

CORESTA RECOMMENDED METHOD N° 53

DETERMINATION OF PAPER WRAPPER BURN SPEED

(May 2002)

0. INTRODUCTION

The paper wrapped around manufactured cigarettes, roll your own and tubed products is a vital component of the cigarette or fine-cut smoking article. The measurement of burn speed has been carried out using a variety of test procedures by the paper manufacture, paper conversion and tobacco industries for many years. The purpose of this method is to provide a reproducible laboratory procedure for the measurement of paper wrapper burn speed.

1. FIELD OF APPLICATION

This method is applicable to all paper wrappers in the form of bobbins, leaflets and rolls and wrapper spills removed from finished tobacco products. It is designed for the testing of paper wrappers and must not be used for the testing of tobacco products. Paper Wrapper Burn Speed is a characteristic of the paper and is not intended to be used to predict smoke yields.

2. REFERENCES

ISO 186:2002

Paper and board – Sampling to determine average quality.

ISO 187:1990

Paper, board and pulps – Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples.

3. DEFINITIONS

For the purposes of this CORESTA Recommended Method, the following definitions apply.

3.1. *Paper Wrapper*

Paper specially prepared and supplied in a form suitable for enclosing the tobacco in manufactured cigarettes, roll your own and tubed products.

3.2. *Burn speed*

$$V = \text{mm} \times \text{sec}^{-1}$$

A measure of the rate at which papers will smoulder under controlled conditions and expressed in seconds to smoulder a fixed distance (mm).

3.3. *Burn time*

The burn time is the time for 15 mm paper burn and the result is expressed in seconds.

3.4. *Laboratory sample*

The sample of paper intended for laboratory inspection or testing and which is representative of the paper to be tested.

3.5. Test sample

Paper for test taken at random from the laboratory sample and which is representative of each of the increments making up the laboratory sample.

3.6. Test Piece

An individual strip of paper for testing.

4. PRINCIPLE

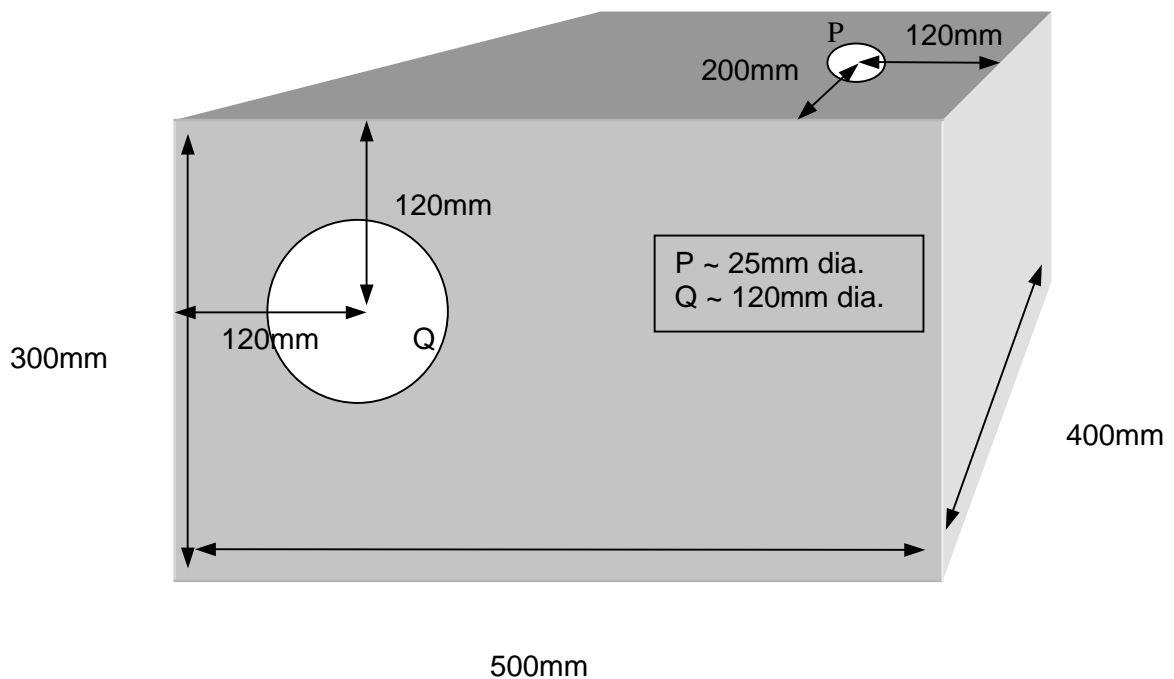
The test piece is rolled and placed in a controlled environment where non-flame ignition is used to begin the smoulder process. The time taken to smoulder between two set points is measured.

