
British Standard

Industrial laundry machinery

Part 2. Methods for the assessment of the effect of extracting machines on textiles

Machines de blanchisserie automatiques

Partie 2. Méthode d'évaluation de l'effet des machines d'extraction sur les textiles

Industriewaschmaschinen

Teil 2. Verfahren zur Beurteilung der Wirkung von Wäscheschleudern auf Textilien

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Foreword

This British Standard has been prepared under the direction of the Fibres, Yarns, Fabrics and Production Standards Committee. The rapid technical development of laundry machinery and the changes in the pattern of purchasing have led to an urgent need for a standard means of assessment of the effect of machine performance on textiles. It has therefore become necessary to draw up standard methods of test for rating or assessing the effects of the principal types of industrial laundry machinery.

Two different approaches to the provision of the necessary information were considered:

(a) verification of the claims made by the manufacturer on the performance of the machine, using conditions arbitrarily agreed between the manufacturer and the user;

(b) preparation of standard methods of test for rating and assessing the effect of the principal types of machines, so that the test results obtained on machines of similar type could be compared directly wherever the machines were located and whenever they were tested.

It was agreed to adopt the second of these options in the preparation of the various Parts of this British Standard, since the urgent need was for procedures that could be used on a range of machines to evaluate their effects under reproducible conditions, including specification of the loads to be used. Thus it will be possible to compare the basic effects of one machine against another and a machine

against a performance specification quoted in a contract. No performance level is set. Another advantage in the approach adopted is that the tests can be conducted at any location where the necessary services are available. Information on the number and qualification of the personnel required, where this is considered to be particularly relevant, is given in appendix H.

There are, at present, no existing British Standards in the industrial laundering industry on any facet of the work, although a few standards exist in the related textile and chemical fields. This lack of published work has led to the problem of breaking new ground and great use has been made of original work by the former British Launderers' Research Association (now incorporated into the Fabric Care Research Association). It is planned to publish the following four Parts to this standard:

- Part 1 Methods for the assessment of the effect of rotary washing machines on textiles
- Part 2 Methods for the assessment of the effect of extracting machines on textiles
- Part 3 Methods for the assessment of the effect of flatwork ironing machines on textiles
- Part 4 Methods for the assessment of the effect of batch drying tumblers on textiles.

It is hoped that with the advance of techniques, and wide-spread use of this standard, updated methods can be incorporated.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

British Standard

Industrial laundry machinery

Part 2. Methods for the assessment of the effect of extracting machines on textiles

1. Scope

This Part of this British Standard describes methods of assessing the effect on textiles processed on extracting machines (excluding washer extractors) in which water is removed mechanically from textile articles in their wet state after washing.

In the case of batch extraction machines, this standard only covers machines with a load capacity in excess of 7 kg of air-dry textile articles.

This Part of this British Standard relates to the assessment of the performance characteristics of extracting machines, which are units in the laundering process.

The following characteristics are tested.

(a) For batch machines only, the moisture retention of the extracted load in relation to the length of the extraction cycle time, for a specific degree or degrees of machine loading, and the productive capacity corresponding to these parameters and to the loading and unloading times when relevant. They are selected in accordance with the particular circumstances of their use as follows:

- (1) when operated as an independent extraction unit and normally loaded to the full rated capacity, the methods described in clause 4 are used;
- (2) when operated as an extraction component of an automatic transfer processing unit that consecutively processes discrete batch loads of a given mass within given intervals of cycle time, the methods described in clause 5 are used.

(b) For roller type hydroextractors which normally form an integral part of an automatic transfer processing unit that continuously processes, without interruption, a regular flow of textile articles, the moisture retention in relation to the productive capacity corresponding to a specified mass flow rate or rates of loading, the methods described in clause 6 are used.

(c) Specific electrical energy consumption and characteristics of power requirements: the methods described in clause 7 are used.

(d) For centrifuges only, the out-of-balance capacity: the method described in clause 8 is used.

NOTE. The titles of the publications referred to in this standard are listed on the inside back cover.

2. Definitions

For the purposes of this Part of this British Standard the following definitions apply.

2.1 air-dry mass. The total mass of bone-dried textile articles (see 2.6) plus the mass of moisture that they contain.

