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## SAFETY WOOD MATCHES — SPECIFICATION

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**Safety wood matches — Specification**

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## Introduction

Matches are generally classified as strike-anywhere matches and safety matches. As the names indicate, the strike-anywhere matches can be ignited by friction on almost any surface, whereas safety matches are ignited by striking against the friction surface only on the outside of the container.

The basic raw materials presently used for the manufacture of safety matches includes wood, match paper, and paraffin wax for the splints, chemicals such as potassium chlorate, sulphur, metallic oxides, for example, amber black oxides of manganese and iron, zinc oxide and yellow oxide of lead for the match head and those for the friction surface include red phosphorus (amorphous phosphorus) and antimony sulphide. In addition, potassium dichromate and methanol (formaldehyde or formalin) are also used in small quantities in preparing the above two compositions. The adhesives used comprise of technical gelatine and casein, the former is used in the preparation of both the match head and friction surface compositions while the latter is mainly used for labelling purposes. Other ancillary materials consumed by the industry are carbon black, glass powder, soda ash or borax, linseed oil, resin, rhodamine dye and tapioca flour.

However the use of other materials not included in the above list are allowed as long as they impose no safety risks and are suitable for the manufacture of safety matches.

ENQUÊTE PUBLIQUE N° 19

## Safety wood matches — Specification

### 1 Scope

This African Standard specifies functional requirements for safety of wood matches in boxes. It defines the performance characteristics of the splints (match sticks), match box and friction surface.

### 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

No references are used in this standard.

### 3 Definitions

For the purpose of this standard the following definitions apply.

#### 3.1

##### **match**

splint tipped with a head of composition which will ignite when struck against an appropriate surface

#### 3.2

##### **safety match**

match designed so that it will not readily ignite unless brought into contact with a friction surface specifically designed to cause ignition

#### 3.3

##### **after-glow (of splint)**

burning splint without flame after the flame resulting from ignition has been completely extinguished

#### 3.4

##### **friction surface**

a chemical coating on the sides of the match box against which the match head is struck to ignite the match

#### 3.5

##### **match box**

a box in which matches are packed for distribution to the consumer

#### 3.6

##### **safety matches**

wood matches packed in match boxes which will ignite only when struck on a friction surface

#### 3.7

##### **splints (match stick)**

wood cut into small pieces

#### 3.8

##### **defect**

failure of a unit (splint, box, friction surface) to meet one or more of the specified requirements

#### 3.9

##### **defective**

a unit containing one or more defects

## 3.10

### lot

a number of containers consisting of products of the same batch, size and quality

## 3.11

### defective boxes

#### 3.11.1

##### broken and crushed boxes

boxes which have been broken and crushed

#### 3.11.2

##### incorrect fit of inner tray

boxes in which the inner tray is loosely fitted into the outer casing

#### 3.11.3

##### match head protruding

boxes in which the match head protrudes

## 3.12

### defective splints

#### 3.12.1

##### badly distorted heads

heads which show profound abnormalities in shape or surface especially heads which carry sharply defined peaks

#### 3.12.2

##### broken splints

splints with or without heads which are shorter than the normal length

#### 3.12.3

##### double heads

heads linked together by a bridge of composition

#### 3.12.4

##### fractured heads

heads whose surfaces have been broken or cracked

#### 3.12.5

##### running heads

heads the composition of which runs down the sides of the splints

#### 3.12.6

##### splints which break

splints which break when struck against the friction surface

#### 3.12.7

##### splints with heads missing

splints of normal length but without heads

#### 3.12.8

##### splints with insufficient heads

splints with heads smaller than normal

## 4 Requirements

### 4.1 General requirements

The chemicals used in the manufacture of the match head shall be safe with no such risks as explosion and the splints shall comply with the safety requirements of this standard, such as the requirements of afterglow.

## 4.2 Physical characteristics

### 4.2.1 Splints (for wood matches)

**4.2.1.1** The splint used for making sticks shall be uniform, smooth, well-polished, and free from bristles, splits tears, cracks or decays and holes along the length. They shall not have fungus or bacterial growth.

Compliance shall be checked by visual inspection and counting and the number failing shall not exceed ten percent of the respective package size.

**4.2.1.2** The splints shall be made such that about two-thirds of its length shall burn smoothly, when held horizontally in a draft free atmosphere. The number of splints failing this test shall not exceed 6 % of the test sample.

**4.2.1.3** In determining the strength of the splints, not more than 5 % of the matches tested when struck against the friction surface shall show bending, breaking or fracture of the splints

**4.2.1.4** Splints shall have the following minimum dimensions:

- a) length of 40 mm  $\pm$  2 mm;
- b) width of 1.9 mm  $\pm$  0.1 mm; and
- c) thickness of 1.9 mm  $\pm$  0.1 mm.

**4.2.1.5** There should be no variation exceeding 2 mm between the length of the splints within the same container.

**4.2.1.6** Book matches shall have splints not less than 35 mm length without the base and 45 mm with the base. The composite width of 10 splints shall not be less than 30 mm.

### 4.2.2 Match container

The match container shall be of good workmanship free from the following defects:

- a) damages such as crushed, broken or torn containers;
- b) twisted or swollen containers, or ill-fitted tray exposing match heads; and
- c) loosely fitted container.

### 4.2.3 Match head

**4.2.3.1** No match head shall protrude out of the container. The number of containers, if any, failing this requirement shall not exceed 4 % of the test sample.