5. APPARATUS

5.1. Testing Box

The Testing Box is illustrated in Figure 1.

Figure 1. Testing Box



A testing box shall be constructed from transparent material and internally should measure approximately 500 mm wide x 400 mm deep x 300 mm high. The front of the box shall contain a 120 mm diameter circular hole to allow the operator to insert the roll of paper. The centre of the hole shall be 120 mm from both the left-hand side and the top of the box. The top of the box shall have a small hole, 25 mm in diameter, to allow circulation placed 120 mm from the right hand side and 200 mm from the front of the box. Both holes shall be left uncovered at the time of the test.

Note:

In case of automatic or semi-automatic test piece ignition, an additional opening, approx. 25 mm in diameter, shall be included on the left hand side.

5.2. Needle

A polished stainless steel needle shall be used with a diameter of 2.5 mm and a length of 100 mm.

5.3. Digital Timer

This shall have an accuracy of 0.1 second.

5.4. Paper Holder

The paper holder shall consist of two components, the holder and the plug that are illustrated in Figures 2a and 2b.

1. The holder, Figure 2a, shall be a hollow stainless steel tube 25 mm long with an inner diameter of 4 mm and an outer diameter of 12 mm. A solid tube, diameter 4 mm, shall be attached at right angles to the hollow tube. This solid tube attaches the holder to a base, which ensures that the holder is held horizontally and securely and that the overall height from the floor of the test box to the centre of the paper holder shall be 140 mm.
2. The plug, Figure 2b, is in the form of a tee, with an overall length of 25 mm. The top of the plug shall be 5 mm thick and 12 mm diameter; the bottom of the plug shall be 20 mm in length with a diameter of 3.9 mm and shall be a snug fit into the hole of the holder. A hole, 2 mm in diameter, shall be in the centre of the 25 mm length of the plug.

5.5. Paper Holder Base

The paper holder base must ensure that the paper holder is held horizontally and securely and that the overall height from the floor of the test box to the centre of the paper holder is $140 \text{ mm} \pm 0.2 \text{ mm}$. The length of the solid tube from the holder will vary according to the design of the paper holder base.

One example of a paper holder base is shown in Figure 3. This has a flat base plate of dimension 65 mm x 65 mm x 3 mm. A tube is fixed vertically to the centre of the base plate of length 94 mm and inner diameter 4.1 mm to take the solid tube from the holder. [The flat base plate measures 3 mm, the filled tube 37 mm, the length of the solid tube 94 mm and the midpoint of the holder 6 mm, giving 140 mm as required in total.]

