety and performance requirements of domestic electric clothes washing machines, to water-extracting machines and to washing and water-extracting machines, either with or without heating devices, for household use, their rated voltage not exceeding 250 V, ac single phase or dc.

It also applies to combinations of these machines with heated driers. Requirement and method concerning the performance of these latter appliances are under consideration.

NOTE – Washing machines for commercial use in blocks of flats or in launderettes are within the scope of this standard, but machines for commercial laundries are not included.

1.2 In addition the provision given in 1 of IS 302-2-7 (1994) for washing machines and IS 302-2-4 (1993) for spin extractors shall apply.

1.3 The standard states and defines the principal performance characteristics of household electric washing machines of interest to the users and to describe the standard methods for measuring these characteristics and their requirements.

2 REFERENCES

2.1 The following Indian Standards are necessary adjuncts to this standard.

IS No.	*Title*
302-1 (1979)	Safety of household and similar electrical appliances : Part 1 General requirement (*fifth revision*)
302-2-7 (1994)	Safety of household and similar electrical appliances : Part 2 Particular requirement, Section 7 Washing machines
302-2-4 (1993)	Safety of household and similar electrical appliances : Part 2 Particular requirements, Section 4 Spin extractors

3 TERMINOLOGY

3.1 In addition to the terminology given in 2 of IS 302-2-7 (1994) for washing machines and IS 302-2-4 (1993) for spin extractors.

3.2 Terms Used to Designate the Appliances

For the purpose of this standard, the following definitions shall apply.

3.2.1 *Electric Clothes Washing Machines*

An appliance designed to wash textile materials by mechanical actions, the necessary energy being electrical (*see also* Annex A).

3.2.2 *Water-Extracting Machine*

An appliance designed to extract washing water from textile materials by mechanical action, the necessary energy being electrical.

3.2.3 *Washing and Water-Extracting Machine*

An appliance permitting complete washing and water-extracting to be carried out by mechanical action, the necessary energy being electrical.

3.2.4 *Agitator-Type Washing Machine*

A machine in which the textile material is substantially immersed in the washing water; in which the mechanical action is produced by a device moving about or along its vertical axis with a reciprocating motion.

3.2.5 *Impeller-Type Washing Machine*

A machine in which the textile material is substantially immersed in the washing water; in which the mechanical action is produced by a device rotating about its axis with a motion which may be continuous or may reverse after a number of revolutions.

3.2.6 *Drum-Type Washing Machine*

A machine in which the textile material is placed in horizontal or inclined drum and partially immersed in the washing water, the mechanical action being produced by rotation of the drum about its axis, the moment being either continuous or periodically reversed.

3.2.7 *Spin Extractor*

A water-extracting machine in which water is removed from textile materials by centrifugal force.

3.2.8 *Single Container Washing and Water-Extracting Machine*

A machine in which the washing and water-extracting operations take place in the same container.

3.2.9 *Double Container Washing and Water-Extracting Machine*

A machine in which the washing and water-extracting operations take place in separate containers and in which the textile material has to be removed from one container to the other by hand.

3.2.10 *Washing Machine Incorporating a Complete Heating Device*

A machine incorporating a heating device and designed to be fed with cold water.

3.2.11 *Washing Machine Incorporating a Complementary Heating Device*

A machine incorporating a heating device and designed to be fed with preheated water.

3.2.12 *Wringer*

A water extracting machine in which water is removed from textile materials by pressure exerted between rotating rollers.

3.3 Terms used to Designate the Characteristics of Appliances

3.3.1 *Rated Capacity*

The maximum mass of dry textile material, in kilogrammes, which the manufacturer declares can be treated in a single operation or cycle operations.

NOTES

1 If in washing and water-extracting machine the rated capacities for washing and water extracting differ, both capacities shall be stated.

2 In case the manufacturer gives two limits for the rated capacity, for example, 4.5 to 5 kg, the greater will be chosen for the measurements.

3.3.2 *Volume of an Agitator or Impeller-Type Washing Machine*

The inside volume, in litres, of the tub available for the movement of the textile material up to the nominal high water level as determined by the machine controls or the manufacturer's instructions.

3.3.3 *Volume of a Drum-Type Washing Machine or Spin Extractor*

The inside volume, in litres, of the drum in which the textile material is placed, after subtraction of ribs or other inward forms, etc.

4 GENERAL REQUIREMENTS

4.1 The provisions of 3 of IS 302-2-7 (1994) for washing machine and IS 302-2-4 (1993) for spin extractor shall apply.

5 GENERAL NOTES ON TESTS

5.1 The provisions of 4 of IS 302-2-7 (1994) for washing machine and IS 302-2-4 (1993) for spin extractor shall apply.

5.2 The general conditions of measurement shall be as follows in addition to those given under **5.1**.

5.2.1 *State of Machine*

The measurements shall be carried out on a new machine installed as in use in accordance with the manufacturer's instructions. Before commencing measurements the machine shall be checked to see that it complies with the manufacturer's specification. Before commencement of measurements the machine shall be run and checked at least once rinse spin.

5.2.2 *Supply Voltage and Frequency*

The supply voltage shall be maintained at the rated voltage of ± 2%. When the appliance is specified by a rated voltage range, the measurements are to be carried out at a voltage equal to the mean value of the range with a tolerance of ± 2%. The supply frequency shall not differ by more than 1% from the rated value.

5.2.3 *Ambient Temperature*

The ambient temperature of the room shall be maintained at 27± 5°C throughout the measurements. When the measurements are carried out at a temperature different from 27 ± 5 °C, this temperature shall be stated in the measurement report.

5.2.4 *Characteristics of Water Used*

For the measurements distilled or deionized water of not more than 250 ppm shall be used. "Water hardness" is used. The type of water used shall be stated in the measurement report.

The temperature of supply water shall be :

- for machines incorporating a complete heating device : 30 ± 5 °C;
- for machines incorporating a complementary heating device 55 ± 5°C;
- for machines not fitted with a heating device temperature indicated by the manufacturer or 55 ± 5° C; if instructions are not given;
- for machines incorporating a complete heating device but employing both hot or cold water feeds;
- for cold water feed : 30 ± 5°C; and
- for hot water feed : temperature as indicated by the manufacturer or 55 ± 5°C if instructions are not given.

When the measurement is carried out with a water temperature different from the limits above, this temperature shall be stated in the measurement report.

The pressure of supply water shall be within the range indicated by the manufacturer and shall be stated in the measurement report.

5.2.5 *Detergent*

Measurements requiring a detergent are carried out with one of the standard detergents, the composition of which is given in Table 1.

5.2.6 *Standard Load*

Measurements requiring the use of a wash load are carried out with a load of textile material equal to the rated capacity as defined in **3.2.2**. The material shall consist of clean hemmed pieces of the cotton textile without dressing, defined hereunder.

The weight of the standard load is determined after it has been left for 24 h exposed to the air, with a relative humidity between 60% and 70%, at a temperature of 27 ± 2°C.

NOTES

1 If it is not possible to carry out the above conditioning, it can be replaced by the following treatment (so-called 'Bone dry') ;

Place dry load in a drier and dry for 10 min depending upon the load size. Remove and weigh before cool down. Repeat these operations with 10 min drying periods until the final weight change is 1 percent or less.

The so obtained "bone dry" weight increased by 8 percent is taken as the weight of the load. This procedure is only

suitable for clean cloth as soils tend to be "fixed" by heating.

The material comprising the load shall have been submitted to at least 20 washing cycles and not more than 60 washing cycles.

2 The recommended characteristics of textiles for unsoiled cloth shall be as follows:

Number of Threads per Centimetre in wrap : 25 ± 2 . threads of 27 ± 2 tex ;

Number of threads per centimetre in weft : 25 ± 2 Threads of 30 ± 2 tex;

Mass per square metre : 140 to 175 g, after conditioning, at 27 ± 5°C and 65% ± 10% relative humidity ;

Width : At least 80 cm;

Tensile strength in wrap : At least 50 kgf, determined on a 50 mm wide test sample as above;

Fluidity value : Between 4 and 5 reciprocal poises, or degree of polymerization between 1 700 and 1 550; and

reflectance (measured immediately after the preparatory treatment) : Greater than 86.

