BRITISH STANDARD METHOD OF TEST FOR

WETTABILITY OF TEXTILE FABRICS

FOREWORD

This British Standard has been published by arrangement between the Textile Institute and the British Standards Institution.

A method of test for wettability of cotton fabrics was given in the 1963 edition of BS Handbook No. 11, ' Methods of test for textiles ', but the reliability of the test was unsupported by any published evidence or inter-laboratory work. The method was examined at the Shirley Institute, together with the A.A.T.C.C.* standard method and a third method developed from a combination of these. This third method was found to be superior to the other two in that the end-point of the test is clearer and the experimental error is less. A Textile Institute Working Party set up to examine the new test method conducted inter-laboratory trials, and a supporting paper† gives the results of these trials together with a summary of the research work undertaken.

The method requires some practice before reliable results are obtained. Operators unfamiliar with the method tend to be over-cautious in interpreting the end-point. The reproducibility of the method is such that in trials carried out in five laboratories differences in mean results obtained on one specimen by different operators were always less than 30% and rarely exceeded 20%. It is known that changes in wettability of less than about 30% have no significance for most practical purposes.

Wettability measurements are particularly useful as an index of the efficiency of scouring, for the investigation of defects due to local wettability variations, and as a guide to the suitability of fabrics for special purposes where speed of uptake of liquid is important.

METHOD

1. SCOPE

This British Standard describes a method of test for wettability of textile fabrics and is primarily intended for fabrics containing hydrophilic fibres. Fabrics giving times exceeding 200 seconds are considered to be unwettable (see clause 2) and are therefore outside the scope of this standard.

2. DEFINITION

For the purposes of this British Standard the following definition applies:

Wettability. The time in seconds taken for a drop of water or 50% sugar solution to sink into the fabric.

Fabrics giving times greater than 200 s with water are considered to be unwettable.

* American Association of Textile Chemists and Colorists.
† See *J. Text. Inst.*, 1969, 60, 14.

3. PRINCIPLE

A drop of water or sugar solution is allowed to fall on to the fabric, and the time taken for it to sink into the fabric is measured under standard conditions. The shorter the time, the more wettable is the fabric.

4. APPARATUS AND REAGENTS

4.1 The following apparatus is required:

(1) A burette (see Appendix A) for each liquid.

(2) Clamps for supporting the burettes in a vertical position so that both the glass tube and the jet are firmly clamped.

(3) A microscope spot lamp of at least 30 W giving a beam which, when at an angle of incidence of 45° to a horizontal plane, illuminates an area not less than 20 mm across at a distance of about 250 mm.

(4) A heat filter* placed in front of the light source to ensure that the temperature in the vicinity of the specimen does not exceed the limits of the standard atmosphere for testing textiles.

(5) A viewing ring of outside diameter 45 mm and inside diameter 20 mm, adjustable in height and inclined downwards at 45° to the vertical.

It is preferable to construct the above five items as a fixed unit with a matt black shield shading the specimen from external light: see Fig. 1.

(6) An embroidery frame of diameter about 150 mm.

(7) Stopwatch or clock, reading to 0·1 s.

(8) Means for providing the standard atmosphere for testing textiles specified in Clause 5.

4.2 The following reagents are required:

(1) Distilled water.

(2) 50% sugar solution (see Appendix B).

5. CONDITIONING AND TESTING ATMOSPHERE

The atmosphere required for conditioning and testing is the standard atmosphere for testing textiles as specified in BS 1051†, i.e. relative humidity of 65 ± 2% and temperature of 20 ± 2°C.

6. TEST SAMPLES

Prepare test samples of suitable size for clamping in the embroidery frame, i.e. approximately 200 mm × 200 mm. Avoid creased or folded places in the fabric. After receipt handle the fabric as little as possible and do not sharply

* Chance HA3 heat filter is suitable.
† BS 1051, ' Terms relating to the conditioning of textiles and methods for the determination of correct invoice weight '.

fold, iron or treat it in any way other than by conditioning. Unless otherwise agreed, take three samples from different places in the fabric to represent it as fully as possible, and make five measurements on each sample.

7. PREPARATION OF TEST SAMPLES

Condition the test samples for at least 24 h in the atmosphere defined in Clause 5.