Figure 2a. The Holder

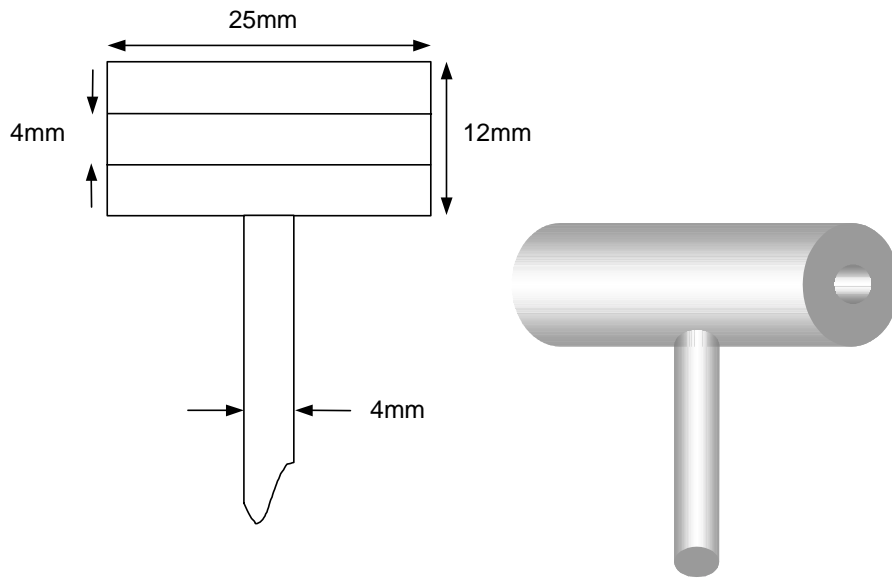


Figure 2b. The Plug

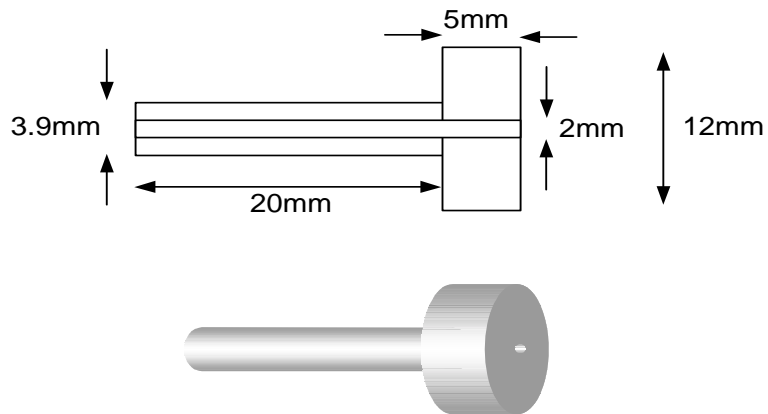
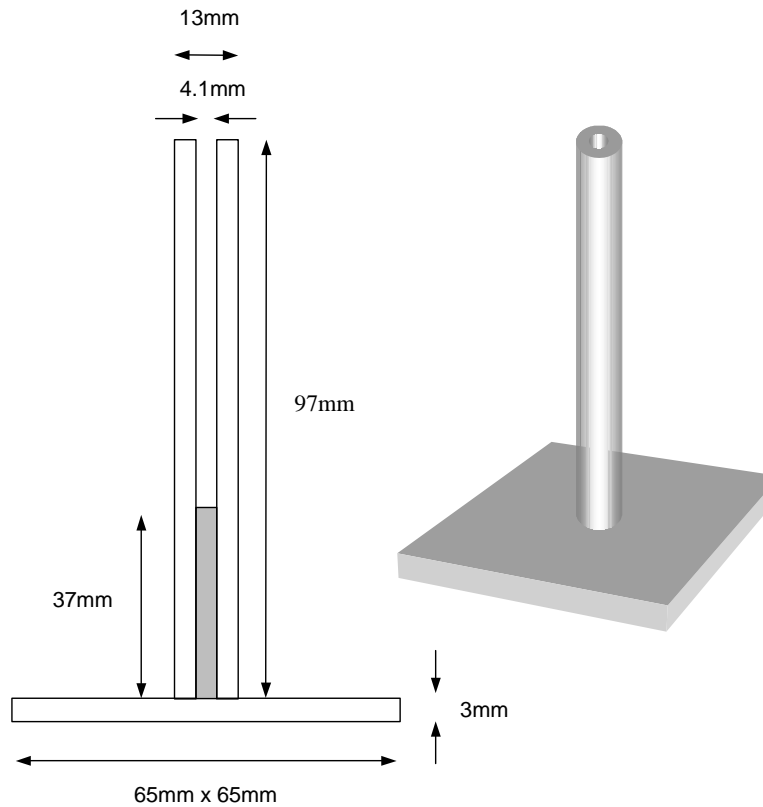


Figure 3. A Paper Holder Base



5.6. Fume Hood

A normal laboratory fume hood capable of holding the testing box should be used.