**4.2.3.2** The match head shall ignite without spurting and the match head particles shall not fly when the head is struck against the friction surface of the container.

### 4.2.4 Striking (friction) surface

**4.2.4.1** The container shall have a uniformly distributed friction surface, none of which shall be present on the inside where contacts with the match heads can occur. The friction surface shall terminate at least 2 mm from each edge of the shorter side of the container.

**4.2.4.2** When tested in accordance with Annex A, the friction surface shall not peel to expose the underlying surface of the container.

**4.2.4.3** When tested in accordance with Annex A, not less than 95 % of the matches in each container shall ignite.

#### **4.2.5 Number of sticks**

The average number of sticks per container shall not be < 4 % of the nominal specified number when determined on the examination of any six containers from the sample and no container out of the six examined shall contain < 90 % of the nominal specified number.

### **4.3 Performance of splints and friction surface**

Splints and the friction surface shall comply with the requirements in Table 1.

**Table 1 — Performance requirements for splints and friction surface**

| Characteristic                                | Requirements             | Method of Test |
|-----------------------------------------------|--------------------------|----------------|
| <b>Splint</b>                                 |                          |                |
| Safety                                        | To pass test             | Annex C        |
| Ignition below 170°C                          | To pass test             | Annex D        |
| Ignition under impact                         | To pass test             | Annex E        |
| Burning quality - spurting                    | 5% max. of test          | Annex F        |
| Afterglow                                     | 5% max. of test samples  | Annex H        |
| Failure to transfer flame from head to Splint | 4% max. of test samples  | Annex I        |
| <b>Friction surface</b>                       |                          |                |
| Wearing strength                              | To pass test             | Annex A        |
| Damp-proofness                                | 60% min. of test samples | Annex G        |

### **4.4 Defects**

The percent defective units found shall not exceed the values given in Table 2.

#### **4.4.1 Defective containers**

##### **4.4.1.1 Broken and crushed**

The broken and crushed containers in the test sample shall not exceed 5 %.

##### **4.4.1.2 Loosely fitted**

When tested in accordance with Annex B the loosely fitted containers in the test sample shall not exceed 4 %.

#### **4.4.2 Unserviceable sticks**

##### **4.4.2.1 General**

The total unserviceable sticks shall not exceed 10 % of the test sample. Sticks which are considered unserviceable are classified below.

##### **4.4.2.2 Badly-distorted heads**

Heads shall be considered distorted when they show pronounced abnormalities in shape or surface, especially heads which carry sharply defined peaks.

**4.4.2.3 Fractured heads**

Heads shall be considered to be fractured when their surface has been broken or cracked.

**4.4.2.4 Doubles**

Heads linked together by a bridge of composition shall be termed as doubles.

**4.4.2.5 Sticks which break or bend**

The splints which break or bend when struck against the friction surface shall be termed as splints which break/bend.

**4.4.3 Absence of after glow**

When tested in accordance with Annex H; splints shall not glow for more than three seconds. The number of matches of which the afterglow persists before turning into ashed remains shall not exceed 40 % of the tested samples.

**Table 2 — Defects table for safety wood matches**

| Defect                                                                           | % Defective, max. |
|----------------------------------------------------------------------------------|-------------------|
| <b>Splints</b>                                                                   |                   |
| (i) Badly distorted heads                                                        | 5                 |
| (ii) Broken splints                                                              | 5                 |
| (iii) Double heads                                                               | 5                 |
| (iv) Fractured heads                                                             | 5                 |
| (v) Running heads                                                                | 5                 |
| (vi) Splints which break                                                         | 5                 |
| (vii) Splints with heads missing                                                 | 5                 |
| (viii) Splints with insufficient heads                                           | 5                 |
| (ix) Total unserviceable splints                                                 | 5                 |
| <b>Boxes</b>                                                                     |                   |
| (i) Broken and crushed boxes                                                     | 6                 |
| (ii) Incorrect fit of inner tray                                                 | 6                 |
| (iii) Match head protruding                                                      | 6                 |
| (iv) Total defective boxes                                                       | 6                 |
| <b>Friction surface</b>                                                          |                   |
| (i) Friction surface compound appearing on the inside of box                     | 5                 |
| (ii) Friction surface not terminating 2mm from each edge of shorter sides of box | 5                 |
| (iii) Non-uniform spread of friction surface                                     | 5                 |
| (iv) Total defective friction surface                                            | 5                 |

## 5 Environmental and toxicological requirements

### 5.1 Sulfur dioxide emission

#### 5.1.1 Safety matches

When tested as described in L.1 matches shall release less than 7 mg of sulfur dioxide per gram of head composition.

#### 5.1.2 Strike anywhere matches

When tested as described in L.1 matches shall release less than 100 mg of sulfur dioxide per gram of head composition.

### 5.2 Heavy metal content

When tested as described in L.2 match heads shall contain less than the levels of heavy metals given in Table 3.

Table 3 — Permitted maximum heavy metal contents in matches

| Metal     | Content   |
|-----------|-----------|
| Antimony  | 10 mg/kg  |
| Arsenic   | 10 mg/kg  |
| Barium    | 400 mg/kg |
| Cadmium   | 20 mg/kg  |
| Chromium  | 400 mg/kg |
| Lead      | 100 mg/kg |
| Manganese | 100 mg/kg |
| Mercury   | 10 mg/kg  |
| Selenium  | 10 mg/kg  |
| Vanadium  | 100 mg/kg |

### 5.3 Biological toxicity test

When tested as described in L.3 the 24h-EC(I)50 value obtained using organism *Daphnia magna* Straus shall be greater than 10 g matches/litre.