8. PROCEDURE

8.1 Setting up the apparatus

8.1.1 If a light shield is not used, care must be taken that the test is not carried out in direct lighting from any other source (e.g. bright daylight).

8.1.2 Mount the conditioned test sample securely (without undue stretching) in the embroidery frame and place it in a horizontal position.

8.1.3 Fill the clean, dry burette with distilled water and mount it in a vertical position, so that the tip of the jet is approximately 6 mm above the surface of the fabric.

8.1.4 Clamp the viewing ring so that it is about 150 mm from the burette, and so that an imaginary line joining its centre to the point on the test sample immediately below the tip of the jet is at an angle of inclination of approximately 45°.

8.1.5 Arrange the spot lamp at least 250 mm from the burette so that the beam of light illuminates the area of the test sample immediately below the tip of the jet at an inclination of 45°, and in a vertical plane passing through the centre of the viewing ring. This condition can be achieved by placing a microscope slide coverglass on the test sample immediately below the tip of the jet and adjusting the position of the beam until the light reflected from the coverglass passes through the viewing ring.

8.2 Testing the fabric

8.2.1 Note the air temperature close to the test sample.

8.2.2 Allow a drop to fall from the burette on to the fabric and start the stop-watch at this instant.

8.2.3 When the diffuse reflection from the liquid vanishes and the liquid is no longer visible above the surface of the fabric, stop the watch and note the time (see Appendix C). Care must be taken not to move the embroidery frame during this time. Record times of less than 10 s to the nearest 0·1 s and longer times to the nearest second.

8.2.4 If the time is less than 2 s, change the burette for one containing 50 % sugar solution.

8.2.5 Repeat the test on four other areas of the test sample such that no area has a centre nearer than 25 mm to that of any area previously tested.

8.2.6 Test two other test samples in a similar manner, to make 15 measurements in all.

8.2.7 Note the temperature again and record the mean of the two observations.

8.2.8 If sugar solution has been used, rinse the burette thoroughly with hot water and then distilled water immediately testing is completed, or if more than half an hour will elapse before the next test. Clean, but wet, burettes must be either oven-dried and allowed to cool to room temperature, or given a final rinse in acetone and allowed to dry, before being used again.

9. CALCULATION AND EXPRESSION OF RESULTS

Calculate the mean of the 15 measurements of wetting time and apply the appropriate correction for temperature (see Appendix D). Record times less than 10 s to the nearest 0·1 s and longer times to the nearest second.

10. REPORT

10.1 The report shall state that the tests were performed in accordance with this method.

10.2 The report shall also state the following:

(1) the number of test samples taken and the number of measurements made on each test sample;

(2) the individual measurements made of wetting times;

(3) the mean of the wetting times corrected for temperature, and quote this as the ' wettability ' of the fabric;

(4) the test liquid used (see Appendix E);

(5) the date of the test*.

* Wettability can change with time, for example, owing to the migration of fats and waxes to the surface of the cloth.

APPENDIX A

BURETTES

A.1 Each burette consists of a jet of hard drawn brass, with a tip of external diameter 1·22 ± 0·03 mm, internal diameter 0·65 mm (see Fig. 2) connected by rubber tubing to a piece of glass tube, of external diameter approximately 6 mm and internal diameter not less than 5 mm; the drop formation is controlled by a suitable Mohr's clip on the rubber tubing. The burette shall hold at least 5 ml of liquid, and the distance between the lower end of the glass and the top of the jet should be about 20 mm. It is preferable to mark the burettes so that one is always used with water and the other with sugar solution.

APPENDIX B

PREPARATION OF SUGAR SOLUTION

Sucrose is dissolved in an equal mass of distilled water in a flask, covered with a loose fitting lid, over a steam bath.

The density of the solution is determined using either (1) a hydrometer or (2) a density bottle.

(1) The hydrometer should have a nominal scale range 1·220 g/ml to 1·240 g/ml and should conform to series L20 of BS 718* for liquids of high surface tension. An overflow vessel shall be used to reduce errors caused by changes in the surface tension due to contamination of the free liquid surface.

The method of measuring the density of the solution and the corrections to be applied are given in BS 718*.