Table 1 Composition and Concentration of Standard Detergent

(*Clause* 5.2.5)

	Parts by Mass
Linear sodium alkyl benzene sulphonate (Mean length of alkane chain : C 11.5)	6.4 percent
Ethoxylated tallow alcohol (14 EO)	2.3 percent
Sodium soap (chain length C 12 to 16 : 13 to 26% C 18 to 22 : 74 to 87%)	2.8 percent
Sodium tripolyphosphate	35.0 percent
Sodium silicate (SiO_2 : 76.75% and Na_2O 23.25%)	6.0 percent
Magnesium silicate	1.5 percent
Carboxy methyl cellulose	1.0 percent
Ethylenediamine-tetra-acetic-sodium-salt	0.2 percent
Optical whitener for cotton (dimorpholinostibene type)	0.2 percent
Water	7.8 percent
Enzymes	0.4 percent
Sodium perborate tetrahydrate	20.0 percent
Activator	4.0 percent
Sodium sulphate (as accompanying substance or added)	Remainder
In case of machines with heating device :	
– Use sodium perborate and activator	
In case of machines without heating device	
– Use enzymes instead of perborate and activator	

NOTE – The detergent specified in the manufacturer's instructions may be used, but if there is any doubt with regard to the test results, the standard detergent as specified in Table 1.

These pieces have the following dimensions :

— Pieces representing sheets : 1 600 mm x 2 500 mm;

— Pieces representing tea towels : 600 mm x 800 mm ;

— Pieces representing hankerchieves : 400 mm x 400 mm

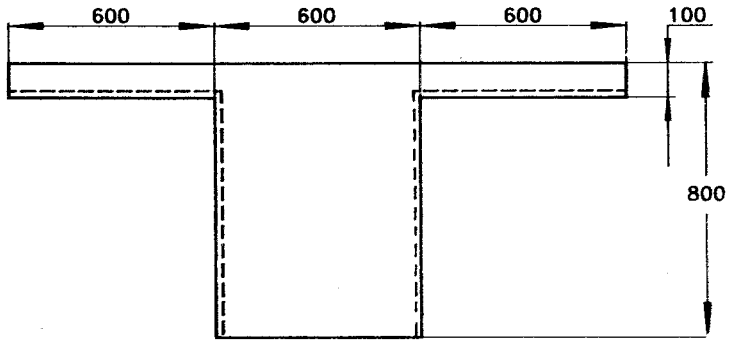
— Pieces representing shirts : As indicated in Fig. 1.

The pieces are distributed according to Table 2.

Table 2 Test Load

(*Clause* 5.2.6)

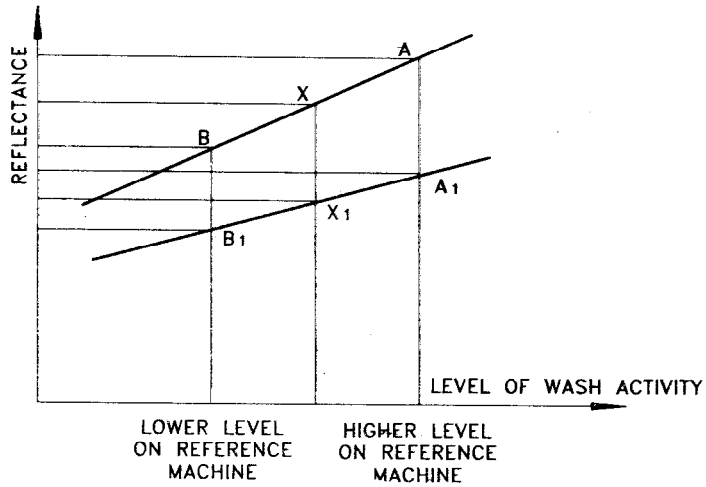
Rated Capacity (kg)	Number of Sheets	Number of Shirts
1	0	1
2	1	2
2.5	1	2
3	1	2
4	2	4
5	2	4
6	3	6
7	3	6
8	4	8
9	4	8
10	4	8



NOTE – The dimensions mentioned in the drawing refer to unsown pieces, they are measured on double thickness of cloth.

All dimensions in millimetres.

FIG. 1



A = Reflectance obtained from reference machine at high level of activity.
B = Reflectance obtained from reference machine at low level of activity.
X = Reflectance obtained from test machine.

FIG. 2

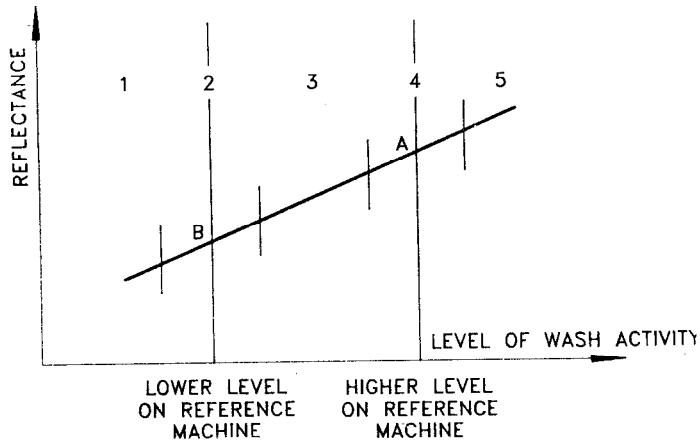


FIG. 3

The total mass of the tea towels and hankerchieves in the additional mass required to make up the rated load, the number of tea towels and the number of hankerchieves should be in the proportion of 2 to 1.

NOTE – In the case of an intermediate figure between those given by the table, the number of sheets and the number of shirts are the same as per the next lighter load.

6 RATING

6.1 The provisions of **5** of IS 302-2-7 (1994) for washing machine and IS 302-2-4 (1993) for spin extractors shall apply.

7 CLASSIFICATION

7.1 The provisions of **6** of IS 302-2-7 (1994) for washing machine and IS 302-2-4 (1993) for spin extractor shall apply.

8 MARKING

8.1 The provision of **7** of IS 302-2-7 (1994) for washing machine and IS 302-2-4 (1993) for spin extractor shall apply.

8.2 The washing machine and spin extractors may also be marked with Certification Mark.

8.2.1 The use of the Standard Mark is governed by the provisions of Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

9 SAFETY REQUIREMENTS

9.1 The washing machines shall comply with the requirements given in **8** to **32** of IS 302-2-7 (1994) for washing machine and IS 302-2-4 (1993) for spin extractor.

10 LIST OF MEASUREMENTS

10.1 Performance is determined by carrying out the measurements indicated in Table 3.

11 DETERMINATION OF THE WASHING PERFORMANCE STANDARD MEASUREMENT WITH A LOAD OF CLEAN MATERIAL AND STANDARDIZED SOILING

11.1 Principle of Measurement

The washing performance of a washing machine is characterized in the so-called "Standard measurement" by the reflectance, measured with a photocolorimeter, of different types of specimens with standardized degrees of soiling washed in the machine under test together with a load of clean linen, such as the one described in **5.2.6**.

NOTE – These standardized soilings may also be used with standardized loads of naturally soiled articles such as those described in Annex F.

The different types of soiling enable the following characteristics to be measured:

11.1.1 The scouring effect due chiefly to mechanical and thermal action, the specimen used being soiled with a mixture of carbon black and mineral oil.

11.1.2 The removal of protein pigments, the specimen used being soiled with blood.

11.1.3 The removal of organic pigments, the specimen used being soiled with chocolate and milk.

11.1.4 The bleaching effect, the specimen used being soiled with red wine.

The test is carried out under the following conditions.

Table 3 List of Measurement

(*Clause* 10.11)

Measurements	Clause	Washing Machines	Water Extracting Machines	Washing and Water Extracting Machines
Washing performance	11	x		x
Rinsing efficiency	13	x	x	x
Wear suffered by linen	If applicable			
Mechanical wear (weight of fibres detached, threads pulled out and folds)	12.3 to 12.3	x		x
Chemical wear and total wear, yellowing, greying	12.2	x		x
Water-extracting efficiency	14		x	x
Determination of water (Hot and cold) and energy consumption	15	x	x	x
Determination of mechanical detergent loss	16	x		x

11.2 Specimens

The test is performed with square specimens measuring 150 ± 20 mm x 150 ± 20 mm cut from the fabric and carrying different types of standard artificial soiled and joined together in a strip with the different kinds of soil in the following order : carbon black mineral oil, blood-chocolate and milked red wine. It is recommended that an unsoiled cloth sample of the same type as the soiled fabric should be attached along the strip as a blank control for the supporting fabric.

The definition of specimens with standardized soiling (supporting fabric, nature and application of the various kinds of soil) is given in Annex B and the constancy of these characteristics may be verified by the methods described in Annex B.

It is recommended to obtain the complete strip, suitably packaged, directly from the specimen manufacturer. If the Kubelka-Munk equations are used (*see* **11.6**) the reflectance of the specimens with standardized soiling is measured before washing.

The strip formed by joining specimens with the four kinds of soil, possibly with the addition of an unsoiled specimen, is large enough not to require the fixing of individual specimens to different items in the load.