## 6 Sampling

### 6.1 Lot

6.1.1 All materials of the same brand in a single consignment produced in the same manufacturing unit shall constitute a lot.

Samples shall be tested from each lot for ascertaining the conformity of the lot for the requirements of this specification. The number of cartons to be selected from a lot shall depend upon the size of the lot and shall be in accordance with Table 4.

Table 4 — Sampling plan

| Lot size (N)  | Number of cartons to be selected (n) |
|---------------|--------------------------------------|
| 3 to 25       | 3                                    |
| 26 to 50      | 4                                    |
| 51 to 100     | 5                                    |
| 101 to 150    | 6                                    |
| 151 and above | 7                                    |

**6.1.2** These cartons shall be selected at random from the lot and for this purpose; random number tables shall be used. In case such tables are not available, the procedure given below shall be adopted:

- a) starting from any carton in the lot, count 1, 2, 3.....etc up to  $r$  and so on in one order. Every  $r$ th carton thus counted shall be withdrawn, where  $r$  is the integral part of  $N/n$ .  $N$  being the lot size and  $n$  the number of cartons to be selected;
- b) from each carton selected in 6.1.2 (a); select at random a certain number of packets depending upon the size of the carton, in accordance with Table 5. To ensure randomness of selection, random number tables or procedure given in 6.1.2 (a) shall be used;

Table 5 — Number of packets to be selected from a carton

| Number of packets in the carton | Number of packets to be selected |
|---------------------------------|----------------------------------|
| 10                              | 3                                |
| 50                              | 4                                |
| 100                             | 5                                |

- d) the packets from the cartons shall also be selected at random and to ensure the randomness of selection, random number tables or procedure given in 6.1.2 (a) shall be used; and
- e) open each of the packets in 6.1.2 (c) and take out at a random four match containers from each of the packets. These containers thus selected from packets shall constitute a sample. These containers shall then be divided at random into two sets of equal number of containers. One set shall be for the purchaser and other set shall be the referee sample. The referee sample shall bear the seals of both the purchaser and the supplier and shall be kept at a place agreed to between the two. The referee sample shall be tested in case of dispute only.

## 6.2 Number of test and criteria for conformity

**6.2.1** All the match containers in a sample set shall be examined for the requirements given in 4.2, 4.2.2, 4.2.4, and 4.4.1.

The lot shall be considered as satisfactory in respect of these requirements, if the sample set of match containers satisfies each one of these requirements.

**6.2.2** From the match containers in the sample set, select at random any six containers and examine them for the number of sticks. After counting the sticks, containers shall be refilled with the same sticks and replaced back into the sample.

**6.2.3** The lot shall be considered as satisfactory, if the six selected containers satisfy the requirements given in 4.2.5.

From the match containers in the sample set, select four containers at random. Pool the sticks from all the four containers together and taking the requisite number of sticks at random from this pool of

stick, carry out the tests as prescribed in Annexes A, C, D, and E. The lot shall be considered as satisfactory in regard to these requirements, if none of the test fails.

**6.2.4** From the remaining containers of the sample set, select at random five containers. Test each of the five containers for wearing strength of the friction surfaces according to Annex A. The lot shall be considered satisfactory, if each of five containers passes the test.

**6.2.5** From the remaining containers of the sample set, select at random five containers and carry out the test for damp-proofness as given in Annex G. The lot shall be considered as satisfactory in regard to this test requirement if the test result satisfies the requirements given in Table 1.

**6.2.6** Take three containers out of the sample at random and examine for the defects given in 4.4.2. The lot shall be considered as satisfactory if the total number of unserviceable sticks in these containers does not exceed 10 %.

**6.2.7** Take the sticks from these containers and test for the requirements as given in 4.2.1. The lot shall be considered as satisfactory, if the total number of sticks not contributing does not exceed 6 %.

### **6.3 Criteria for conformity**

The lot shall be declared as conforming to the requirements of this specification, if the different test results as obtained in 6.2.1 to 6.2.6 meet the corresponding requirements given in this standard.

## **7 Methods of test**

Safety wooden matches shall be tested as specified in the annexes of this standard.

## **8 Compliance with the standard**

The lot shall be deemed to comply with the standard, if after inspection and testing, it complies with the requirements specified in Clauses 4 and 5.

## **9 Packing and marking**

### **9.1 Packing**

The splints shall be packed in suitable boxes. A suitable number of the match boxes shall be packed in packets, and a suitable number of packets in cartons. For bulk distribution, several cartons shall be packed in cases.

### **9.2 Marking**

#### **9.2.1** On match boxes, packets and cartons

The match box shall be marked or labelled with the following particulars:

- a) name of the product and the trade name or brand name, if any;
- b) name and address of the manufacturer;
- c) number of match sticks in a box
- d) number of boxes in a packet (if applicable)
- e) number of packets in a carton (if applicable)
- f) country of origin.

**Annex A**  
(normative)

**Wearing strength of friction surface**

**A.1 Principle**

The test is carried out by striking the match sticks against the friction surface.

