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Assessment of industrial laundry machinery by its effect on textiles —

Part 1: Washing machines

Évaluation des machines à laver industrielles par leurs effets sur les textiles

Partie 1: Machines à laver rotatives



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 7772-1 was prepared jointly by Technical Committees ISO/TC 38, *Textiles*, and ISO/TC 72, *Textile machinery and machinery for dry-cleaning and industrial laundering*.

ISO 7772 consists of the following parts, under the general title *Assessment of industrial laundry machinery by its effect on textiles*:

- *Part 1: Washing machines*
- *Part 2: Extracting machines*
- *Part 3: Flatwork-ironing machines*
- *Part 4: Batch-drying tumblers*

Annexes A to D form an integral part of this part of ISO 7772, annex E is for information only.

Introduction

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.

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

- a) definition of essential specifications for laundry machinery, for use by agreement between manufacturer and customer (see for example ISO 9398);
- b) preparation of standard methods for rating and assessing the effect of the principal types of machine so that the test results obtained on machines of a similar type could be compared directly wherever the machines were located and whenever they were tested.

ISO 7772 deals with the second approach, since the urgent need was for procedures that could be used on a range of machines to evaluate their effect 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 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.

It is hoped that, with the advance of techniques, and widespread use of ISO 7772, updated methods can be incorporated.

Assessment of industrial laundry machinery by its effect on textiles —

Part 1: Washing machines

1 Scope

This part of ISO 7772 specifies methods for the assessment of the effect on textiles of washing machines, including batch-washing machines, continuous-washing machines and washer-extractors.

Methods are described for determining mechanical effects due to the rotary action of the machine, the rinsing effectiveness, the mixing time and the consumption of water, heat and power. Certain other effects such as retention of whiteness may be evaluated using the methods specified in ISO 4312.

In the case of batch-washing machines, this part of ISO 7772 applies only to machines with a capacity in excess of 7 kg.

The methods described in this part of ISO 7772 can be used separately, and therefore any combination of them can be agreed on between the interested parties.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 7772. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 7772 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2267:1986, *Surface active agents — Evaluation of certain effects of laundering — Methods of preparation and use of unsoiled cotton control cloth.*

ISO 2602:1980, *Statistical interpretation of test results — Estimation of the mean — Confidence interval.*

ISO 3801:1977, *Textiles — Woven fabrics — Determination of mass per unit length and mass per unit area.*

ISO 6330:—¹⁾, *Textiles — Domestic washing and drying procedures for textile testing.*

ISO 7772-2:1996, *Assessment of industrial laundry machinery by its effect on textiles — Part 2: Extracting machines.*

IEC 60258:1968; 60258 am1:1976, *Direct acting recording electrical measuring instruments and their accessories.*

¹⁾ To be published. (Revision of ISO 6330:1984)

3 Definitions

For the purposes of this part of ISO 7772, the following definitions apply.

3.1

air-dry mass (ADM)

the total mass of clean textile articles, including the mass of the moisture absorbed from the ambient atmosphere (see also 3.4)

3.2

alkalinity

the concentration of alkali in a liquor

3.3

batch-washing machine

a washing machine that, in a washing sequence, discontinuously washes and rinses textile articles

3.4

bone-dry mass (BDM) (moisture content between 0,5 % and 1,0 %)

the mass of a textile article (or of a 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 of the textile greater than 0,5 %

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 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 part of ISO 7772.

3.5

cage

that part of a washing machine which rotates and contains the load during the washing and rinsing processes

3.6

carrier

cotton fabric, complying with ISO 2267, cut into squares measuring 1 000 mm × 1 000 mm in which "windows" are cut for attachment of MA test pieces (see 3.18), to ensure proper movement during washing and for ease of identification after processing

3.7

compartment

a subdivision of a cage

3.8

continuous-washing machine

a washing machine in which textile articles pass continuously or intermittently from the loading point, through the machine, to the discharge point

3.9

dwel time

the time for which the cage is stationary during reversals in the direction of rotation

3.10

extraction

the mechanical removal of liquor from wet textiles

3.11

final extraction

in a washer-extractor, the final stage of a process during which the cage rotates at its highest speed in order to achieve low moisture retention within the load

3.12**gross cage volume**

the theoretical volume within the major internal dimensions of the cage

3.13**hydro-extractor**

a machine in which water is removed from wet textile articles by mechanical means