(2) When the density of the solution is determined by means of a density bottle, the bottle should conform to BS 733† and must be clean and dry before liquid is introduced, and the liquid in the bottle must be allowed to come to equilibrium in a constant temperature before being weighed.

$$\text{Density of solution}(S) = \frac{D_w \times M_s}{M_w} \text{ g/ml}$$

* BS 718, ' Density hydrometers and specific gravity hydrometers '.
† BS 733, ' Density bottles '.

where D_w = density of water at constant temperature interpolated from the values given in the following table:

Density of water (g/ml)		
at 15 °C	at 20 °C	at 25 °C
0·9991	0·9982	0·9971

M_s = mass (in g) of sugar solution in bottle at the same constant temperature

M_w = mass (in g) of water in bottle at the same constant temperature.

The density of the solution having been calculated, its concentration can be found from the following table:

Concentration mass	Density, S, of sugar solution (g/ml)		
%	at 15 °C	at 20 °C	at 25 °C
48	1·2208	1·2186	1·2164
49	1·2262	1·2241	1·2218
50	1·2317	1·2296	1·2273
51	1·2373	1·2351	1·2328
52	1·2428	1·2406	1·2384
53	1·2485	1·2462	1·2439
54	1·2541	1·2519	1·2495

The concentration will usually be greater than 50 % because of evaporation of the liquid on heating.

Amount of water to be added =

$$\text{Volume of solution} \times S \left(\frac{\text{concentration of solution \%}}{50} - 1 \right) \text{ml}$$

When the water has been added, the density is remeasured at 20 ± 2 °C and the concentration should be not less than 49·9 % and not more than 50·1 %.

The prepared sugar solution must be stored in an airtight bottle and should not be kept for more than two days. If storage for a longer time is unavoidable, 0·05 % by mass of mercuric chloride may be added to the solution to prevent mould formation. After storage, the density of the solution should be checked before use.

CAUTION. Mercuric chloride is highly poisonous and can be absorbed through the skin. All the usual precautions concerning the handling of poisonous substances should be adopted.

APPENDIX C

END-POINT OF TEST

Fig. 3 shows the successive stages in the absorption of the drop.

3*a*. The drop rests on the fabric and presents a smooth surface, which gives specular reflection.

3*b*. The drop loses its symmetry, and reflection from the liquid still above the surface of the fabric is diffuse. The end point is reached when diffuse reflection from the liquid vanishes; at this point the watch or clock is stopped.

3*c*. Liquid no longer exists above the surface of the fabric, and the distinct diffuse reflection has given way to the dull opaque appearance of wet fabric.

APPENDIX D

CORRECTION FOR VARIATION OF TEMPERATURE FROM 20 °C

Corrections can be applied to take into account changes in the viscosity of the test liquid that are due to variations in temperature from 20 °C, although it is not possible to make an allowance for any changes in wettability of the fabric that may occur with temperature. Within the limits of the standard atmosphere for testing, the wetting times can be corrected by the formula:

$$t_{20} = \frac{t_x}{1 + \alpha\,(20 - x)}$$

where t_{20} = wetting time at 20 °C,

t_x = wetting time at x °C,

α = factor depending on the liquid and its rate of change of viscosity with temperature.

The value of α is 0·042 for 50 % sugar solution and 0·025 for water.

APPENDIX E

INTER-CONVERSION OF TIMES MEASURED WITH 50 % SUGAR SOLUTION AND WATER

It is sometimes desirable to be able to convert times obtained with one liquid to the values that would have been obtained with the other liquid, for instance, when one is comparing the effect of a number of scouring treatments or finishes on a fabric.

The times with water are approximately one-twelfth of the times obtained with 50 % sugar solution, but the value can vary from fabric to fabric. It is possible to obtain a relation between the times obtained with water and those obtained with sugar solution for a particular fabric by carrying out tests with alternate drops of each liquid.