2.2 automatic transfer processing unit. A machine (or a number of machines linked together by suitable means) that carries out consecutively and continuously all the processes of washing and extraction without manual assistance.

2.3 basket. That part of a centrifuge that rotates and contains the load during the process of extraction.

2.4 batch compression type hydroextractor. A hydro-extractor that functions by pressure applied by piston or diaphragm.

2.5 batch machine. A machine in which discrete loads are processed.

2.6 bone-dry mass. The mass of textile article (or number of articles) after being dried in a specified manner, when successive determinations of mass after several drying procedures show no progressive change in mass greater than 0.10 %.

NOTE. Specified drying procedures include repeated processing of the article or articles in a heated tumbler from which the exhaust air reaches a temperature of not less than 80 °C nor more than 120 °C or by repeatedly passing the article or articles through a flatwork ironing machine. These temperatures are appropriate to cotton fabrics, which constitute the test loads and test pieces specified in this standard.

2.7 cage. That part of a washing machine that rotates and contains the load during washing and rinsing processes.

2.8 centrifuge. A hydroextractor that functions by centrifugal force.

2.9 compartment. A subdivision of a cage.

2.10 component unit. A hydroextractor that forms an integral part of an automatic transfer processing unit.

2.11 continuous washing machine. A washing machine in which textile articles pass without interruption or in batches, continuously from the loading point, through the machine, to the discharge point.

2.12 extraction. The mechanical removal of liquor from wet textile articles.

2.13 final compression unit. That part of a batch compression type hydroextractor in which the major part of extraction takes place.

2.14 'g factor'. The numerical ratio obtained by dividing the radial acceleration of a point towards the centre of the circular arc in which it is moving by the standard vertical acceleration due to gravity.

2.15 hourly output. The mass of textile articles that a hydroextractor processes in 1 h under defined conditions.

2.16 hydroextractor. A machine in which water is removed from wet textile articles by mechanical means.

2.17 independent unit. A hydroextractor that does not form part of an automatic transfer processing unit.

2.18 load. The textile articles with which a hydroextractor is charged.

2.19 load container. That part of a hydroextractor (other than a centrifuge) that contains the load during the process of extraction.

2.20 mean. The arithmetic mean of a group of measurements or observations.

2.21 moisture retention. The amount of moisture retained by textile articles after extraction, usually expressed as a percentage of the mass of the textile articles in their bone-dry state.

2.22 nip. That part of the periphery of the rollers in a roller type hydroextractor that applies the squeezing action to the wet textile articles.

2.23 out-of-balance limiting safety device. A means of stopping a centrifuge if its out-of-balance capacity is exceeded.

2.24 pre-form compression unit. A device that accepts loads of wet textile articles from the washing component of an automatic transfer processing unit, assembles them into a configuration appropriate to the final compression unit that it serves and that may lightly compress them prior to their transfer to the final compression unit.

2.25 productive capacity. The mass of textile articles that a hydroextractor is capable of processing to a specific degree of moisture retention in a given time.

2.26 regain. The difference between air-dry mass and bone-dry mass, expressed as a percentage of bone-dry mass.

2.27 resilient roller. A roller with elastic properties, in a roller type hydroextractor.

2.28 roller type hydroextractor. A hydroextractor that functions by pressure between rollers.

2.29 sheets. Plain weave white cotton sheets of mass per unit area $170 \pm 20 \text{ g/m}^2$ (determined in accordance with BS 2471).

2.30 soiled sheets. Sheets soiled under conditions of average normal use.

2.31 steady state. The state in which the rate of flow of textile articles, the temperatures, chemical conditions and rates of flow of appropriate services in a continuous washing machine are stabilized to the conditions required for the specific tests to be carried out.

2.32 washing machine. A machine that is used for washing textile articles in water with the assistance of washing materials, heat and mechanical energy.

2.33 washing process. A sequence of operations by which textile articles are freed from dirt in a washing machine.

other ancillary equipment directly associated with and necessary for the operation of the test machine shall be recorded in accordance with **A.2**, **B.2**, **C.2** or **D.2**. The reference numbers of any diagrams, drawings or photographs necessary to supplement these data shall also be recorded.