3.14**intermediate extraction**

in a washer-extractor, the extraction between process stages

3.15**lifter**

a step or ledge on the internal periphery of the cage, usually parallel to the cage axis

3.16**load**

the textile articles with which a washing machine is loaded

3.17**loading factor**

the air-dry mass of the load, expressed in kilograms per litre of net cage volume

3.18**MA test piece:**

a cotton fabric of specified construction and dimensions, in which five circular holes of specified diameter and location are cut

3.19**MA figure**

the number of unbroken loosened threads in the hole of the MA test piece after processing, giving an indication of the degree of mechanical agitation during processing

3.20**net cage volume**

the gross cage volume less the total of the volumes occupied by lifters, recessed loading doors and the like

3.21**outer cylinder**

the part of a washing machine that encloses the cage and the liquor

3.22**process time**

the net total time taken for washing and associated rinsing in the agreed process

3.23**recovered water**

effluent from a washing machine which is made available for re-use

3.24**reference washing machine**

a washing machine of specified characteristics in which a reference washing process is carried out

3.25**laundry regain**

the difference between air-dry mass and bone-dry mass, expressed as a percentage of bone-dry mass

NOTE — This term is used for practical purposes for industrial laundry machinery, but does not have the same meaning as "moisture regain" (see ISO 6348).

3.26**rinsing**

the freeing of textile articles from wash products by dilution with water

3.27**running dip**

the mean depth of liquor in the cage during any specific stage of a washing process, measured vertically through the cage axis and expressed as a percentage of the cage diameter

3.28**sheets**

plain-weave white cotton sheets of mass per unit area $175 \text{ g/m}^2 \pm 10 \text{ g/m}^2$ (determined in accordance with ISO 3801)

3.29**standing dip**

the depth of liquor in the cage, measured vertically through the cage axis when the cage is stationary and without load

3.30**steady state**

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

3.31**transit time**

the time that elapses in a continuous-washing machine between a textile article entering and leaving the cage

3.32**washer-extractor**

a batch-washing machine in which liquors are centrifugally extracted from the textile articles

3.33**washing**

the freeing of textile articles from dirt in an aqueous medium with the assistance of washing materials, heat and mechanical energy

4 Preliminary procedures

4.1 Machine identification

The data required for the identification of the test machine and of any other ancillary equipment directly associated with and necessary for the operation of the test machine shall be recorded as given in annex A. The reference numbers of any diagrams, drawings or photographs necessary to supplement these data shall also be recorded.

4.2 Availability of test loads and other materials

Sheets and all other materials required for a particular method shall be assembled in sufficient quantities to ensure that the complete test can be carried out without interruption.

4.3 Machine installation and test conditions

4.3.1 The manufacturer of the machine to be tested shall provide, wherever practicable, a complete statement of requirements in respect of the installation conditions of the machine and of the running conditions required. 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.

4.3.2 The manufacturer shall be informed and invited to inspect, check and certify in the test report that the machine and all relevant aspects of its installation and functioning under test conditions are satisfactory.

4.3.3 If the installation and/or running conditions are outside the limits stated by the manufacturer, they shall be agreed to by him or his authorized representative. Failing such guidance or agreement, the installation and/or test 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 annex and attached to the test report.

4.3.4 The power rating of the electric motor or motors, the function which each motor performs and the manufacturer's stated peak loading and running load in kilovolt amps shall be recorded in a table with the format as given in table 5.

NOTE — See clause 7 for the measurements of the actual conditions of supply of services to the test machine during the tests and for the provision for the recording of such measurements in comparison with the figures recommended by the manufacturer.

4.3.5 The manufacturer's stated or recommended requirements in respect of electric-power supply, water, steam or heat-transfer fluid and any other external services (e.g. compressed air) shall be obtained and recorded as given in table 6.

NOTE — See clause 7 for the measurements of the actual conditions of supply of services to the test machine during the tests and for the provision for the recording of such measurements in comparison with the figures recommended by the manufacturer.

4.4 Tolerances

Tolerances are given for numerical values of dimensions, temperatures and times that are considered critical. If no tolerance is given, the precision of the measurements need be only that to be expected when using common instruments and reasonable care. The precision is further indicated by the number of significant figures in the values given.

5 Relationship between liquor quantity and dip level for open-drum washing machines

5.1 Principle

The quantity of liquor required to produce specified running-dip levels at different loading factors is determined by adding water through a meter and observing the water level through a sight glass.