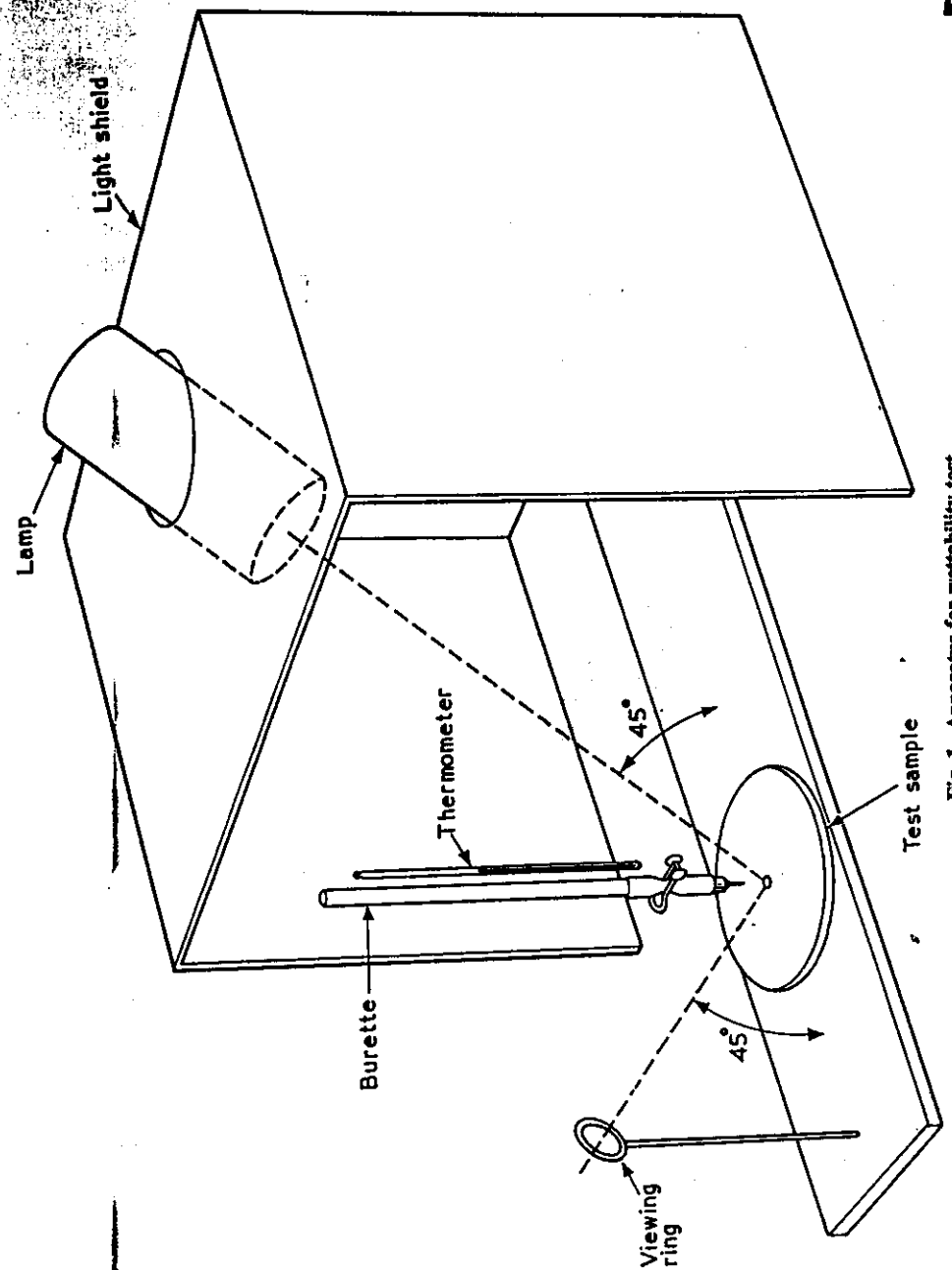


Fig. 1. Apparatus for wettability test

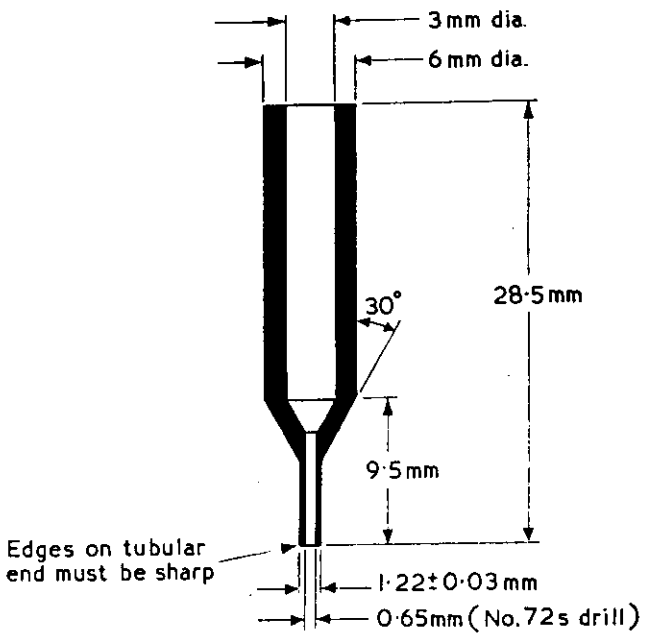