**A.2 Procedure**

Take five containers from the sample and condition them at a temperature of  $27\text{ °C} + 1\text{ °C}$  and  $65\% + 2\%$  relative humidity for one hour before carrying out the test. The cover of the container shall be removed during conditioning. Strike all the sticks in the container one by one on one friction surface side of the container. The sample shall be taken to have passed this test, if one friction surface side is sufficient to ignite all the sticks. The friction surface shall be suitably used so that the entire area of one side is utilized in the test.

**Annex B**  
(normative)

**Test for functional failure of matches**

In determining the correct fit of tray, use a test set of 50 % of containers at random selected from the gross sample, and test each container as follows:

- a) allow the container to stand on its end, and then grasp it by its friction-painted sides lightly between the thumb and index finger of one hand and lift the container vertically. Unless the tray tends to fall out, proceed to check that the tray slides easily in the outer casing; and
- b) note and record as defectives the number of containers in which the following failures occur:
  - i) the tray slide or dropped out under its own mass and that of its contents; and
  - ii) the tray did not slide easily in the outer casing.

**Annex C**  
(normative)

**Safety**

**C.1 Principle**

The test is carried out by striking the match sticks against a flint paper or equivalent.

**C.2 Procedure**

Take three containers from the selected containers of the sample and strike over a sheet of flint paper. The average length of stroke on the flint paper shall be about 50 mm.

The sample shall be taken to have passed the test, if none of the sticks in the container catches fire.

**Annex D**  
(normative)

**Ignition below 170 °C**

**D.1 Principle**

The test is carried out by placing the match sticks in an oven maintained at 170 °C and examined for ignition.

**D.2 Apparatus**

**D.2.1 Oven**, the size and shape of the oven shall be such that the inner chamber shall be approximately 150 mm x 150 mm x 225 mm. It will be fitted with a shelf of perforated sheet metal at a distance of 120 mm from the top lining of the oven. A vent shall be provided at the top of the oven to permit air circulation.

**D.2.2 Thermometer** to read up to 250 °C

**D.2.3 Wooden block**, of 30 mm thick and 50 mm square having a hole of 10 mm diameter to a depth of 25 mm in the centre to serve as a receptacle to hold the sticks

**D.3 Procedure**

Take 10 matches from the selected containers of the samples and place them with the heads up in the receptacle of the wooden block or a metal holder. Place the block/holder in the centre of the oven maintainer at 170 °C. After 10 min remove the block/holder, note and record as defectives the number of matches that have ignited. The sample shall be taken to have passed the test, if the sticks do not catch fire.

## Annex E (normative)

### Ignition under impact

#### E.1 Principle

The test is carried out by striking the match sticks with a hammer of 170 g and examined for ignition.

#### E.2 Apparatus

The apparatus shall be assembled as shown in Figure 1.

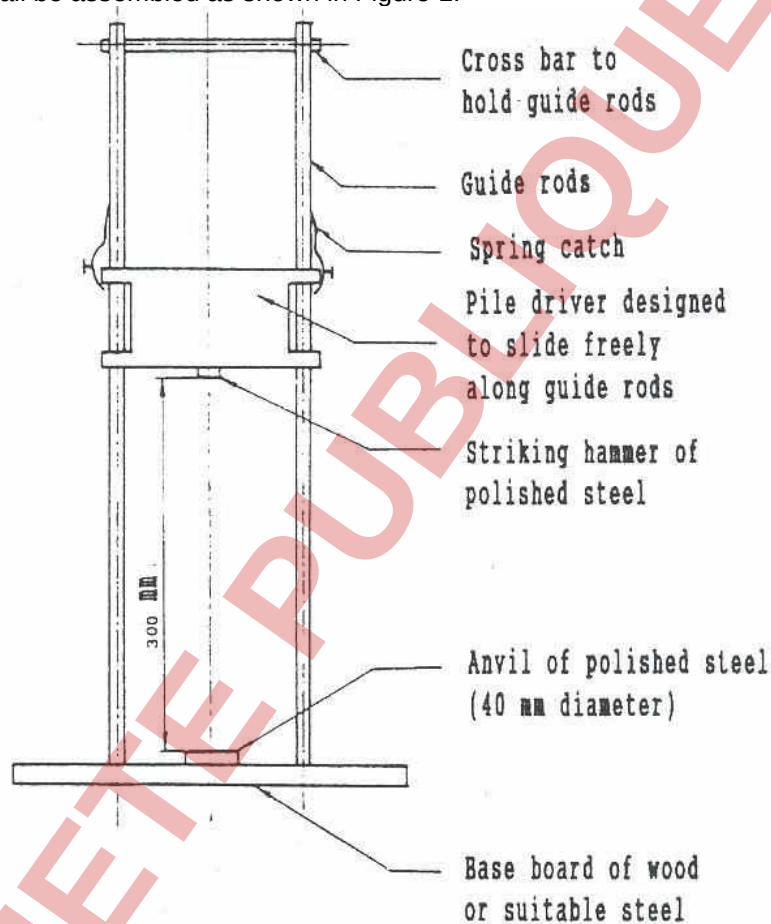


Figure 1 — Apparatus for ignition under impact test

#### E.3 Procedure

Take 10 sticks from the selected containers of the sample and test each stick separately. Place the stick on the anvil of polished steel, in such a way that the stick is horizontal and the head is at its centre.