5.2 Apparatus and materials

5.2.1 Indicating sight glass, fitted to the washing machine (see figure 1).

5.2.2 Water meter.

5.2.3 Cotton test sheets, which have been laundered previously, in sufficient number to load the machine to the recommended loading factors of 0,100 kg/l, 0,083 kg/l and 0,067 kg/l to within an accuracy of $\pm 5\%$.

5.3 Procedure

5.3.1 Add water at $15\text{ }^{\circ}\text{C} \pm 10\text{ }^{\circ}\text{C}$ through the meter to the machine, with the cage stationary, until the water is level with the bottom of the cage.

5.3.2 Mark the sight glass, denoting this level as zero, and make two further marks to represent 10 % and 33 % of machine cage diameter.

5.3.3 Record the quantity of water, in litres, added to reach the zero level (V_0).

5.3.4 Prepare a test load such that its air-dry mass corresponds to the recommended loading factor of 0,100 kg/l. Add this test load to the machine.

5.3.5 Allow the machine cage to rotate. This will cause the water level in the sight glass to fluctuate. Add water slowly until the maximum height in the indicating sight glass above the zero mark ($h_{10,max}$) corresponds to 10 % of the machine cage diameter.

Allow the cage to continue rotating for 5 min, adding further water, if necessary, to maintain the maximum height of the water level. Record the minimum height of the water during this time ($h_{10,min}$).

5.3.6 Calculate the midpoint between the maximum and minimum heights as

$$\frac{h_{10,max} - h_{10,min}}{2}$$

5.3.7 For the mark at 10 % level to represent the mean water level h_{10} , add water slowly whilst the cage is rotating until the maximum level in the sight glass corresponds to

$$h_{10,max} + \frac{h_{10,max} - h_{10,min}}{2}$$

Record the quantity of water added (V_{10}).

5.3.8 Add further water slowly, with the cage rotating, until the maximum height in the sight glass above the zero mark ($h_{33,max}$) corresponds to 33 % of the machine cage diameter. Allow the cage to continue rotating for 2 min, adding further water, if necessary, to maintain the maximum height of the water level. Record the minimum height of the water ($h_{33,min}$).

5.3.9 Calculate the midpoint between the maximum and minimum heights as

$$\frac{h_{33,max} - h_{33,min}}{2}$$

5.3.10 For the mark at 33 % level to represent the mean water level (h_{33}), add water slowly, whilst the cage is rotating, until the maximum level in the sight glass corresponds to

$$h_{33,max} + \frac{h_{33,max} - h_{33,min}}{2}$$

Record the quantity of water added (V_{33}).

NOTE — V_{33} is the total quantity of water added in 5.3.8, 5.3.9 and 5.3.10.

5.3.11 Repeat 5.3.4 to 5.3.10, using test loads with air-dry masses corresponding to the other two recommended loading factors of 0,083 kg/l and 0,067 kg/l (see 5.2.3).

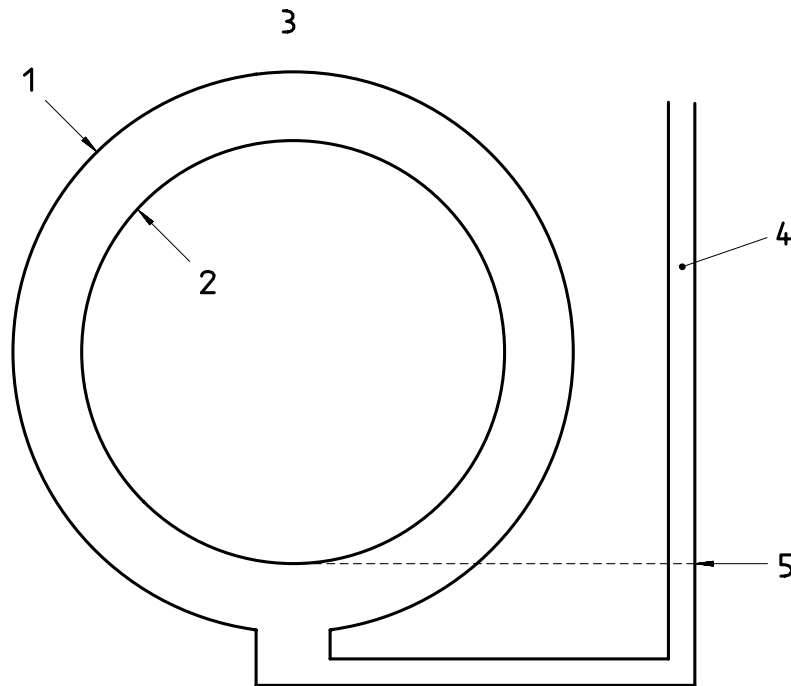
5.4 Expression of results

From 5.3.3 to 5.3.7:

$$\text{Quantity of water required to 10 \% dip level} = V_0 + V_{10}$$

From 5.3.3, 5.3.7 and 5.3.10:

$$\text{Quantity of water required to 33 \% dip level} = V_0 + V_{10} + V_{33}$$



Key

- 1 Outer cylinder
- 2 Inner cage
- 3 Washing machine
- 4 Sight glass
- 5 Zero level

Figure 1 — Indicating sight glass

6 Mechanical agitation (MA)

6.1 Principle

Prepared MA test pieces are subjected to agitation in the washing machine for a fixed time period under specified conditions. Evaluation of the number of unbroken threads which are loosened from previously cut areas of the test pieces gives an indication of the degree of agitation.

6.2 Apparatus and materials

- 6.2.1 Test pieces**, 96 for batch machines or 24 for continuous machines, prepared as described in annex C.
- 6.2.2 Carriers**, 96 for batch machines or 24 for continuous machines, prepared as described in annex C.
- 6.2.3 Weighing machine**, accurate to $\pm 1\%$, for determining the mass of the load.
- 6.2.4 Stopwatch**, or other means of measuring time, accurate to 1 s or better.
- 6.2.5 Test loads** of used cotton sheets.

6.3 Test procedure

6.3.1 Batch machines

6.3.1.1 Prepare eight carriers, each with one MA test piece attached, for inclusion in each load after the wetting-out stage (see 6.3.1.3).

6.3.1.2 Prepare a test load such that its air-dry mass, together with that of the carriers and test pieces, corresponds to the loading factor of 0,100 kg/l.

6.3.1.3 Load the machine with the test load only. Wet out the load by adding a suitable quantity of water at a temperature of $15\text{ }^{\circ}\text{C} \pm 10\text{ }^{\circ}\text{C}$ and running the machine for 5 min.

6.3.1.4 Introduce the carriers and test pieces and rapidly adjust the water level to a running dip equivalent to 33 % of the machine cage diameter.

6.3.1.5 Allow the cage to rotate for 20 min, then immediately stop the machine, drain without agitation, spin for 1 min to 5 min and empty the machine. Remove the carriers and test pieces. Detach the test pieces from the carriers and dry the test pieces on a laundry press.

Do not tumble-dry the MA test pieces.

6.3.1.6 Repeat 6.3.1.4 and 6.3.1.5 with the same load, without drying or other treatment, but using new test pieces.

6.3.1.7 Repeat 6.3.1.4 to 6.3.1.6 using a water level equivalent to 10 % of the machine cage diameter.

6.3.1.8 Repeat 6.3.1.2 to 6.3.1.7 using test loads together with carriers and test pieces such that the values of their air-dry mass correspond to loading factors of 0,083 kg/l and 0,067 kg/l.

6.3.2 Continuous-washing machines

6.3.2.1 Include eight carriers, each holding one MA test piece, in a compartmental load and process through the machine three times at 5 min intervals, operating the machine with a normal load of lightly soiled white work and weighing the load carefully to be equivalent to a loading factor recommended by the manufacturer. Record the following data:

- a) The compartment dip levels for the prewash, main wash and rinse stages. (All dip level settings shall be checked by the manufacturer to ensure that they are within recommended limits for a medium-soil white-cotton process.)
- b) The quantity of fresh water fed to the machine, measured using a fitted water meter or the manufacturer's flow-measuring device, if fitted. (The total quantity of fresh water supplied to the machine shall be between 8 litres and 12 litres per kilogram of load processed.)
- c) The maximum temperature, measured by taking water samples from the appropriate compartment.
- d) The machine transit time. (Carry out the tests with the transit time set at $30\text{ min} \pm 1\text{ min}$.)
- e) The loading factor used.

6.3.2.2 Remove the carriers and test pieces immediately before the final hydro-extraction stage and dry on a normal laundry press.

6.4 Measurement of MA figure

Examine each test piece on each side and count all the unbroken loose threads, including those that are merely connected by a single fibre and those that are just slightly loosened (to qualify as loose, a thread shall be free by more than 2 mm).