6. SAMPLING

Provide a laboratory sample by a suitable sampling scheme such as that given in ISO 186:2002. This sample will normally contain paper samples taken from different parts of the population. Make up the test sample required for the test by randomly selecting paper from the different parts of the population represented in the laboratory sample.

7. METHOD

7.1. *Sample handling*

Non-talc surgical or cotton gloves shall be used at all times when handling the test pieces.

7.2. *Laboratory conditioning*

Condition the test pieces, prior to measurement, in a conditioning enclosure set at $23^{\circ}\text{C} \pm 1^{\circ}\text{C}$ and $50\% \pm 2\%$ relative humidity (RH) in accordance with ISO 187:1990. Samples shall be held such that the conditioning air has free access to all their surface.

IMPORTANT - In laboratories unable to use the conditions given in ISO 187:1990, the conditions $22^{\circ}\text{C} \pm 1^{\circ}\text{C}$ and $60\% \pm 2\%$ RH given in ISO 3402:1999 may be used. In these cases a note shall be included with the test report.

7.3. *Sample marking*

The sample marking is illustrated in Figure 4.

The test piece from the test sample shall be cut in the machine direction, approx. 60 mm long and a minimum of 26 mm and a maximum of 28 mm wide.

Draw two parallel lines 15 mm apart along the length of the paper test piece. Line A illustrates the 5 mm depth of insertion from the holder edge. The edge, to be inserted into the holder shall be the gummed edge if applicable. Line B shall be drawn 7 mm from the holder edge and Line C 22 mm from that edge. A minimum width of 26 mm gives 4 mm of paper prior to Line C on the edge to be ignited and a maximum width of 28 mm gives up to 6 mm of paper prior to Line C on the edge to be ignited.

It is most important for the correct operation of this test that the distance between Lines B and C is $15 \text{ mm} \pm 0.3 \text{ mm}$.

The pencil lines shall be drawn on the wire-side of the paper where this can be determined. Where the wire-side cannot be determined a note shall accompany the test result to this effect.