The number of strips used for a washing test is proportional to the size of the load, and is determined as follows:

— 1 strip for a load up to 1.4 kg;
— 2 strips for a load up to 2.4 kg;
— 3 strips for a load up to 3.4 kg;
— 4 strips for a load up to 4.4 kg;
— 5 strips for a load up to 5.4 kg; and
— 6 strips for all loads greater than 5.4 kg.

For intermediate loads, the next lowest value in kilogrammes shall be taken into consideration.

11.3 Method of Measurement

At least five complete washing cycles are carried out in accordance with the manufacturer's instructions for white cotton fabric, excluding the special programme provided for bio-active detergents.

If more than one programme corresponds to this definition, the manufacturer shall state which programme is to be used.

If the machine is not provided with a timer, or if the manufacturer's instructions do not specify a washing time, the following shall be used:

— for impeller type machines, 4 min;
— for agitator type machines, 15 min;
— for rotating drum type machine (without heating device); and
— for rotating drum type machines with heating device: heating-up time + 10 min.

The concentration of the washing agent (*see* **5.2.5**) shall be in accordance with Tables 4 and 5.

Table 4 Concentration for Type I - Detergent

(*Clause* 11.3)

(For Tests with a Clean Load Plus Specimens Soiled with Artificial Soils)

Type of Machine	Concentration for		
	50 ppm	150 ppm	300 ppm
Agitator and impeller	2.5 g/l	3 g/l	4 g/l
Drumwithout prewashing	20 g/kg	25 g/kg	30 g/kg
Drum with prewashing :			
For prewash	12 g/kg	15 g/kg	20 g/kg
For main wash	15 g/kg	20 g/kg	27 g/kg

The total sum of the quantities of prewash and main wash detergents is mandatory; however, the ratio between the quantities used for the main wash and the prewash should be in accordance with the manufacturer's instructions, and in the absence of any such instructions, in accordance with the data given in the table.

Table 5 Concentration for Type II – Detergent

(*Clause* 11.3)

(For Tests with a Clean Load Plus Specimens Soiled with Artificial Soils)

Type of Machine	Concentration for Soft Water
Agitator and impeller	1.6 g/l
Drum	13.2 g/kg

NOTE – After each cycle, every piece is rinsed and dried before being used again.

11.4 Final Measurements

After each washing cycle, every strip is dried and ironed by a method in which "shine" is avoided (that is ironed between two pieces of fabric, or with an ironing machine). The duration and temperature shall be such that the specimen does not undergo any other alteration, in no case shall the sole plate temperature of the iron exceed 150° C.

The photocolorimeter used for measuring the reflectance shall be suitable for tristimulus measurements and a filter absorbing U.V. light is placed between the light source and the specimen. For the washing test, only the blue filter is used. The type of instrument and the measuring conditions shall be stated in the test report.

Before each measuring operation, the apparatus is set as follows:

Point 100 : Reference white (magnesium oxide)
Point 0 : Mechanical 0 (lamp disconnected or diaphragm closed)

Two measurements shall be on each side of each specimen, thus giving a total of 16 measurements per strip.

On photocolorimeters affected by orientation of the specimen, as in some single-beam instruments, the warp of the textile material should be parallel to the plane of the incident light. If this is impracticable, each measurement shall be repeated after turning the sample through 90 to provide an average for each position measured.

11.5 Data Analysis

The following calculations are carried out:

a) Average for each washing cycle;

For each of the n washing cycles the arithmetic mean $\bar{x}$ of the individual readings x obtained in **11.4.**

$$\bar{x} = \frac{x}{N}$$

where N = number of readings per wash.

b) Grand average for all washing cycles

The arithmetic mean of the n values calculated in item a)

$$\bar{X} = \frac{\bar{x}}{n}$$

c) Standard deviation between washing cycles:

$$\sigma = \sqrt{\frac{\Sigma (X - \bar{x})^2}{n}}$$

or if the number of cycles is less than or equal to 5

$$\sigma = \sqrt{\frac{\Sigma (X - \bar{x})^2}{n - 1}}$$

d) Standard deviation within a given washing cycle

$$\sigma = \sqrt{\frac{\Sigma (\bar{X} - \bar{x})^2}{N}}$$

This latter calculation being optional.

11.6 Expression of Results

The washing performance may be expressed for each type of soil separately, with reference to the scouring effect, removal of organic pigments and proteins, and bleaching effect of the machine:

— either by the absolute values measured under the conditions given in **11.4** and calculated as shown above.

— or by the ratio between the values obtained with the test machine and those obtained from the reference machine described in Annex C.

— or by calculating from the Kubelka-Munk equations given in Annex E the percentage of soil removed on a basis of the initial and final values of the reflectance of specimens soiled with standard artificial soil.

11.7 Principle of the Measurement

(For information with naturally soiled textile material)

The washing performance of a washing machine is assessed during the measurement "for information" by comparing the soil and stain removal on standardized loads of naturally soiled laundry articles achieved in the machine judged and in the reference machine described in Annex D, running simultaneously.

NOTE – It is requested that suitable values of performance may be suggested for incorporating the same in document.

12 DETERMINATION OF WEAR SUFFERED BY TEXTILE (DETERMINATION OF DEGREE OF MECHANICAL WEAR SUFFERED BY LINEN, BY MEASURING WEIGHT OF FIBRES DETACHED)

12.1 Principle of Measurement

The measurement consists in retaining the fibres after the washing and rinsing water is filtered and in weighing them.

NOTE – This test is given provisionally to allow introduction of tests for determination of total wear (by measurement of tensile strength), chemical damage (by measurement of fluidity or degree of polymerization) and yellowing, greying, etc.

12.1.1 *Standard Load*

The standard load composition is given in **5.2.6.**

12.1.2 *Method of Measurement*

The machine loaded, as indicated above, undergoes at least five complete washing cycles, carried out in accordance with the manufacturer's instructions for the longest programmed cycle excluding any programme especially meant for biological detergents. The washing agent and its concentration are indicated in **5.2.5** and **11.3.** No drying is carried out between cycles; after these five cycles, an additional rinsing cycle is carried out outside the machine under test in a large volume of water, at least 10 l kg.

The rinsing and washing water expelled from the machine is filtered by means of a strainer, the mesh rating dimension of which is 0.090 mm; the fibres retained on the strainer, as well as those recuperated inside the machine, particularly in the filter, the drum, etc, are separated for any other insoluble products retained and then dried in an oven at 80 °C, until weight is stabilized. The fibres are then conditioned as in **5.2.6** and carefully weighed.

12.1.3 *Method of Expressing Results*

The degree of wear suffered by the linen is characterized by the weight of the collected abraded fibres in grams per kg of washed dry linen. It may be compared with the value obtained with the appropriate reference machine described in Annex C.

12.2 Determination of Total Wear and Chemical Wear (Greying , Yellowing , Etc)

Under consideration.

12.3 Determination of Threads Pulled Out, Folds, Etc

12.3.1 *Principle of Measurement*

The measurement consists in counting faults, such as

threads pulled out, folds, holes, etc, occurring on a piece of light net curtain after washing in the machine.

12.3.2 *Standard Load*

The standard load consists of a rectangular bag made of material, the characteristics of which are stated hereunder, filled with pieces of the same material. The bag and filling should amount to 20 percent of the rated capacity of the machine.

The bag the dimensions of which are 1 500 mm x 500 mm is obtained from a rectangle 1 500 x 1 000 mm in size, folded and sewn on three sides, at 1 cm from the edge.

The pieces filling the bag, are rectangles 1 000 mm x 1 500 mm in size.

The material used for the bag is an overstitch stocknet, made on "Rachel" type loom with three rods, in which the rod I works in the warp and the rods II and III in the weft.

Rod I (Warp)	*Length ratio*
Matt multi-thread polyester yarn (75.5 decitex *f* 24*t* 0)	100
Rod II (Weft)	
Matt multi-thread polyester yarn (76 decitex *f* 24 *t* 0)	55
Rod III (Weft)	
Matt multi-thread polyester yarn (75.5 decitex *f* 24 *t* 0)	80
Number of columns per 10 cm	58
Number of rows per 10 cm	206
Number of groups of three rows per 10 cm	68.6

Width : 1 500 mm

Mass : 45 g/m^2 to 50 g/m^2

12.3.3 *Method of Measurement*

The standard load is put into the machine and then submitted to agitation in cold water without detergent. The other operating conditions are in accordance with the manufacturer's instructions for the longest programmed cycle, excluding any programme especially meant for biological detergent; however, the heating device is not operating.