3.2 Availability of test loads and other materials. Sheets and all other materials required for a particular method of test shall be assembled in sufficient quantities to ensure that the test is carried out in full without interruption.

3.3 Installation and test running conditions

3.3.1 The manufacturer of the machine to be tested shall be requested to provide a complete statement of requirements in respect of the installation conditions of the machine and of the running conditions required for test purposes. Wherever practicable, each requirement shall be expressed as a range of values within which the test procedure is acceptable, rather than as a single specific value.

3.3.2 The installation of the test machine shall be in accordance with the manufacturer's recommendations or requirements in respect of foundations and fixing, working space, electric power supply, other external supply services and drainage of effluent.

The voltage of the electrical supply shall be within the limits for which the electrical equipment is designed and all electric cables shall be of sufficient size to maintain adequate voltage at all times.

NOTE. Particular attention should be paid to the effect of voltage drop on the acceleration of centrifugal hydroextractors. This can arise from coincidental peak current demands of other machines.

3.3.3 The running conditions under which the machine is to be tested shall, in all cases, be within the limits stated by the manufacturer.

3.3.4 The manufacturer shall be requested to inspect, check and certify that the machine and all relevant aspects of its installation and functioning under test conditions are satisfactory.

3.3.5 If the installation and/or running conditions are outside the limits stated by the manufacturer, they shall be agreed by him or his authorized representative. Failing such guidance or agreement, the installation and/or test running conditions shall be acceptable to the party commissioning testing. Where appropriate spaces are not provided in the test report forms, particulars of any differences between the manufacturer's stated limits and the actual conditions as measured or observed during testing shall be clearly set out as an appendix and attached to the test report.

3.3.6 Running conditions shall be recorded in accordance with the appropriate appendix. The manufacturer's stated or recommended running conditions shall be recorded as follows:

- (a) for centrifuges: basket speed and 'g factor' (see **A.3** and **C.3.1**);
- (b) for batch compression type hydroextractors: hydraulic and/or pneumatic pressure(s), (see **B.3.1**);
- (c) for roller type hydroextractors: operating pressure(s) and peripheral and linear speeds, (see **D.3**);
- (d) for all machines: the temperature of wet textile articles immediately prior to extraction.

3. Preparation

3.1 Machine identification. The data required for the identification of the test machine and of any mechanical aids used for loading, unloading or feeding, and of any

For items (a), (b) and (c), corresponding figures shall be obtained with the machine loaded and running under test conditions for entry in the test report as required in the respective tests.

NOTE. The basket speed of a centrifuge is its maximum speed when loaded. The measurement of this speed will be dictated by the design and construction of the particular test machine in the respective tests.

3.3.7 The power rating of the electric motor or motors, the function which each motor performs and the manufacturer's stated peak loading in kV·A shall be recorded in accordance with **A.4**, **B.4**, **C.4** or **D.4**. In the case of centrifuges, the permissible maximum number of starts per hour, as stated by the manufacturer, shall be recorded in accordance with **A.3.3** and **C.3.1(c)**.

3.3.8 The manufacturer's recommended requirements in respect of electric power supply and any other external services (e.g. compressed air) required to operate the machine shall be recorded in accordance with **A.5** and **A.6**, **B.5** and **B.6**, **C.5** and **C.6** or **D.5** and **D.6**.

3.4 Assessment of accuracy of automatic controls and instruments. Where the operation of controls and/or the readings of instruments forming an integral part of the machine affect the derivation of test results, their accuracy shall be tested and, where necessary, correction factors established. These shall be determined and recorded in accordance with **A.8**, **B.8**, **C.8** or **D.8**.

4. Moisture retention of textile materials and productive capacity of batch machines used as independent units

4.1 Principle. Test pieces of known characteristics are included with a test load and the percentage of moisture retained by them after processing is measured.

Tests are carried out at various extraction cycle times to determine the relationship between moisture retention and cycle time.

The hourly output potential of the test machine at a specific moisture retention is calculated.

Additionally, an assessment is made of the cycle time necessary to approach the lowest achievable moisture retention of which the machine is capable.

4.2 Apparatus

4.2.1 Weighing machine, accurate to $\pm 1.0\%$, for determining the mass of the load.

NOTE. In order to achieve the required accuracy it may be necessary to provide apparatus of differing capacities.