Drop the striking hammer by releasing the spring catch. Observe whether the head catches fire under this impact.

**Annex F**  
(normative)

**Burning quality — Spurting**

**F.1 Principle**

The test is carried out by striking the match sticks against the friction surface and examine for spurting, if any.

**F.2 Procedure**

Take three containers from the selected containers of the sample and strike against the friction surface of these containers. Observe the number of heads which spurt out while burning

## Annex G (normative)

### Damp-proofness test

#### G.1 Principle

The test is carried out by keeping the match containers in a desiccator containing water for 24 h and examined for their burning quality.

#### G.2 Apparatus

**Desiccator**, with a plate having an inside diameter of about 250 mm

#### G.3 Procedure

Carry out this test at a temperature of  $27\text{ }^{\circ}\text{C} + 1\text{ }^{\circ}\text{C}$ . Place a sufficient amount of water in the desiccator so that the distance between the surface of the water and the nearest portion of the exposed matches kept over the plate is about 25 mm. Take five containers from the sample and place these containers on the desiccator's plate so that the head side of each container is half open and each container resting on its edge with the friction surface vertical as well as with the heads up. The containers shall be placed at a distance of at least 20 mm away from the walls of the desiccator. Close the desiccator and leave it undisturbed for 24 h (see Note). Remove the container at a time from the desiccator, and strike each stick not more than twice over its own friction surface until all the sticks inside each container are exhausted or there is no more friction surface available for striking. Count the number of sticks which ignited during the test.

NOTE If condensation of water is likely to take place during the test, then the match head may be suitably shielded with a glass plate.

#### G.4 Calculation

Calculate the damp-proofness as follows

$$\text{Damp-proof-ness, percentage} = \left[ \frac{n}{5 \times N} \right] \times 100$$

where

$n$  is the total number of sticks ignited in five containers; and

$N$  is the nominal stick of each container.

## Annex H (normative)

### Method of test for afterglow

**H.1** Place the bases of the splints of 25 matches into holes in a metal plate 20 mm  $\pm$  0.5 mm apart, arranged in a 5 x 5 array as shown in Figure H.1.

**H.2** In a darkened room, apply a flame to an outside row of the matches and tilt the metal plate so as to ignite all of the matches on the plate as quickly as possible.

**H.3** Allow the splints to burn away completely and, when the flame dies out, examine the ashed remains of the splints for any afterglow, ignoring any pinpoint glow immediately beneath the head.

**H.4** Where afterglow is considered to persist for longer than 3 s, repeat the test on a further 25 matches struck as directed in Annex I and examine them individually.

**H.5** Repeat H.1 to H.4 on a second group of 25 matches and record a cumulative result for the 50 matches tested.

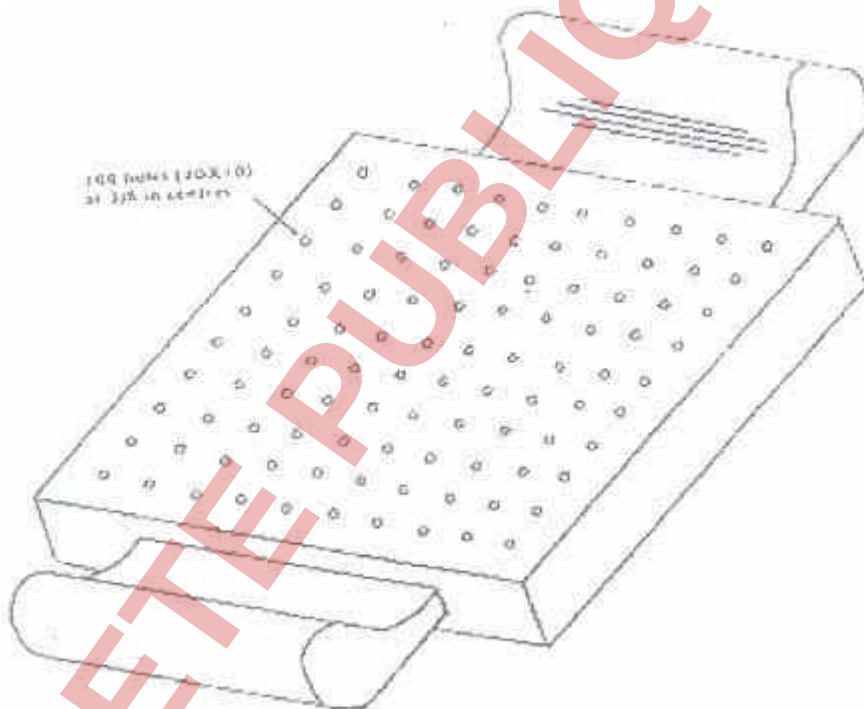


Figure H.1 — Perforated metal plate

## Annex I (normative)

### Method of test for striking performance

**I.1** Ensure that this test is in a draught-free environment and that matches are not moved once ignition has been initiated.

**I.2** With the match container held over an A4 sheet of white paper of grammage  $(80 \pm 5) \text{ g/m}^2$ , hold the match firmly between the first finger and thumb, as shown in Figure I.1, and strike it against the striking surface of the container with the minimum pressure necessary to cause ignition. The match should be held approximately 100 mm above the sheet of paper during testing.

NOTE 1 The match should be held at approximately 15 mm from the head or for short and/or flexible matches, at a position consistent with normal use of the product (see Figure I.2).