The effective washing period is:

- for impeller-type machines : 4 min;
- for agitator-type machines: 15 min;
- for rotating drum-type machines (without beating device) : 15 min;
- for rotating drum-type machines (with heating device) : heating up time 10 min.

NOTE – The stopping time during reversals, if any, is not taken into account.

At least five tests are performed under these conditions and only the bag is changed before each test.

12.3.4 *Method of Expressing of Results*

For each test, the wear of linen is expressed by the number of faults occurring on the bag itself (for instance, threads pulled out, displaced, holes, etc).

If the width of the fault is less than 1 cm, the number of faults is expressed by the length of the fault in centimetres.

If the width of the fault is more than 1 cm, the number of faults is expressed by the surface area of the fault in cm^2.

NOTE – Faults occurring in a 5 cm wide selvedge, parallel to the sewing of the bag, are not taken into account.

The wear of linen is expressed by the average of the five values thus obtained.

13 DETERMINATION OF WATER RETENTION PERCENTAGE

13.1 Principle of Measurement

Rinsing efficiency is expressed as one or more of the following:

For machine with or without water extraction means:

a) alkalinity of the water remaining in the clothes relative to the tap water — A_r

b) dilution of the wash liquor. — D

For machines with water extraction means:

a) as dilution factor modified to take into account the extraction efficiency — $\frac{DW}{W_r}$

b) *as the amount of undiluted wash liquor per kg of load remaining in the clothes — $\frac{W_r}{DW}$

c) as the amount of wash alkali per kg of load remaining in the clothes. — $\frac{Ar\ Wr}{W}$

NOTE – *b) is reciprocal of a).

13.2 Standard Load

The standard load is stated in **5.2.6.**

Record dry weight of clothes in kilogrammes to an accuracy of 5 g.

13.3 Wash Liquor Sample

A washing cycle is carried out with this load.

Concentration of the standard detergent shall be that stated in **11.1.3.**

10 g/l of anhydrous sodium carbonate may be added for measurements (b), (c) and (d), but not for alkalinity measurements (a) or (e).

A 25 ml sample of wash liquor is taken from the machine during the last 5 min of the actual washing period, that is before the first rinsing stage commences and before the addition of any clean water to the wash liquor.

13.4 Rinse Water Sample

At the end of the cycle of washing, rinsing and water extraction, the complete load is removed and weighed. (No weighing is done if no extraction is carried out by the machine.) Weigh to an accuracy of 5 g.

The complete load is transferred (in parts, if necessary) to a spin extractor with an internal drum diameter between 250 mm and 300 mm, and spun at about 2 800 rev/min. A 250 ml sample is taken when the flow of water reduces to a minimum continous trickle.

In the case of washing machines incorporating a fast spin extractor (above 1 500 rev/min), the 250 ml sample is taken from the water extracted by the machine's extractor when the flow reduces to a minimum continous trickle. The load is removed for weighing when the spin cycle is completed.

13.5 Tap Water Sample

A one-litre sample is taken from the same source and at the same time as the water used for rinsing in the machine under test.

13.6 Titrations

13.6.1 *Wash Liquor*

- take 10 ml wash liquor + 90 ml distilled water;
- titrate with N/10 HCl, using micro-burette calibrate in 0.01 ml divisions, to *p*H 3.8*;
- record acid used in millilitres as m_w;
- alkalinity of wash liquor $m_w = 10\ m_w$ milliequivalents per litre.

13.6.2 *Rinse Water*

- take 100 ml rinse water;
- titrate with N/10 HCl, using a micro-burette calibrated in 0.01 ml divisions, to *p*H 3.8*;
- record acid used in millilitres as M_r; and
- alkalinity of rinse water = M_r milliequivalents per litre.

13.6.3 *Tap Water*

- take 100 ml tap water;
- titrate with N/10 HCl, using a micro-burette calibrated in 0.01 ml divisions, to *p*H 3.8*;
- record acid use din millilitres as M_t;
- alkalinity of tap water = M_t milliequivalents per litre.

NOTE – Methyl orange or dimethyl yellow indicators may be employed if a *p*H meter is not available, but accuracy is liable to be affected.

13.7 Calculation of the Various Rinsing Factors

For the determination of the various rinsing factors shown in **13.1** and of the amount of alkali retained in the clothes after washing, rinsing and extraction, the following calculations are carried out:

a) Alkalinity of rinse water relative to tap water

$A_r = M_r - M_t$ milliequivalents per litre

b) Dilution of the wash liquor

$$D = \frac{\text{Alkanity of wash water} - \text{alkalinity of tap water}}{\text{Alkanity of rinse water} - \text{alkalinity of tap water}}$$

c) Dilution factor modified to take into account the extraction efficiency

$$\text{Dilution} \times \frac{\text{dry mass of clothes}}{\text{mass of water retained in clothes}}$$

where W_r = clothes mass after extraction minus dry mass

d) Amount of undiluted wash liquor per kg of load remaining in clothes

$$\frac{\text{mass of water retained in clothes}}{\text{Dilution into dry mass of clothes}} = \frac{W_r}{W} \cdot \frac{M_r - M_t}{M_w - M_t}$$

litres per kg

d) is reciprocal of c)

e) Amount of wash alkali per kg of load remaining in clothes

$$A_r \frac{W_r}{W} = \frac{W_r (M_r - M_t)}{W} \text{ milliequivalents per kg}$$

13.7.1 The specific value of revising efficiency is under consideration.

14 DETERMINATION OF THE WATER-EXTRACTING EFFICIENCY

14.1 Principle of Measurement

The water-extracting efficiency is expressed by the amount of moisture remaining in the cotton material after extraction, relative to the dry weight in air of the same material.

14.2 Standard Load

For this measurement, the load comprises pieces of cotton material, the dimensions of which are 600 mm x 800 mm.

Characteristics of the material and its treatment are stated in **5.2.6**.

NOTE – When it is impossible to keep the temperature and relative humidity within the limit stated in **5.2.6**, the actual values shall be stated in the measurement report.

14.3 Moistening of the Load

The mass of the test load (M_1) is determined to an accuracy of 5 g. The load is then submitted to a complete cycle of washing and rinsing in the following conditions.

14.3.1 *Extractors Incorporated in a Washing Machine*

The cycle of washing and rinsing is performed in the machine according to the manufacturer's instructions for white cotton material, with washing agent stated in **5.2.5**, the concentration of which is stated in **11.3**.

If instructions on washing temperature are not given, this is taken as 85 °C.

14.3.2 *Separate Extractors*

The cycle of washing and rinsing is performed in a drum-type washing machine, with the standard detergent, the washing temperature being not less than 80 °C.

14.4 Method of Measurement

14.4.1 *Extractors Incorporated in a Washing Machine*

After the cycle of washing and rinsing stated in **14.3.1**, the water is extracted from the load for the time stated by the manufacturer of 4 min, if instructions are not given.

14.4.2 *Separate Spin Extractors*

After the cycle of washing and rinsing stated in **14.3.2**, the standard clothes are put one beside the other along the wall of the drum of the extractor under test in such

a way that a diagonal of each cloth is parallel to the circumference of the drum.

When the clothes reach about 1/3 of the height of the drum, they are pushed from the circumference to the centre so as to fill the hollow in the centre of the drum.

This is repeated once or twice as the drum is further filled.

The load is finally covered at the top with the last standard cloth which is folded over double for this purpose.

The water is then extracted for the time stated by the manufacturer or for 4 min, if instructions are not given.

14.4.3 *Wringers*

After the cycle of washing and rinsing stated in **14.3**, the standard clothes are fed through the wringer one at a time at the highest pressure at which the wringer rollers can be set.

The clothes are fed through the wringer, beginning at a point in the middle of a seam and passing the cloth length-wise through the wringer.

With a hand-operated wringer, each cloth is fed through in 10 s.

14.5 Final Measurements

After the operations specified in **14.4**, the mass M_2 of the test load is determined to an accuracy of 5 g, and the ratio

$$\frac{M_2 - M_1}{M_1}$$ is calculated.

14.6 Methods of Expressing Results

Five tests are carried out in the conditions specified in **14.4**; the water-extracting efficiency is assumed to be the arithmetic mean of the five values so obtained.

It can be expressed:

— either by an absolute value, or

— by the ratio between the value obtained from the machine under test and the one obtained from the appropriate reference machine described in Annex C.

14.6.1 The calculated water retention shall be not exceding 75 percent.

15 DETERMINATION OF WATER AND ENERGY CONSUMPTION

15.1 The determination described applies to automatic washing machines and to automatic washing and water extracting machines, fed with cold water and including an incorporated heating device.

NOTE – A test method for machines fed with hot water is under consideration.

15.2 The purpose of this measurement is to determine the electric energy and the quantity of cold water consumed by the washing machine for the particular operating cycle selected.