4.2.2 Weighing machine, accurate to $\pm 0.1\%$, for determining the mass of the extracted test pieces and their bone-dry mass.

4.2.3 Stem type thermometer, $0\text{ }^{\circ}\text{C}$ to $100\text{ }^{\circ}\text{C}$ complying with BS 1704 or BS 5074.

4.2.4 Stop watch.

4.2.5 Safe means for measuring the speed of rotation, with an accuracy of $\pm 1.0\%$.

4.2.6 Washing machine, of capacity not less than the manufacturer's full rated loading of the extractor to be tested.

NOTE. If more convenient, a compartment of a washing machine may be used, provided that the capacity of the compartment is not less than the manufacturer's full rated loading of the extractor to be tested.

4.2.7 Textile load handling equipment, appropriate to the test.

4.2.8 Calender or drying tumbler, see **4.4.7**.

4.3 Test load. The test load or loads shall consist of the 20 textile test pieces (with or without net bags and/or dividing cloths) and an additional quantity of sheets or soiled sheets. Any sheets received for processing in an obviously damp condition shall not be used for test purposes.

The mass of the test load shall be based on that of textile test pieces and sheets or soiled sheets having a regain of between 4% and 8% . If the sheets available for test loads have a regain, as described in appendix G, that is not within these limits, the mass used for testing shall be that of the equivalent test load as defined in appendix G.

NOTE. When testing batch compression type hydroextractors, the textile test pieces may be placed in suitable net bags in order to facilitate their separation from the remainder of the load after extraction. Pre-positioning of the net bags before extraction and/or the use of dividing cloths may also be of assistance in this respect. Such facilities should not be applied to the testing of centrifuges, for which the random distribution of the textile test pieces within the test load is a specific requirement.

4.4 Procedure

4.4.1 Prepare the test load such that its air-dry mass, when weighed by the lower accuracy weighing machine (**4.2.1**) corresponds to the manufacturer's recommended full rated loading of the extractor. Wash and rinse the test load in the washing machine (**4.2.6**) using a process that incorporates at least one washing stage and from which bleaching and softening agents are excluded.

4.4.2 Without delay, load the extractor with the washed and rinsed test load, using the facilities normally employed (**4.2.7**). Measure and record the loading time using the stopwatch (**4.2.4**).

4.4.3 Insert the thermometer (**4.2.3**) into the load and record the indicated temperature.

4.4.4 Run the extractor for a selected nominal extraction cycle time as given in appendix E. Measure and record the actual cycle time.

4.4.5 Unload the extractor, using the facilities normally employed. Measure and record the unloading time.

NOTE to 4.4.2 and 4.4.5. In cases where manual assistance is required to perform this function, any part of the total time taken in loading and/or unloading that involves manual processes should be expressed as basic time as defined in term no. 43023 of 4.3 of BS 3138 : 1979.

4.4.6 After unloading, separate the test pieces from the load and weigh them immediately using the higher accuracy weighing machine (**4.2.2**). Record the sum total of their masses.

4.4.7 Dry the test pieces by passing them twice through the calender (**4.2.8**) operating at the speed normal for such sheets.

NOTE. Should the test site be such that no calender is available to dry the test pieces, a drying tumbler may be used for this purpose, provided that it is capable of reducing the test pieces to a dryness condition comparable with that which would be produced by a double passage through a calender.

4.4.8 Carry out the stages described in **4.4.1** to **4.4.7** three times for each of the four nominal extraction cycle times specified in appendix E.

NOTE. If the same test load is used for all tests in clause 4, the procedure for assessing the mass of the equivalent test load (see **4.3**) need not be repeated.

4.4.9 In the case of batch compression type hydro-extractors, where possible measure and record the following for each of the 12 tests:

- (a) the time taken from the start of the extraction cycle to the attainment of full working pressure and the magnitude of this pressure, (see **B.3.2**) and;
- (b) the time taken from the start of de-pressurization to the end of the extraction cycle time (see **B.3.3**).

4.4.10 During the course of the tests, measure and record the following in order to ensure that they are within the agreed limits:

- (a) the maximum basket speed, in the case of centrifuges;
- (b) the full working pressure, in the case of batch compression type hydroextractors (see **B.3.1**).