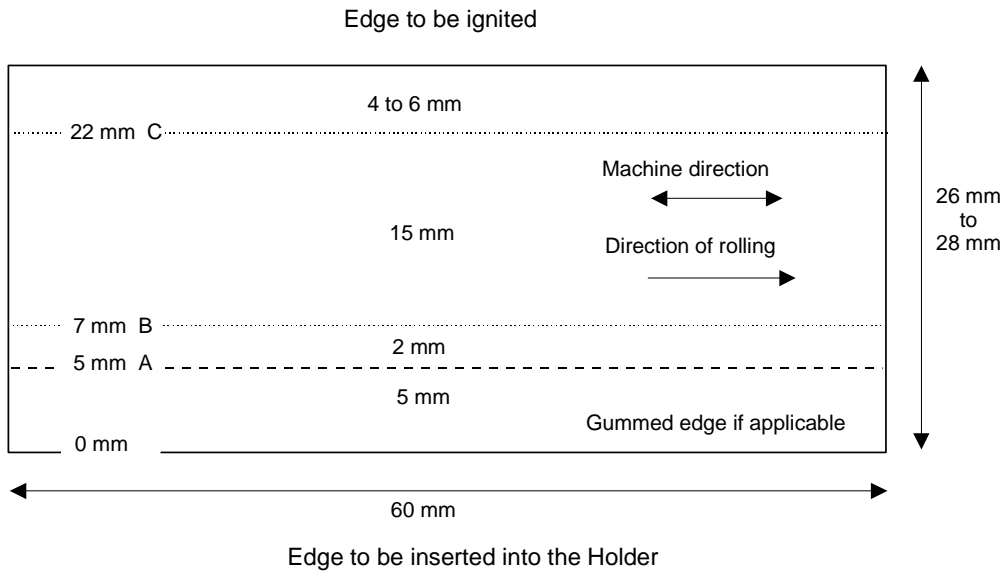
7.4. *Box preparation*

7.4.1. The holder shall be placed in the centre of the floor area of the testing box. The paper holder base into which the holder is inserted must ensure that the paper holder is held horizontally and securely and directed towards the 120 mm diameter hole. The overall height from the floor of the test box to the centre of the paper holder is 140 mm.

7.4.2. The box should be placed in a normal fume hood. The airflow in the fume hood shall be switched off at the time of the test.

The fume hood may be switched on between groups of tests to exhaust any fumes.

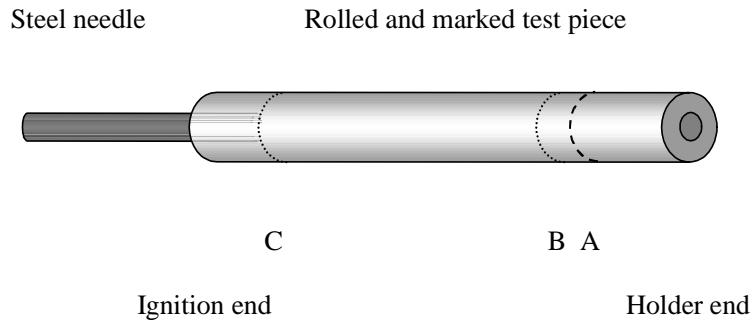
Figure 4. Sample Marking



7.5. Test piece preparation

The test piece shall be placed, with the lines on the outside, *i.e.* wire-side outside, on the needle and firmly and evenly rolled round the needle to form a small roll. The edge to be inserted into the holder when rolled shall be at the end of the needle. The edge to be ignited when rolled shall be at the body of the needle. This is illustrated in Figure 5.

Figure 5. Sample Preparation



All test pieces shall be rolled as firmly as possible and to the similar degree of tension. This rolling may be assisted by means of a simple jig, which is described in Annex A.

Fit the plug into the holder. Insert the roll at the open end of the needle into the holder to a depth of 5 mm given by the plug.

Slide the needle from the roll, retaining the tight roll within the holder. Carefully push the roll to the correct position against the plug. Ensure that the plug is in place during the test.

This is illustrated in Figure 6.

7.6. *Position of the paper holder*

The holder containing the paper roll shall be placed in the paper holder base in the Testing Box such that the paper roll is horizontal and parallel with the front edge of the box with the ignition end facing left towards the hole in the front of the box. The overall height from the floor of the test box to the centre of the holder shall be 140 mm.

7.7. *Ignition*

Ignite the end of the roll using non-flame ignition. Ensure the end of the roll is smouldering over the whole surface and does not flare.

7.8. *Closure of the fume hood*

Once the paper holder is in place in the box, and before the paper roll is ignited, the fume hood should be switched off and after ignition the hood should be closed.