A minimum of five complete tests is required for each operating cycle being measured.

NOTE – For reasons of reproducibility this measurement is carried out in reference conditions, without soiling nor detergent. The possibility of carrying out this measurement in conjunction with the performance test is under consideration.

15.3 General Conditions for Measurements

The conditions described in **5** are applicable except for the modifications or additions shown below:

a) *State of machine* (**5.2.1**) - The washing machine is installed in accordance with manufacturer's instructions.

The machine and the load are kept at ambient temperature for at least 24 h before starting the test. Between each cycle, the machine and the load are maintained at ambient temperature for at least 2 h.

b) *Supply voltage and frequency* **5.2.2.**

NOTE – If the rated voltage of the machine differs from the nominal system voltage, measurement carried out at rated voltage may be misleading for the consumer.

Additional measurement may be necessary. If the test voltage differs from the rated voltage, this shall be reported.

c) *Ambeint temperature* (**5.2.3**) – The ambeint temperature shall be 27 ± 2 °C. However, if it is not possible to maintain it within these tolerances, it shall be within 27 ± 5 °C. Two tests are then carried out, one at a temperature below 27 ± 5 °C, the other at a temperature above 27 °C and the result is obtained by interpolation.

d) *Supply water* (**5.2.4**) – The water hardness shall be equal to 250 ppm. The water supply temperature shall be 27 ± 5 °C. The energy consumption measurement shall be corrected as shown in **15.4.**

NOTE – This enlargement of the tolerance is due to the use of the correction formula.

The pressure of the supply water shall be controlled and maintained at 240 ± 35 kpa when the washing machine is filling.

e) *Detergent* (**5.2.5**) – This test is carried out without detergent.

f) *Standard load* (**5.2.6**) – When the measurement is conducted for the cycle corresponding to the washing of white cotton, the machine is loaded as specified in **5.2.6** but using only pieces representing tea towels (600 mm x 800 mm).

NOTE – For other cycles, the conditions of loading, the machine are under consideration.

15.4 Method of Measurement

Select the cycle to be measured and operate the washing machine through one complete cycle under general test conditions as outlined in **15.3.**

Record for each cycle, the characteristics specified in **15.5.**

If the supply water temperature differs from 27 °C, the measured energy consumption shall be corrected according to the following formula:

$$W = W_t + \frac{V(T - 27)}{860}$$

where

w = corrected value, in kilowatt-hours, of energy consumed during a complete cycle;

w_t = measured value, in kilowatt-hours, of energy consumed during a complete cycle, the supply water temperature being t °C;

t = actual supply water temperature in °C; and

V = Volume of water, in litres, which has to be heated up:

- for machines with thermostatically controlled prewash and thermostatically controlled main wash, V is the sum of the water volumes introduced into the machine during the pre- and the main- wash;
- for machines with time-controlled prewash and thermostatically controlled main wash, V is the sum of the water volumes introduced into the machine during the pre- and the main-wash minus the water volume pumped out (drained) after the prewash.

1/860 = Conversion factor for expressing the thermal energy in kilowatt-hours.

15.5 Data to be Reported

a) Name of cycle tested.

b) Supply voltage at which measurements are made.

c) Energy (kWh) consumed by the washing machine during the test. Kilowatt-hours are measured and reported to the second decimal place. The average of five or more tests are averaged and reported as one value.

d) Volume (litres) and temperature (°C) of the cold supply water used water measurement quantities are measured to 0.1 litre and the average of the five or more test measurements are reported to nearest whole number of litres.

e) Test load [15.3 (f)].

f) Length of cycle, in minutes, to the nearest whole number.

g) Suggested form in which data is to be reported.

Cycle	*Supply Voltage During Test*	*Washing Machine Operational Energy W*	*Total Quantity of Water Used V_{tot}*	*Temperature of Supply Water t*	*Test Load*	*Length of Cycle*
	(V)	(kWh)	(litres)	(°C)	(kg)	(min)

NOTE – A test method for the measurement of the maximum water temperature is under consideration.

15.5.1 The maximum energy consumption and the maximum water consumption shall be as declared by the manufacturer under the normal operating conditions.

16 DETERMINATION OF MECHANICAL DETERGENT LOSS IN THE SUM OF WASHING MACHINES (Wash Liquor Re-circulation Method)

16.1 The determination described applies to automatic drum-type washing machine and may be used for prewash or main wash cycles.

The cycle during which the mechanical detergent loss is determined shall be selected and stated in the measurement report.

16.2 The purpose of this test is to determine the amount of detergent that remains dissolved or undissolved in the sump of the washing machine and therefore does not take part in the wash. This amount of detergent (mechanical product loss) may be due to constructional details of the machine.

NOTE– This method concerns only powder-type detergents.

16.3 The mechanical product loss is determined by the difference in the amount of dry matter dissolved in the wash liquor just before the end of the wash cycle and the amount of dry matter dissolved in the water after circulating the wash liquor several times through the pump in order to dissolve all the powder that has not participated in the wash process because it stayed dissolved or undissolved in the pump housing, etc.

16.4 Conditions described in **5.2** are applicable except for the modifications or additions shown below:

a) State of machine (**5.2.1**) – The height of the outlet of the drain hose shall be in accordance with the manufacturer's instructions. In the absence of such instructions, the outlet of the drain hose shall be 85 cm above the floor level.

b) Supply voltage and frequency **5.2.1**.

NOTE – If the rated voltage of the machine differs from the nominal system voltage of the country concerned, measurements carried out at rated voltage may be misleading for the consumer. Additional measurements may be necessary if the test voltage differs from the rated voltage, this shall be reported.

c) Supply water (**5.2.4**) – For the measurements, local supply may be used as with this method deposits in the water are taken into account when calculating the mechanical product loss. The water hardness shall be stated in the measurement report.

d) Detergent (**5.2.5**) – Test detergent with perborate, type 1, as specified in Table 2 shall be used.

NOTE – *See* Annex F for the maximum and minimum granulometry values for both powders and their bulk density.

The powder is accurately weighed as 80 parts base powder, 20 parts of sodium perborate for each separate determination.

The H_2O content of the mixed base powder shall be established and specified in the measurement report.

NOTE – Differing H_2O content of detergent in two laboratories may lead to differences in the average percentage mechanical product loss as determined in these two laboratories.

In order to have a constant solubility of detergent and also of sodium parborate, both powders shall be stored under dry and cool conditions.

NOTE – Only pieces representing tea towels (600 mm x 800 mm) are used.

It is advisable to have several identical loads which may be used in rotation.

Before using for measurements these loads shall be washed five times with detergent as stated in item (d) and in **16.5.2**.

The preparation shall be conducted in the mainwash programme suitable for normally soiled white cotton (excluding prewash) with the corresponding rinsing cycles.

After each test for the determination of detergent loss, the load shall be adequately rinsed, for example in a complete wash programmes carried out without detergent.

After that the load shall be dried ready for the next use in a household dryer.

Each load shall be identified and always be used as a total unit. The load life can be as much as 50 cycles.

16.5 Method of Measurement

16.5.1 *Preparation of Measurement*

Prior to each cycle, the machine is drained, the filter cleaned, and then in order to have reproducible results the machine rinsed and spun without load. The dispenser is cleaned and dried. The machine is then filled with the standard load [**16.4** (e)].

16.5.2 *Preparation of Detergent*

For each test, 120 g of standard detergent and 30 g of sodium perborate in freshly weighed out and mixed. Mixing is done by shaking in a closed 1 litre wide-neckee glass bottle. The mixing time is 2 min.

16.5.3 *Introduction of Detergent*

150 g of perborate detergent is added to the appropriate dry dispenser. The method of filling the dispenser shall be consistent (for example, by an appliance, a funnel, rigidly fixed above the dispenser).

16.5.4 *Operation of Machine*

The programme wherein the mechanical detergent loss should be determined is selected (for example, the main wash programme suitable for normally soiled white cotton, excluding prewash, or the main wash programme suitable for normally soiled coloured cotton, excluding prewash, or a prewash programme only).

The programme selected shall be stated in the measurement report. The water supply shall be in accordance with **16.4** (c).

To ensure that all the detergent is drawn into the machine during the filling period, the dispenser shall be examined at the end of the filling period and flushed with 1 litre of water.

Immediately before adding cold water at the end of the washing period, the water inlet tap is closed. Before closing the water inlet tap, the pressure control device of the machine regulates the necessary amount of water. All the detergent is drawn into the machine. The volume of water used and the additional 1 litre separately added through the dispenser are recorded in the measurement report. The machine programme is then run normally until the maximum temperature is reached.