NOTE 2 As soon as the match head ignites, the match should be oriented so that the splint is horizontal. This movement should be complete before the head has finished burning.

**I.3** Record any breakage or fracture of the stem prior to ignition and whether ignition occurs or is delayed.

**I.4** At ignition, record any explosion or fragmentation of the match head or any breakage of stem which results in separation of the broken pieces.

**I.5** During ignition, record any dropping of hot ash sufficient to permanently mark the paper with burn marks.

**I.6** Following ignition, record any breakage or fracture of the stem or detachment of the burning head and whether the flame transfers successfully from the head to the stem.

**I.7** Allow the match to continue to burn with the stem horizontal until the flame has spread halfway along the stem. Record whether liquid drips from the stem during burning (see note to I.8).

**I.8** When the flame reaches half-way along the stem, or after burning for at least 10 s, extinguish it with a puff of air and record whether the charred stem continues to glow for more than 4 s or, for cardboard and wax matches, for more than 6 s (see note).

NOTE If the match extinguishes before the flame reaches half way along the stem, record events at and after the moment of extinguishing.

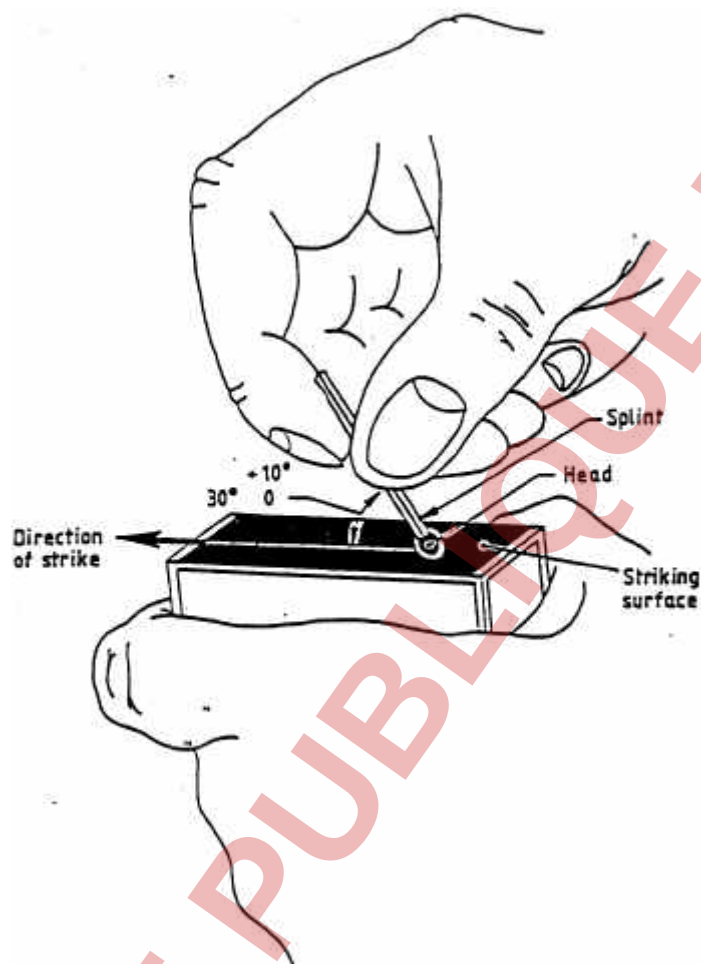
**I.9** Take a second sample of matches for measurement of flame height and duration.

Hold the match in position by inserting the stem 5 mm into a metal tube clamped in the horizontal position. Position the match  $(25 \pm 3) \text{ mm}$  in front of a vertical plane mirrored plate scribed with two horizontal lines separated by 10 mm. Adjust the height of the plate so that the upper surface of the match splint, its mirror image and the lower line are all coincident. Ignite the match by touching the tip of the head with a heated soldering iron. At the same time start a stop watch. Observe the flame carefully during the period between 3 s and 10 s from ignition and record whether the flame does not exceed 10 mm in height. This is indicated if the tip of the flame does not cross the upper of the two lines scribed on the mirrored plate. At all times during the observation of the flame ensure that the stem, its mirror image and the bottom line remain coincident in order to prevent parallax errors. Record whether the flame does not remain alight for 10 s or, if the match is less than 40 mm in length, for 6 s.

NOTE Alternative arrangements for measurement of flame height are acceptable provided adequate arrangements to prevent parallax errors are incorporated.

**I.10** Strike the matches on a supported fresh sheet of grade PBO (FEPA 43-GB) waterproof silicon carbide paper and record whether ignition can be initiated.

**A.11** Repeat I.10 substituting a supported fresh sheet of grade P600 (FEPA 43-GB) waterproof silicon carbide paper as the strike surface and record whether ignition can be initiated.



**NOTE** The match is struck along the striking surface of the container with an upward sweep and held clear of the container to avoid damage to the striking surface.