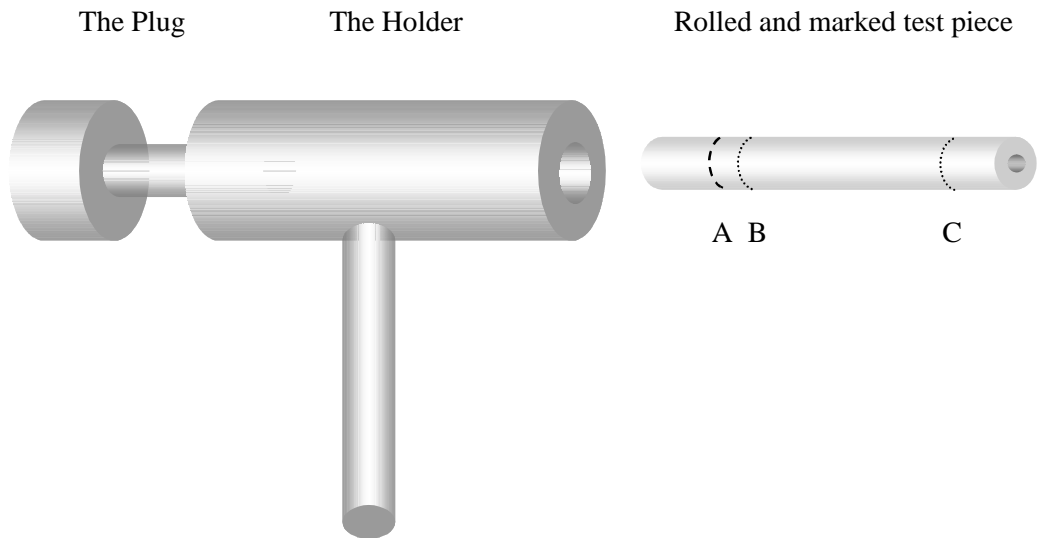
7.9. *Measurement*

Using a digital timer, measure the time taken for the roll to burn between the two lines, C and B. The time shall be measured to the nearest 0.1 second. The observation should be taken from the front side.

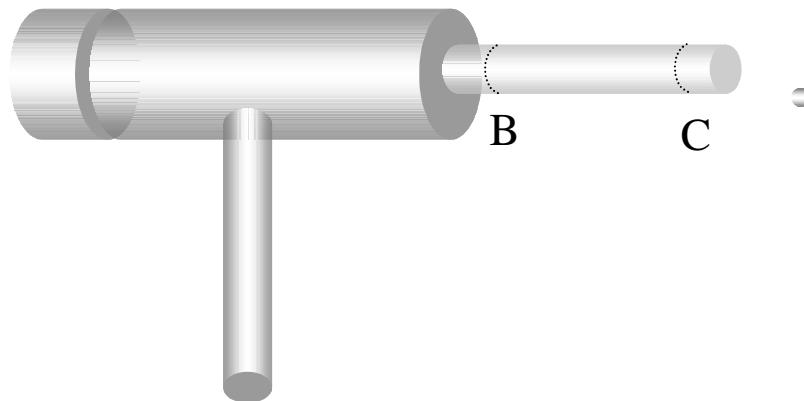
At the end of the test remove any residue from the test holder using tissue, filter paper or tweezers and ensure that the hole is clean before the next test.

This test procedure shall be repeated on 10 test pieces for each sample type. The reported result is the mean value from the 10 individual measurements.

Figure 6. Assembly of the Plug, Holder and Rolled Test Piece



The Plug, Holder and Test Piece during assembly



Plug, Holder and Test Piece after assembly

8. TEST REPORT

The test report shall show the method used and the results obtained. It shall also mention any operating conditions not specified in this CORESTA Recommended Method, or regarded as optional, as well as any circumstances that may have influenced the results. The test report shall include all details required for complete identification of the sample.

8.1. *Characteristic data about the paper*

Paper identification. This should include:

Name of manufacturer. Country of manufacture

Brand name and sub-brand name

Pack number (of that product sampled that day)

Marks on any tax stamp

Printed classification (if any).

8.2. *Sampling*

Type of sampling procedure

Date of sampling

Place of purchase or sampling

Sampling point (*e.g.* address of retail outlet or machine number)

8.3. *Description of test*

Reference to this CORESTA Recommended Method

Date of test

Number of test pieces tested in the entire determination

Temperature and relative humidity in the testing room at the time of testing

Atmospheric pressure (in millibars) during testing.

8.4. *Test results*

The following data shall be given for each of the samples tested:

The time taken to smoulder 15 mm for each of the ten individual test pieces to 0.1 second. Report the mean for the 10 pieces to the nearest 0.1 second.

9. REPEATABILITY AND REPRODUCIBILITY

The precision of this test method is given in the table below.