16.5.5 *Taking of Samples*

At the end of the cycle, stop the machine. The moment to switch off the machine may be determined as follows: before the actual test, start the cycle several times, measure the time until the beginning of dilution and the moment when the lye is pumped. The moment to switch off the machine for taking samples shall be selected about 1 to 2 min before the time taken in the described manner.

The maximum temperature reached in the wash cycle before taking the samples shall be stated in the measurement report.

After stooping the machine, remove sufficient wash liquor direct from the drum to obtain 2 times 100 ml portions (approximately 250 ml).

Experience has shown that the cotton fibres contained in the sample do not disturb the subsequent determination of the mass.

NOTE – For front-loading machines, the sample may be taken either through the open door or by siphoning off via a plastic tube inserted through the filling aperture. Care should be taken that the wash liquor sample is taken from the upper third of the solution contained in the machine.

To determine the weight of dry residue (W_1), proceed as stated in **16.5.6**.

The wash liquor is then recirculated through the sump, pump, drain hose and product dispenser.

For top-loading machines, the drain hose is put into the tub with the lid opened.

The recirculation lasts for 3 min. During recirculation precautions should be taken to ensure that the drum is rotating.

After 3 min recirculation, the drum and the pump are switched off and a second sample is taken. To determine the weight of dry residue (W_2) of this sample, proceed as stated in **16.5.6**.

To determine the weight of dry residue (W_3) of a blank control sample, draw approximately 250 ml of the water used for each test run and treat as in **16.5.6**.

16.5.6 *Treatment of Sample*

The samples are cooled and shaken carefully. Then, using a pipette, two 100 ml portions are transferred into preweighed evaporation dishes with flat bottom and pouring lips (for example, diameter 115 mm, capacity 320 ml). The dishes are placed in hot-air oven with an air-circulating fan and maintained for 16 h at 105 °C.

The dishes are weighed after cooling in a desiccator for 1 h and then redried.

This treatment is repeated until constant mass is obtained (normally samples are completely dry after 16 h).

16.6 Calculation of Results

$$\text{percent loss} = \frac{W_2 - W_1}{W_2 - W_3} \times 100$$

W_1 = dry residue of sample before recirculation,

W_2 = dry residue of sample after recirculation, and

W_3 = dry residue of blank control sample.

The calculation shall be carried out on the basis of at least ten machines runs for W_1 and W_2. In addition to the average percentage product loss, the test report shall state the average value, standard deviation and coefficient of variation of W_1 and W_2, and the confidence interval.

16.6.1 The mechanical detergent loss shall be as declared by the manufacturer under normal operating condition.

17 ENDURANCE

17.1 The machine shall be so constructed that in normal use, there will be no electrical or mechanical failure that might improve compliance with this standard. The insulating shall not be damaged and contacts and connections shall not work loose as a result of reading, vibration, etc.

Moreover, overload protection devices, if any, shall not operate under normal running conditions.

Heating elements are only in circuit if otherwise the other parts of the washing machine would not function safely.

The tests of this clause need not be made if it can be shown that the components have withstood an equivalent endurance test under conditions no less severe.

17.2 The washing machine, without textile material, is filled as in normal use with water, without detergent. It is operated at a voltage equal to 1.1 times rated voltage for 48h, reduced by the running time necessary for the tests of 11 and 13.

Washing machines provided with a programme controller are operated with the most unfavourable programme, without a rest period between the cycles of operation, unless the temperature rise of any part of the washing machine exceeds the temperature rise obtained during the test of 11, in which case rest periods of forced cooling are introduced.

For washing machines, without a programme controller, but with means for water extraction and discharge pumping, and in which the same motor is used for pumping, and in which the same motor is used for washing, water extraction, discharge pumping and any other function, or in which separate motors, which cannot be used simultaneously, are used for these purposes, the specified operating time applies to the washing machine as a whole, this time being equally divided between washing and each of the other functions.

The washing machine is then operated under the same conditions at a voltage equal to 0.9 times rated voltage for a further 48 h.

The specified operating time is the actual running time.

For washing machines without a programme controller, but incorporating separate motor which can be used simultaneously, the specified operating times apply to each motor.

17.3 During the test of **17.2**, overload protection devices, if any, shall not operate.

After the test of **17.2**, the machine shall withstand the test of **16.4** given in IS 302-1 (1979).

Connections, handles, quards, brush caps, and other fittings or components, shall not have worked loose, and there shall be no deterioration impairing safety in normal use.

18 FINISH

18.1 The external finish used in metal components shall be of a heat and moisture resisting nature and shall not be adversely attached by variation in temperature occurring under normal operating conditions or after endurance test.

19 TESTS

19.0 Tests are classified as type, acceptance and routine tests.

19.1 Type Tests

The test specified in Table 6 below shall constitute the type tests and shall be carried out on two samples of the same type and rating selected preferably at random from a regular production lot. Before commencement of the tests, the water heaters shall be visually examined and inspected for obvious visuals defects in respect of components, parts and their assembly, construction, stability, markings, provision of suiitable terminals for supply connections, earthing and the effectiveness of screws and connections. The external surface finish shall be even and free from finishing defects.

Table 6 Schedule of Type Tests

(*Clause* 19.1)

Sl No.	Test	Clause Reference
i)	Safety requirement	8 to 32 of IS 302-2-7 (1994)
ii)	Determination of washing performance	11
iii)	Determination of wear suffered by textile	12
iv)	Determination of rinsing efficiency	13
v)	Determination of water extracting efficiency	14
vi)	Determination of mechanical detergent loss in the sump of washing machine (wash lignor re-circulation method)	15 16
vii)	Endurance	17
viii)	Finish	18

19.1.1 *Criteria of Acceptance*

All samples shall successfully pass all the type test for proving conformity with the requirements of the standard. If any of the samples fails in any of the type tests, the testing authority, at its discretion, may call for fresh samples not exceeding twice the original number and subject them again to all tests or to the test(s) in which failure(s) occurred. No failure should be permitted in the repeat test(s).

19.2 Acceptance Tests

The following shall constitute the acceptance test:

Tests	*Clause Reference of IS : 302-2-7 (1994)*
a) Protection against electric shock	8
b) Input	10
c) Temperature-rise	11
d) Insulation resistance and leakage current at operating temperature	13
e) Moisture resistance	15
f) Insulation resistance and electric strength (After humidity treatment)	16
g) Construction	22
h) Provision for earthing	27
j) Determination of the washing performance	11
k) Determination of rinsing efficiency	13
m) Determination of water extraction efficiency	14

NOTE – For the purpose of the acceptance tests, the humidity treatment is done for 24 h while conducting the test for moisture resistance (15).

19.2.1 A recommended sampling procedure for acceptance tests is given in Appendix B of IS 302-1 (1979).

19.3 Routine Tests

The following tests shall constitute the routine tests:

Tests	*Clause Reference of IS : 302-1 (1979)*
a) Protection against electric shock	8
b) High voltage	13.3.2
c) Provision for earthing	27

ANNEX A

(*Clause* 3.2.1)

DEGREES OF AUTOMATION OF WASHING MACHINES

Due to the diversity of the operation carried out by washing machines, it is difficult to set up plain definition covering all cases of automaticity.

So it appeared better to replace these definitions by diagrams showing:

- the functions for which provision is made;
- the number of interventions of the operator required for control of the different operations;
- the number of times the linen is handled;
- the grouping of the operation.

In these diagrams the following symbols are used:

———	(uninterrupted beam)	:	no intervention of the operator is necessary between subsequent parts of the cycle.
— —	(interrupted beam)	:	intervention of the operator is necessary to start the next part of the cycle.
↓	(vertical arrow)	:	adding detergent for main wash.
⌒	(curved arrow)	:	handling the load between two subsequent operations.

The following diagrams are given as examples:

Machine Designation / Operations	Prewash	Main wash	Rinsing	Extracting	Drying
1. Non Automatic washing machine	—	↓	—	—	
2. Automatic washing machine	↓	———			
3. Double container washing and water-extracting machine	—	↓	—	⌒	
4. Automatic double container washing and water-extracting machine	↓	———		⌒	
5. Automatic washing and water-extracting machine.	↓	———			

ANNEX B

(*Clause* 11.2)

FABRIC SOILED WITH STANDARD ARTIFICIAL SOIL

B-0 The contents of this annexure are given by way of information, and are intended to be used for trail testing.

B-1 The washing performance of a household washing machine is due to mechanical and chemical action, and to a combination of both.

The total effect may be investigated by using different types of artificial or semi-natural soils having preparation corresponding to those of the various kinds of natural soil. These contain fatty matter, proteins, and organic and inorganic pigments in complex mixtures. Some kinds of natural soil are more sensitive to mechanical action, and some to chemical action such as oxidation (bleaching), solubilization and emulsion. High temperatures increase the effect of mechanical and chemical action.