Fig. 2. Jet of hard drawn brass

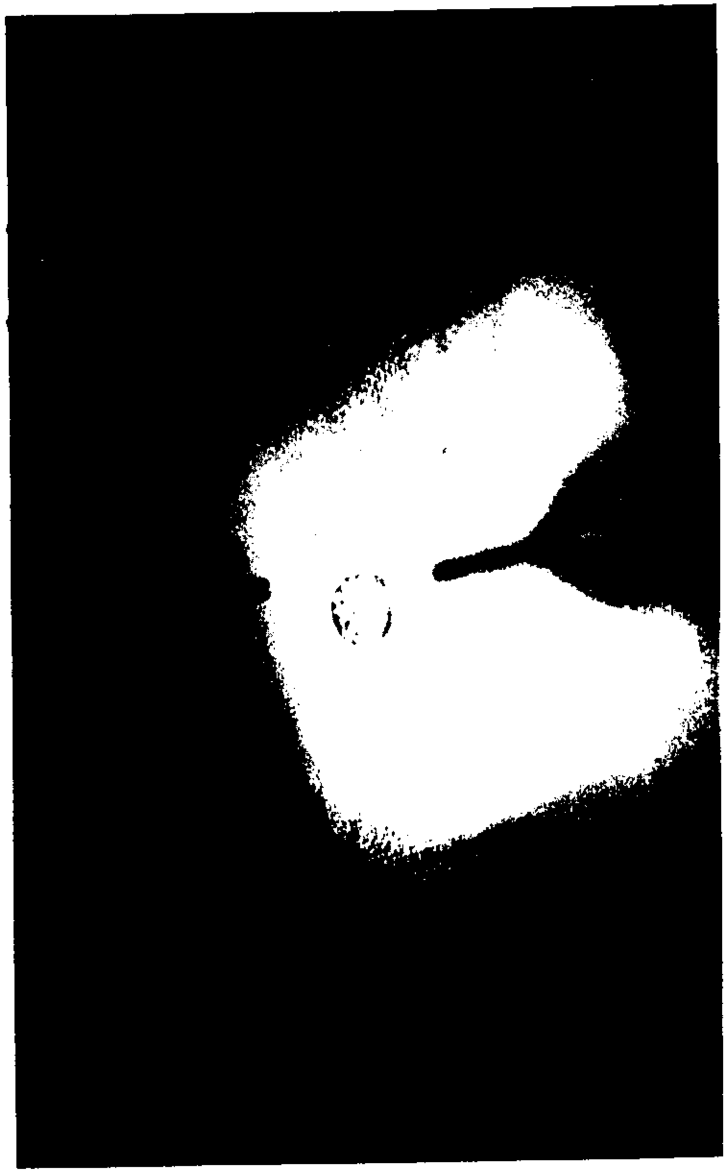


Fig. 3a

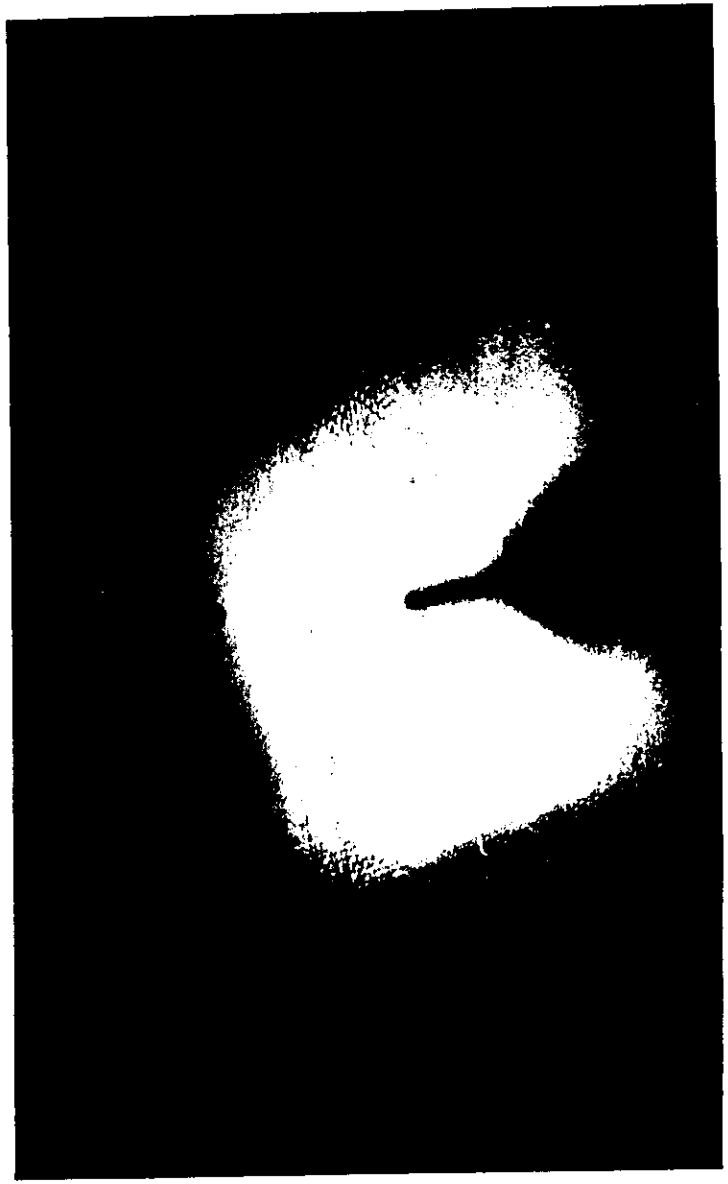