**Figure I.1 — Method of striking matches**

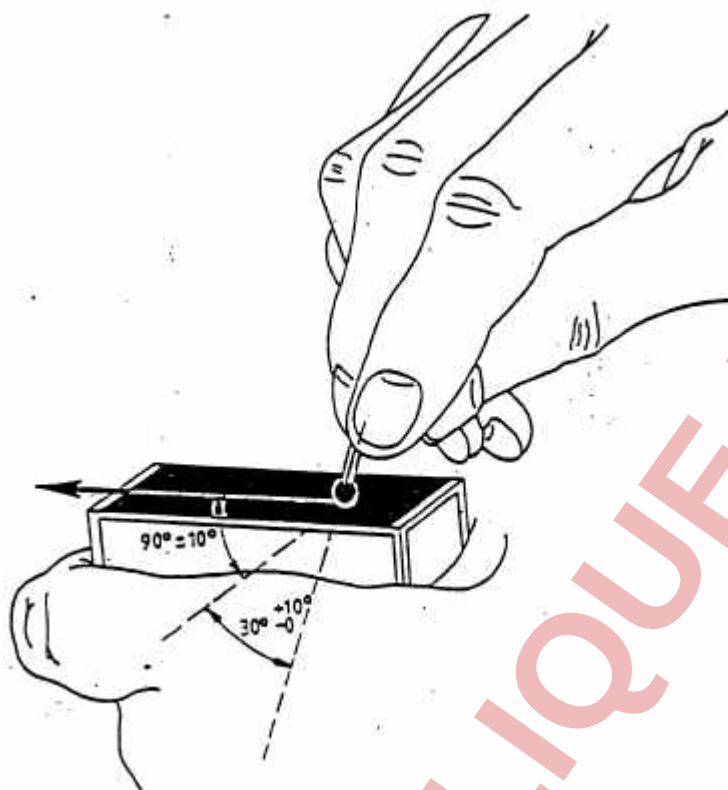


Figure I.2 — Method for striking flexible matches e.g. cardboard or wax matches

**Annex J**  
(normative)

**Test for breaking resistance of splint**

The apparatus illustrated in Figure H.1 is used to conduct this test.

The moment arm on the apparatus is,

- a) 2 cm in length, where wood matches are being tested;
- b) 1.5 cm in length, where matches other than wood matches are being tested.

The match is inserted in the apparatus as illustrated in Figure H.1 and the clamp and match gradually lowered until the match breaks.

The maximum force registered on the scale or balance required to break the splint is recorded.

## Annex K (normative)

### Methods of test for performance of the striking surface

#### K.1 Damp removal

Apply a single drop of water to the striking surface. After 20 s carefully wipe the surface with a soft dry tissue and record if any removal of the striking surface exposes the underlying surface of the container.

#### K.2 Durability and ignition

K.2.1 For match containers of average contents up to and including 50 matches, strike the entire contents of the match container, using the method described in A.1 on an area of striking surface restricted to  $(50 \pm 5)\%$  of that provided on the container.

NOTE: The area of striking surface may be controlled, e.g. by using one side only of a match container with striking surface on both sides or by masking of a section of the available surface with cellulose tape.

K.2.2 For containers of average contents exceeding 50 matches strike not less than 10 % of the contents or 50 matches, whichever is the greater, using the method described in A.1, on that percentage of the striking surface provided determined by:

$$\frac{\text{no. of matches struck} \times 50}{\text{total contents}}$$

Round fractional numbers to the nearest whole number.

#### K.3 Ignition of the friction surface

Strike one match on each match container (see A.2) and record any continued burning of the friction surface after the match has ignited.

#### K.4 Loss of burning fragments

Strike one match on each match container (see A.2) and record any loss of burning fragments from the friction surface.

**Annex L**  
(normative)

**Environmental and toxicological tests**

**L.1 Determination of sulfur dioxide emission**

**L.1.1 Reagents**

During the analysis, unless otherwise stated, use only reagents of recognized analytical grade and only distilled water or water of equivalent purity.

**L.1.1.1** 0.01 moles per litre iodine solution made by dissolving 2.54 g of iodine and 25 g of potassium iodide in 1L of distilled water;

**L.1.1.2** Sodium bicarbonate.

The apparatus shown in Figure L.1 is assembled and 10 ml of the iodine solution is pipetted into the absorption bottle. Approximately 50 ml of water is added together with 1 g of sodium bicarbonate.

**L.1.2 Apparatus**

L.1.2.1 Glass tube handle.

L.1.2.2 Soldering iron, of power rating 40 W.

L.1.2.3 Cotton wool plug.

L.1.2.4 Three necked flask, of capacity 500 ml.

L.1.2.5 Dreschel bottle, of capacity 125 ml.

L.1.2.6 Vacuum pump.

**L.1.3 Procedure**

**L.1.3.1** Assemble the apparatus as shown in Figure L.1. Pipette 10 ml of the iodine solution (L.1.1.1) into the Dreschel bottle (L.1.2.5). Add approximately 50 mL of water together with 1 g of sodium bicarbonate (L.1.1.2). Draw a stream of air through the apparatus, such that when a match is inserted, no smoke escapes from the flask and all smoke is drawn through the solution. Insert the matches, one at a time, into the three-necked flask until they touch the hot soldering iron and ignite. Continue to insert matches until the iodine is decolourized or until 75 matches have been ignited, whichever is the sooner. Record the number of matches ignited.

**L.1.3.2** Determine the head mass on a sample of 50 matches by carefully scraping off the heads and weighing them.

**L.1.4 Expression of results**

**L.1.4.1 Method of calculation**

Calculate the sulfur dioxide emission as milligrams of sulfur dioxide per gram of head composition using one of the following formulae:

If the test is terminated when 75 matches have been struck calculate the sulfur dioxide emission from

$$S < \frac{0.0853}{w}$$

If the test is terminated when less than 75 matches have been struck calculate the sulfur dioxide emission from

$$S = \frac{6.4}{N \times w}$$

where

$N$  is the number of matches ignited;

$w$  is the head mass in grams;

$s$  is the sulfur dioxide emission in mg/g of head composition.