The method described in **11** is intended to determine the behaviour of the machine by means of photocolorimetric reflectance measurements made with the following different types of standard artificial soils.

B-1.1 Specimen based on carbon black and mineral oil enabling the scouring effect mainly due to mechanical and thermal action.

B-1.2 Specimen based on blood enabling the removal of protein pigments.

B-1.3 Specimen based on chocolate and milk enabling the removal of organic pigments.

B-1.4 Specimen based on red wine enabling the bleaching effect. These different types of soil are deposited on fabric supports of the same kind of cloth and the various specimens may be joined together to form a strip with the different types of soil arranged in the above order.

B-2 SUPPORTING FABRIC FOR SOIL

B-2.1 Nature

According to this standard, the cloth for soiling is of pure cotton.

B-2.2 Weaving

The weaving method should allow a homogenous distribution of soil.

Final textile characteristics (after treatment - *see* **B-2.3**)

- warp : 34 ± 2 double threads of 30 tex/cm;
- weft : 20 ± 2 threads of 50 tex/cm; and
- mass : 200 ± 10 g/m^2.

The textile width shall be at least equal to the dimensions fixed in **11.2**.

B-2.3 Treatment

The cloth for soil should undergo a treatment so as to obtain the following characteristics.

B-2.3.1 Reflectance measured with the test apparatus described in **11.4** greater than 86%, the reference value being 90 ± 1%.

B-2.3.2 *Fluidity Index : 4 to 5 Poises*

For information, the treatment may include : singeing, desizing, secouring, bleaching without any optical bleaching agent, and calendering.

B-3 REPRODUCIBILITY

Only specialized manufacturers, manufacturing large quantities of textiles are likely to supply this textile with an adequate guarantee of reproducibility.

B-3.1 Artificial Soil

B-3.1.1 Composition of soil; based on carbon black and mineral oil

Pigment :	Carbon black	
	Average size of grains	: 295
	Average surface of grains	: 94 m^2/g
	Carbon content	: 96.0%
Oil	Paraffin oil	
	Specific weight	: 0.885 g
	Ignition temperature	: 221° C
	Liquefaction temperature	: – 26° C

The proportion of pigments and fatty materials shall be such as to obtain the reflectance specified in **B-4.2**. If a solvent is necessary, carbon tetrachloride is used.

B-3.1.2 *Composition of Soil Based on Blood*

Pig's blood, fresh and stabilized by the addition of 10 g/l ammonium citrate.

B-3.1.3 Composition of soil based on chocolate with milk 'Cailler' unsweetened cocoa with sugar, full cream cow's milk and water.

B-3.1.4 Composition of soil based on red wine "Alicants" red wine.

NOTE – A more precise definition of the compositions of soil mentioned in **B-3.1.2**, **B-3.1.3** and **B-3.1.4** is under consideration.

B-3.2 Origin of Soil

It is recommended to have one single source of production for each of the elements entering in the composition of soil.

The following materials are in accordance with the above specification:

Pigment : Gasruss CKR from Degussa, and

Oil : Ondina oil 33 from Shell.

B-4 APPLICATION OF SOIL ON CLOTH

B-4.1 Method

The application of soil by immersing the textile is recommended.

For information, the treatment may include the following operations:

— immersion;
— calendering;
— drying;
— new immersion, if necessary;
— calendering;
— drying; and
— ageing.

B-4.2 Soil Checking After Deposition of Soil

The manufacturer should make sure that soil is evenly and regularly deposited. At the end of operations, the reflectance measurements, carried out on the apparatus described in **11.4** should be, for soil based on carbon black and mineral oil.

— reflectance value 25%, and
— variation of reflectance from one batch to the other measured at least on one side; + 5% of the measured average value.

NOTE – For the other types of soil, these values are under consideration.

B-4.3 Soil Checking After Washing in the Reference Machine

After washing according to the cycle provided for heavily soiled white cotton (high-activity level), in the reference machine described in Annex D, reflectance measurements should be for soil based on carbon black and mineral oil.

— reflectance value : 65 ± 2%.

NOTE – For the other type of soil, this value is under consideration

B-5 INFORMATION

Each batch of soiled test-pieces should be easily identified and include the following information.

B-5.1 Serial Number of Permit Checking Date of Manufacture

B-5.2 Limit date for use the minimum duration of the period ensuring reproductibility conditions should be one year from date of manufacture.

B-5.3 Reflectance Value of the Non-soiled Fabric – (*see* C-2.3).

B-5.4 Reflectance Value of the Soiled Fabric – (*see* C-4.2).

B-5.5 Reflectance Value After Washing in the Reference Machine – (*see* C-4.3).

NOTE – It will be possible for the supplier to attach to the delivered batch a washed sample on which he will have stated the reflectance value reached in his laboratory, this sample will preferably belong to the delivered batch.

B-5.6 Advice with Regard to the Action of the Oxygen of the Air During Transport and Storage

B-5.7 Advice with Regard to the Climatic Action (Heat, Humidity) During Transport and Storage

B-5.8 Advice with Regard to the Action of Light

B-6 QUALITY CHECKING OF THE ARTIFICIALLY SOILED TEST- PIECES, BY THE USER, BEFORE USE

It is recommended to the user to check the marking of the reflectance values defined in **B-5.4** and **B-5.5** just before use.

ANNEX C

(*Clauses* 11.2, 11.6, 12.1.3 *and* 14.6)

DESCRIPTION OF THE REFERENCE MACHINE AND METHOD OF USE

NOTE – The particulars in this Annex are given for information are provided for use in investigations.

C-1 SPECIFICATION OF CHARACTERISTICS OF THE REFERENCE MACHINES

C-1.1 Reference Machine of Periodically Reversing Drum-Type for Comparison with any other Drum Type

Inner drum (concentric with outer drum)

— Diameter		515 mm
— Volume		65 l (net)
— Lifting vanes	number	3
	height	53 mm
	Tip radius	17 mm
	Base With	65 mm
— Perforations (countersunk)	Diameter	5 mm
	Depth of countersink	2.5 mm
	Total hole area	520 cm^2
— Material		18 / 8 stainless steel

Outer drum

— Diameter		575 mm
— Sump	H x W x D	80 x 150 x 260 mm
— Material		18/8 stainless steel

Drum speed		
	Wash	52 + 1 rev/min (with 5 kg load and 25 l of water)
	Spin	530 + 20 rev/min
Reversing rhythm (all time are switching times)	Normal: on	12 ± 0.1 s
	Normal: off	3 ± 0.1 s
	Gentle: on	3 ± 0.1 s
	Gentle: off	12 ± 0.1 s
Water levels	2-adjustable. Accuracy ± 1.01	
Thermostats	Continuously variable. Independent settings for prewash and main wash.	
	Accuracy at switch-off temperature equal to ± 1 °C.	
	Switch-on temperature not more than 4 °C below switch-off temperature.	

Programme timer motor to be inoperative during the heating-up periods before prewash and main wash temperatures are initially attained, but to remain operative during the washing period, after first switch-off operation of the thermostat.

— Drainage	pump operated
— Prewash water quantity	25 ± 1 l
— Main wash water quantity (total)	25 ± 1 l
— Watts input to heater	5.4 kW ± 2%
— Rinse water quantity (total)	50 ± 2 l (per rinse)
— Drain time	2 min
— Water inlets	hot and cold

NOTES

1 A machine with these characteristics and supplied with flexible control arrangements for laboratory use can be obtained from Axtiebolaget C.T.C., Goteborg C, Swedon.

2 Other machines of suitable, but not identical characterististics, may be employed after correlation tests with the machine described above.

C-1.2 Reference machine of oscillating agitator type for comparison with any other machine washing in a sufficient quantity of water to submerge the clothes

— Diameter of wash tub :	540 mm
— Volume to water level :	50 l (net)
— Diameter of agitator :	340 mm
— Number of agitator vanes :	4
— Height of agitator vanes :	76 mm (at max.)
— Angle of oscillation :	214°
— Speed	51 oscillations per minute

Functions of heat, wash and drain are all individually controlled.

NOTES

1 A machine with the characteristics can be obtained from B.D.A., Peterborough, England. A power wringer is supplied as standard for this machine.

2 Other machines of suitable but not identical characteristics, may be employed after correlation with one of the machines described in C-1.1 and C-1.2 of this Annex.

C-2 METHOD OF USE OF THE REFERENCE MACHINE

C-2.1 Check of Artificially Soiled Cloth

This checking will be carried out if it is thought necessary. The use of the reference machine for comparison purposes will tend to make this test superfluous.