4.5 Calculation and expression of results

4.5.1 Relationship between moisture retention and extraction cycle

4.5.1.1 For each of the 12 moisture retention tests, calculate the quantity of moisture retained by the textile test pieces and express this as a percentage of their bone-dry mass, using the following formula:

$$R = \frac{M_2 - M_1}{M_1} \times 100$$

where

R is the moisture retention of the textile (expressed as a percentage of bone-dry mass);

M_1 is the mass of the bone-dry textile test pieces (in kg);

M_2 is the mass of the textile test pieces after extraction (in kg).

4.5.1.2 Plot on a graph the 12 values of percentage moisture retention against the respective cycle times (in minutes). Draw a smooth curve through or between the plotted points to represent the general relationship between percentage moisture retention and the extraction cycle time (see appendix E).

4.5.2 Productive capacity

4.5.2.1 Using the graph (see **4.5.1.2**), determine the time corresponding to the point of intersection of the line representing a moisture retention of 55 % (for centrifuges) or 60 % (for batch compression type hydroextractors) and the smooth curve. This time is designated the test extraction cycle time.

4.5.2.2 Calculate the productive capacity of the extractor using the following formula:

$$P = \frac{A \times 60}{B}$$

where

P is the productive capacity (in kg/h);

A is the air-dry mass of the full rated load of the extractor (in kg);

B is the sum of the test extraction cycle time (see **4.5.2.1**) and the mean loading and unloading times assessed in accordance with **4.4.2** and **4.4.5** (in min).

NOTE. In cases where the specified moisture retention of 55 % and 60 % for the respective types of hydroextractors cannot be achieved by the machine under test, the manufacturer's recommended

extraction cycle time should be taken as the test extraction cycle time and used for calculating the productive capacity. The percentage moisture retention corresponding to this particular extraction cycle time should be determined from the graph and recorded.

4.5.3 Minimum moisture retention. Using the graph, estimate from the curve (extended where necessary until it becomes closely parallel to the time axis) the minimum percentage moisture retention likely to be achieved by the test machine. Draw a line representing 105 % of this minimum percentage and record the time corresponding to the intersection of this line with the smooth curve (see appendix E).

4.5.4 Mean temperatures. Calculate and record the mean of the temperatures recorded as given in **4.4.3** (see **A.9(b)** and **B.9(b)**).

4.5.5 Mean times. Calculate and record the mean times for the attainment of working pressure and for depressurization as given in **4.4.9** (see **B.3.2** and **B.3.3**).

4.6 Test report. Enter the observations made in accordance with **4.4** and the calculated results made in accordance with **4.5** in the appropriate sections of the test report forms specified in appendix A or appendix B and attach a copy of the graph.

5. Moisture retention of textile materials and productive capacity of batch machines used as component units of batch automatic transfer processing units

5.1 Principle. Textile test pieces of known characteristics are included in each of a number of test loads whose air-dry mass corresponds to that of the batch loads that are processed consecutively by the automatic transfer processing unit. After extraction for the specific operating cycle time of the unit, the percentage of moisture retained by the test pieces is measured and recorded against the hourly output rating of the unit.

The methods of test in this clause are applicable to two differing types of circumstances.

In the first, it is possible to predetermine the mass of the load by the fact that the extractor is to be used as a unit directly coupled to a continuous washing machine that delivers to the extractor loads of a mass that is, to all intents and purposes, constant. If, however, the continuous washing units deliver their 'fixed mass' loads at time intervals that may vary according to the hourly output rating of the washing unit, the test will need to embrace varying operating cycle times.

In the second circumstance, the machine has to be tested in order to establish its output characteristics when processing loads of various mass (i.e. to establish its suitability for use in conjunction with a specific washing machine). In such a circumstance, the tests will need to embrace variables of both load mass and operating cycle time and will therefore be of a more comprehensive nature.

Because of the high output rates of continuous washing machines and the necessity of establishing consistent operating cycles under a steady state, it is considered that tests of this type of extractor are likely to take place under normal operating conditions in a working laundry. Since disruption of work flow is likely to be unacceptable in such circumstances, the tests are divided into three parts.