## **L.2 Determination of heavy metal content**

### **L.2.1 Reagents**

During the analysis, unless otherwise stated, use only reagents of recognized analytical grade and only distilled water or water of equivalent purity.

**L.2.1.1 Concentrated nitric acid**, analytical grade reagent,

**L.2.1.2 Distilled water.**

### **L.2.2 Apparatus**

**L.2.2.1 Glass beaker**, of capacity 100 ml.

**L.2.2.2 Watch glass.**

**L.2.2.3 Graduated flask**, of capacity 100 ml.

**L.2.2.3 Filter funnel.**

**L.2.2.4** Cellulose ashless quantitative filter paper with the following characteristics:

- a) particle retention of 16  $\mu\text{m}$ ;
- b) thickness of 0.22 mm;
- c) mass of 95 g/m<sup>2</sup>;
- d) ash content of typically 0.007 %.

NOTE Whatman grade 43 has been found to be suitable.

### **L.2.3 Procedure**

**L.2.3.1** Prepare a test solution by carefully scraping the heads from 50 matches and weigh them into the beaker.

NOTE The same heads used to determine the head mass in L.1 can be used.

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Add 10 ml of nitric acid, cover with a watch glass, and boil gently for 1 h. Cool the solution and dilute to 50 ml with distilled water. Filter the solution into the 100 ml graduated flask and wash the filter paper with distilled water, adding the washings to the graduated flask. Add sufficient distilled water to adjust the solution volume to the mark on the graduated flask.

**L.2.3.2** Prepare a blank solution in an identical way to the test solution but without the addition of the match heads to be analyzed with each set of test samples.

NOTE This is required to check on the purity of the reagents and to correct the results for the blank contribution.

**L.2.3.3** Either analyze the solution by graphite furnace atomic absorption spectrometry to assess the concentration of heavy metal.

or use

an alternative method of analysis which is of equivalent sensitivity and accuracy.

### **L.2.3.4 Expression of results**

Express the heavy metal content in parts per million of head composition using the following formula:

$$z = \frac{100y}{w}$$

where

$w$  is the mass of match heads, in grams;

$y$  is the heavy metal concentration of the solution in mg/L;

$z$  is the concentration of heavy metal content in mg/kg composition.

**L.3** Biological test, determination of 24h-EC(I)50 value (see 6341:1989)

### **L.3.1 Reagents**

**L.3.1.1** Distilled water.

### **L.3.2 Apparatus**

**L.3.2.1** Glass beaker, of capacity 500 ml.

**L.3.2.2** Magnetic stirrer.

**L.3.2.3** Filter funnel.

**L.3.2.4** Filter paper (see L.2.2.4).

### **L.3.3 Procedure**

Take 25 matches and weigh. Place the matches in the beaker (L.3.2.1) 250 ml of distilled water (L.3.1.1) and stir with the magnetic stirrer (L.3.2.2) for 16 h to 18 h at ambient temperature. At the end of the period filter the solution and determine the 24h-EC(I)50 value on filtrate.

### **L.3.4 Expression of results**

Express the results in grams of matches per litre.

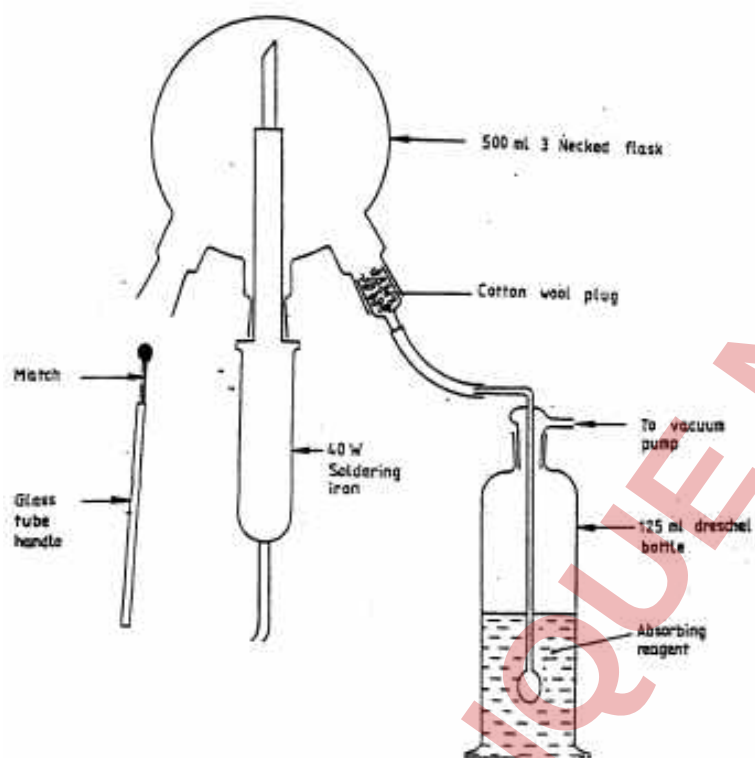


Figure L.1 — Apparatus for the determination of sulfur dioxide emitted from burning matches

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