Use standard load of clean material defined in **5.2.6**; include samples of the artificially soiled clothes to be checked (**11.1.2**) and wash under conditions stated in **D-2.2** of this Annex.

Reflectance results (**11.1.4**) should be within agreed limits after washing.

C-2.2 Use of Reference Machine for the Expression of Results of Washing Tests

C-2.2.1 Wash the loads of laundry in the machine or machines to be compared, under the conditions prescribed in **5.2** and **11**.

C-2.2.2 Wash similar loads in the reference machine under the same conditions of **5.2** and **11**, one-half of the total number of loads being washed at a higher level of washing activity and the remainder at a lower level of washing activity.

These two levels of activity will be in the general region accepted for "Whites" washing but will be different not only mathematically but also visibly in terms of practical washing results.

Two levels fulfilling these requirements are given, as examples, briefly as follows:

a) Using the reference machine, drum type, described in **D-1.1** of this Annex.

Load : 5 kg

Detergent : Type I

	High Activity	*Low Activity*
Prewash	Fill (cold) to 25 ± 1 l	Fill (cold) to 25 ± 1
	Heat and tumble to 40 °C + 6 min	Heat and tumble to 40 °C + 6 min
	Drum rhythm: 12 s "on" /3s "off"	Drum rhythm : 3 s "on" / 12 s "off"
	Drain 2 min	Drain 2 min
Main wash	Fill (cold) to 25 ± 1 l (total)	Fill (cold) to 25 ± 1 l (total)
	Heat and tumble to 85 °C	Heat and tumble to 85 °C
	Drum rhythm : 12 s "on" / 3 s "off"	Drum rhythm : 3 s "on" / 3 s "off"
	Tumble 15 min Drum rhythm : 12 s "on" / 3 s "of"	Tumble 5 min Drum rhythm : 12 s "on" / "of"
	Drain 2 min	Drain 2 min
Rinses	Four rinses of 2 min each at high water level (50 ± 2 l total). Drain after each rinse 2 min	
Spin	5 min at end of cycle	

NOTES

1 Heater input 5.4 kW + 2 %.

2 Water temperature to remain under control of thermostat during timed part of prewash and main wash.

b) Using the reference machine, oscillating agitator type, described in **D-1.2** of this Annex.

Load : 2.75 kg

Detergent : Type 1

	High Activity	*Low Activity*
Water	50 l at 55 °C Zero hardness	50 l at 55 °C Zero hardness
Heating	55 °C to 85 °C No agitation	None
Wash time	12 min	10 min
Drain	4 min	4 min

C-2.2.3 *Expressing Results*

The arithmetic mean of reflectance results obtained on the artificially soiled samples after washing may be illustrated as follows.

C-2.2.4 *Comparison of Two Series of Washes*

If at a later date, another series of identical tests is carried out on the same machines, reflectance values A_3, B_3, and X_3, might be obtained possibly due to the use of another batch of artificially soiled samples.

The order of wash activity levels should, however, be the same and the following relationship between the two series of results will be approximately correct:

$$X = B + \frac{A - B}{A_3 - B_3}(X_3 - B_3)$$

This relationship will allow any result obtained in the second series to be converted for insertion into the first series and *vice versa*.

NOTE – A straight line relationship has been assumed between reflectance and the level of wash activity and this can be regarded as approximately correct over the two levels of activity described in **D-2.2.2** of this Annex.

C-2.2.5 *Use of Results*

An example of use of the results is shown as follows:

It shall be pointed out that the example should only be treated as such and that the wash levels do not necessarily represent current practice in any country. They should not be accepted as a standard of requirement since the specification is only concerned with test method.

In this example, bands 1 to 5 are chosen as ascending orders of washing activity so as to the significantly different from one another both mathematically and practically.

ANNEX D

(*Clause* 11.7)

CONVERSION OF REFLECTANCE TO PERCENT OF SOIL REMOVAL

The change in reflectance values of soil swatchs does not have a linear relationship with the amount of soil removed. The Kubelka-Munk equations have been chosen as the ones to be used to change reflectance readings to "percent soil removed".

These equations are :

$$K/S = \frac{(1 - R)^2}{2R}$$

where

K = coefficient of reflectivity,

S = coefficient of light scattering, and

R = observed reflectance

$\frac{(K/S)s - (K/S)w}{(K/S)s - (K/S)u} \times 100 = SR$ = percent of soil removal.

s denotes soiled cloth,

w denotes washed cloth, and

u denotes unsoiled cloth.

ANNEX E
(*Clause* 11.6)

DETERMINATION OF WASHING PERFORMANCE BY JUDGING THE SOIL AND STAIN REMOVAL OF NATURALLY SOILED ARTICLES

(Under consideration)

The following method is given for information and is provided for use in investigation.

E-1 LOAD

The load consists of naturally soiled laundry articles of uncoloured or predominantly cotton.

If coloured articles are used, they shall be colour fast at 100°C.

The load shall comprise articles from the following kinds : sheets, pillow-cases, tea clothes, serviettes, towels, men's underwear, taking into account the following requirements:

the number of sheets and pillow-cases is stated in the following table:

Rated Capacity of the Machine	*Number of*	
kg	Sheets	Pillow-cases
2	1	2
3	2	4
4	2	4
5	3	6
6	3	6

- as far as possible all enumerated kinds are represented.
- towels shall be included in the load with a maximum of 10% by weight.

Similarly articles of the same degree of soiling are distributed equally in the machine under measurement and in the reference machine. They are marked in order to make it possible to identify comparable articles after washing.

E-2 EXECUTION OF THE TEST

Ten complete cycles, are carried out as indicated in 11.1.3.

E-3 JUDGING OF THE SOIL AND STAIN REMOVAL

After each washing cycle, the marked articles are visually judged as to soil and stain removal under standardized illumination using reference machine as standard of comparison.

As the test have a comparative character, the kind of illumination is not decisive, provided that colour and intensity of the light (at least 1 000 lux on the articles to be judged) permit a good visibility of stains and dingy parts. Of course, the same illumination has to be used for judging all articles from one cycle.

All flatwork has to be ironed before judging kitchen towels, serviettes and tableclothes are checked on soiled spots and stains.

Stains which cannot be removed by washing (for example rust, paint) are not taken into consideration.

Sheets and pillow-cases are checked on dingy parts on the side that has evidently been used, as in general they do not show soiled spots or stains.

A grey or yellow shade on the complete surface or on the edgings is left out of consideration. Greying and yellowness caused by the washing process will be determined by tristimulus reflectance measurements of white cotton test pieces.

Underwear (undershirts, drawers, chemises and panties) are checked on parts which are still dirty, especially stains of perspiration, urine and faeces.

Kitchen towels and serviettes are supposed to be divided into eight equal fields, four on each side; each field withtout a single soiled spot or stain is awarded 1¼ points; a completely clean cloth receives 8 x 1¼ = 10 points.

Table clothes, sheets, pillow-cases and underwear are valued with 1 to 10 points (10 meaning completely clean).

E-4 METHOD OF EXPRESSING RESULTS

The soil and stain removal is expressed as a ratio (in 2 decimals) found by dividing the total sum of points a machine has scored after at least 10 washes by the total sum of points scored by the reference machine after the same number of washes.

To evaluate the results, the statistical sign test is applied to pairs of articles which have been selected for having the same degree of soiling before washing. The sign test is not the most powerful statistical test, but it is the only one applicable to the discontinuous marks as are awarded to the judged articles.

For investigators with no experience in judging washed laundry articles, it may be advisable to restrict the number of points awarded to tableclothes, sheets, pillow-cases and underwear in the beginning to 5.

After a short time, the need will be felt to enlarge this number to 10 as some training will enable the judge to distinguish more subtly.

As to kitchen towels and serviettes, the method of judging is such that after some training no appreciable differences between the number of points awarded by two different judges should occur.

As to the other articles, the marks awarded by one judge may well be higher or lower right down the whole line than those awarded by a second judge. This need not meet with objections as long as he ranking order of the machines under test remains the same, since the results are expressed as a ratio.

ANNEX F

(*Clauses* 11.1 and 16.4)

BULK DENSITY AND GRANULOMETRY OF THE DETERGENT AND THE SODIUM PERBORATE

F-1 DETERGENT

Bulk density :	340 ± 20 g/dm^3
Granulometry values	Above sieve 1 000 micron : 0.7%
	through sieve 100 micron : 1.5%

F-2 SODIUM PERBORATE

Bulk density ;	750 ± 50 g/dm^3
Granulometry values :	above sieve 1000 micron : 0.3%
	through sieve 100 micron 0%

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