Level	Burn Time	Repeatability Conditions		Reproducibility Conditions	
	Mean s	s_r	r	s_R	R
1	26.3	0.29	0.82	1.00	2.83
2	30.8	0.50	1.40	1.70	4.81
3	37.2	0.43	1.22	2.08	5.89
4	43.0	0.50	1.41	3.06	8.65
5	52.1	0.68	1.91	4.80	13.57

Where s_r and s_R are unbiased estimates of standard deviation.

The relationship between repeatability and reproducibility and the mean value can also be expressed approximately by the following equations within the range of data, shown in the above table.

$$\text{Repeatability [r]} = 0.0357 \times \text{Mean.}$$

$$\text{Reproducibility [R]} = 0.4 \times \text{Mean} - 8$$

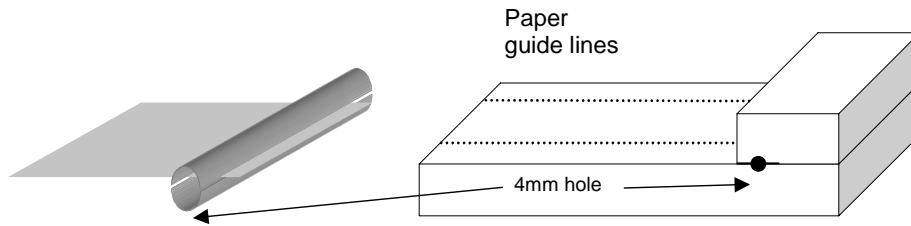
The difference between two results with the same operator using the same equipment on identical test items within the same laboratory will exceed the repeatability, r, on average in no more than one in twenty cases in the normal and correct operation of the method.

The difference between two results with a different operator using different equipment on identical test items within different laboratories will exceed the reproducibility, R, on average in no more than one in twenty cases in the normal and correct operation of the method.

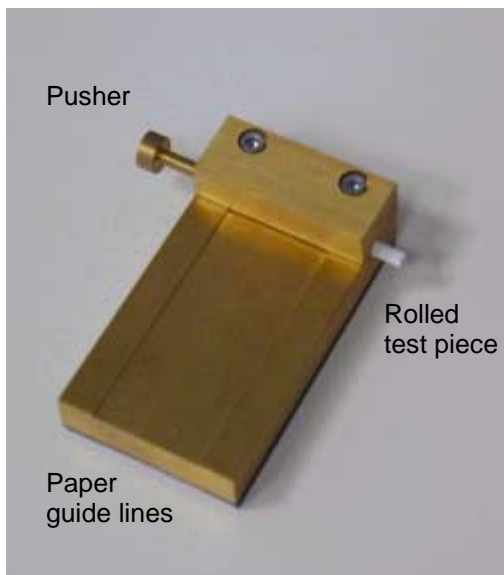
These values may be applied within a range of 26 to 52 seconds. They were determined from a uniform level experiment conducted in April/May 2001 involving 12 laboratories and 5 paper samples. The data from one of the paper samples tested by two of the laboratories were detected as outliers and deleted.

ANNEX A (Informative)

A jig to facilitate test piece rolling



The concept of a jig to facilitate test piece rolling is illustrated in the two drawings above. This requires the use of a needle that is split from one end for about 30 mm of its length rather than the plain needle described in paragraph 7 of this Method. The needle (split not shown) is pushed into the 4 mm hole with the split in line with the slit in the jig. The test piece is placed between the guidelines and slid through to the other side of the 4 mm hole through the split in the needle. The needle is then rotated to roll the test piece. The split needle is removed and the rolled test piece is ready for transfer to the holder.



A further refinement of the jig is shown in the illustrations above.

A spacer is inserted at one side of the 4 mm hole and the split needle is inserted at the opposite side. This ensures that the split needle is in the correct position. After rolling, the split needle and the spacer are carefully removed and the pusher inserted to transfer the rolled test piece to the holder.