Fig. 3b

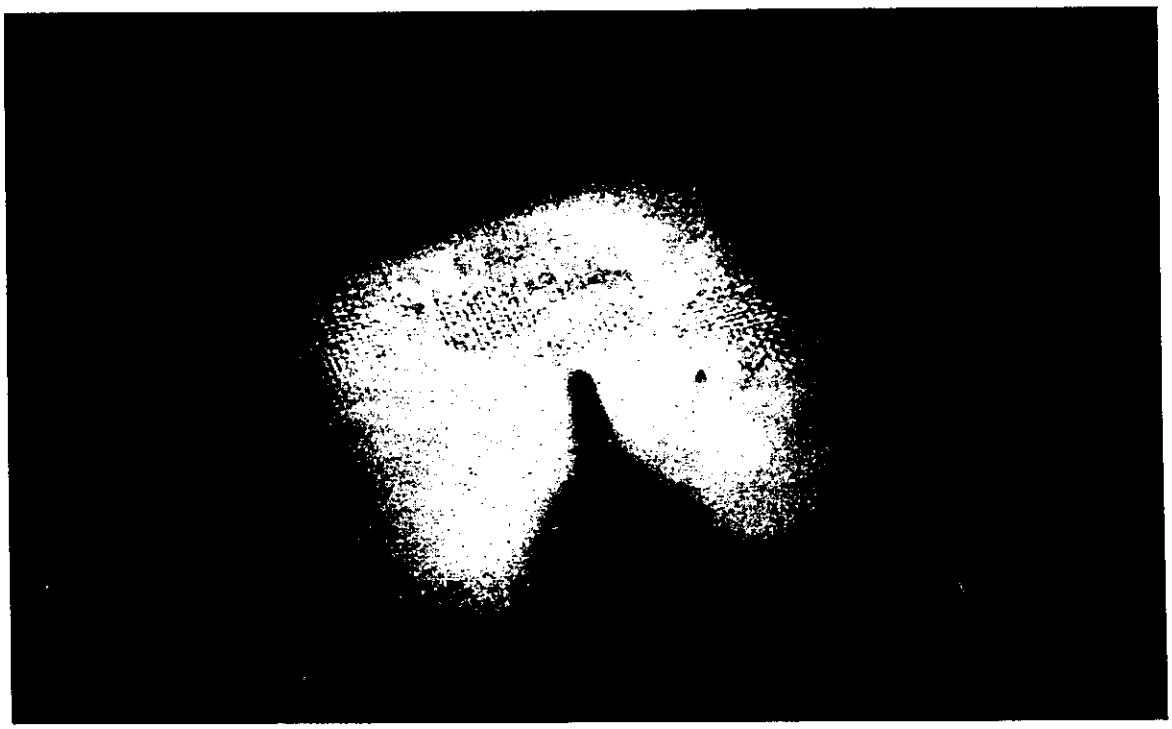
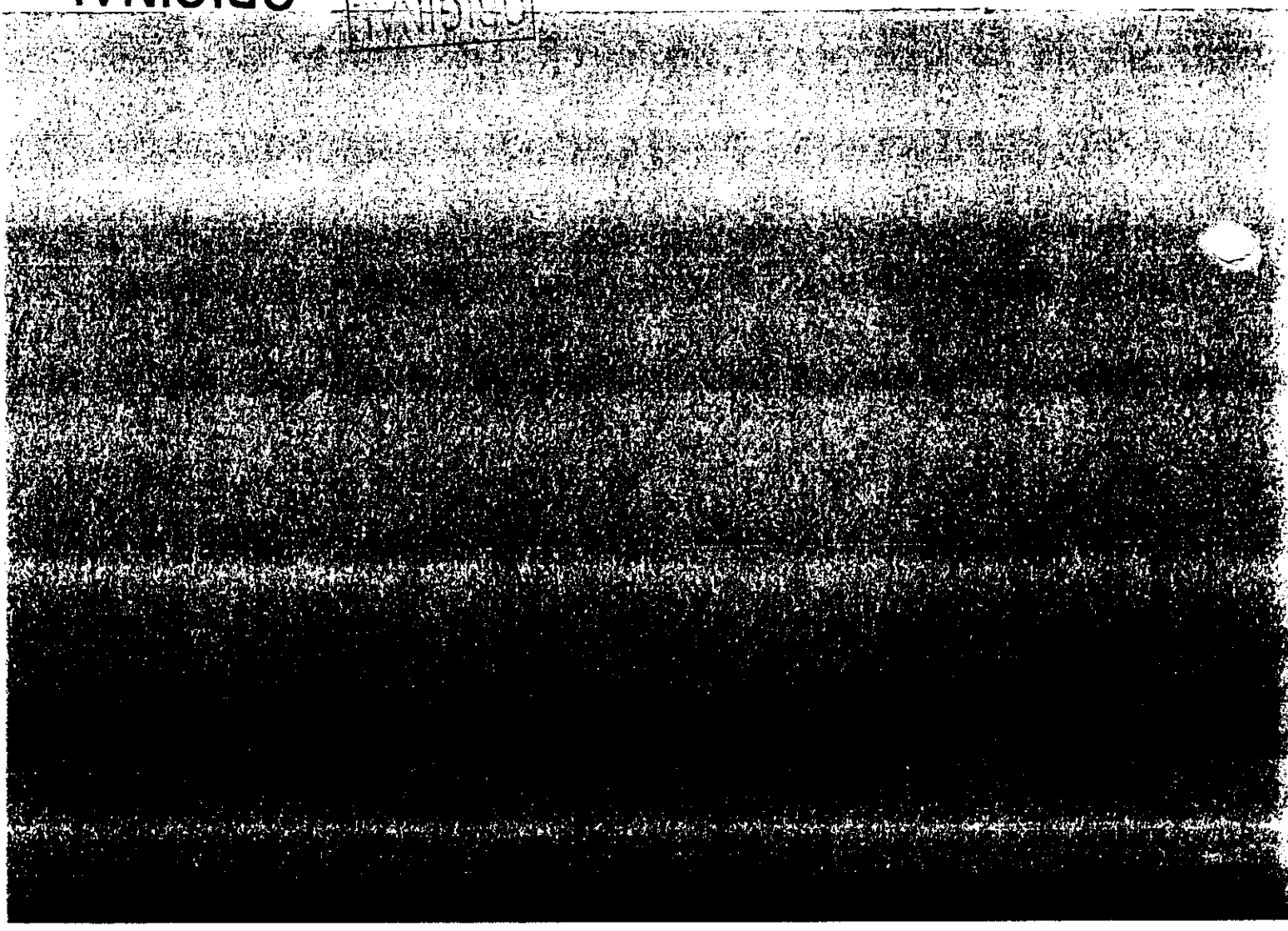


Fig. 3c

Fig. 3. Successive stages in absorption of drop (see Appendix C)



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