Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

Indian Standard

CORRUGATED FIBREBOARD BOXES FOR PACKING AND TRANSPORTATION — SPECIFICATION

(First Revision)
FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Paper and Its Products Sectional Committee had been approved by the Chemical Division Council.

This standard was first published in 1991. In this revision, tolerance on dimension of assembled box, Cobb value of corrugated fibreboard boxes and minimum grammage of kraft paper used in linear and partition are modified. Requirement of mould inhibitor has been deleted. Marking clause has also been modified.

The general requirements of corrugated fibreboard boxes for transportation of goods have been covered in IS 2771 (Part 1): 1990 'Corrugated fibreboard boxes — Specification: Part 1 General requirements (second revision)'. In this standard, emphasis has been laid on the performance requirements of the boxes rather than the specifications of the raw materials such as kraft paper, adhesives, etc, which go into making of a box. As such, ultimate strength requirements of the fibreboard box have been specified in this standard.

A scheme for labelling environment friendly products known as ECO-Mark has been introduced at the instance of the Ministry of Environment and Forests (MEF). The ECO-Mark would be administered by the Bureau of Indian Standards (BIS) under the BIS Act, 1986 as per the Resolution No. 71 dated 20 February 1991, published in the Gazette of the Government of India. For a product to be eligible for ECO-Mark it shall also carry Standard Mark of BIS for quality, in addition to the compliance with the optional environment friendly (EF) requirements. For this purpose, the Standard Mark of BIS would be a single mark being a combination of the ISI Mark and the ECO logo. Requirements to be satisfied for a product to qualify for the BIS Standard Mark for ECO friendliness, will be optional; manufacturing units will be free to opt for the ISI Mark alone also.

The composition of the Committee responsible for formulation of this standard is given in Annex B.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2: 1960 'Rules for rounding off numerical values (revised)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.
Indian Standard

CORRUGATED FIBREBOARD BOXES FOR PACKING AND TRANSPORTATION — SPECIFICATION

(First Revision)

1 SCOPE
This standard covers requirements and methods of sampling and test for corrugated fibreboard boxes for packaging and transportation of various items such as apples, butter packed in primary cartons, canned/frozen sea foods, cigarettes, soaps and jars/bottles of processed foods.

2 REFERENCES
The standards listed below contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

<table>
<thead>
<tr>
<th>IS No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1060 (Part 1) : 1966</td>
<td>Methods of sampling and test for paper and allied products: Part 1 (revised)</td>
</tr>
<tr>
<td>2771 (Part 1) : 1990</td>
<td>Corrugated fibreboard boxes — Specification: Part 1 General requirements (second revision)</td>
</tr>
<tr>
<td>4006 (Part 1) : 1985</td>
<td>Methods of test for paper and pulp based packaging materials: Part 1 (first revision)</td>
</tr>
<tr>
<td>4006 (Part 2) : 1985</td>
<td>Methods of test for paper and pulp based packaging materials: Part 2 (first revision)</td>
</tr>
<tr>
<td>4261 : 2001</td>
<td>Glossary of terms relating to paper and pulp based packaging materials (first revision)</td>
</tr>
<tr>
<td>6481 : 1971</td>
<td>Guide for principal uses and styles of fibreboard containers</td>
</tr>
<tr>
<td>7028 (Part 6) : 1987</td>
<td>Performance tests for complete, filled transport packages: Part 6 Compression test (first revision)</td>
</tr>
<tr>
<td>7063 (Part 2) : 1976</td>
<td>Method of test for corrugated fibreboard: Part 2 Edgewise crush resistance of board</td>
</tr>
<tr>
<td>7186 : 1973</td>
<td>Glossary of terms relating to paper and flexible packaging</td>
</tr>
</tbody>
</table>

3 TERMINOLOGY
For the purpose of this standard, the terms and definitions given in IS 2771 (Part 1), IS 4261 and IS 7186 shall apply.

4 MATERIAL

4.1 The fibreboard shall be manufactured from fibre based paper/paper board such as kraft paper, kraft liner, duplex board, pulp board, etc, in suitable combination. This may also include coated, impregnated, waxed, laminated or bituminized paper or paperboard so as to satisfy the requirements of this standard.

4.2 Adhesive
Any suitable adhesive capable of firmly adhering the various plies together may be used. Sodium silicate or any other highly alkaline adhesive shall not be used.

4.3 Staple Wire
Unless otherwise specified by the purchaser, galvanized mild steel wire not less than 0.51 mm thick and 2.20 mm wide shall be used for stapling the manufacturer’s joint.

4.4 Linear and Partition
For packaging of glass jars and bottles filled with processed food, the side, top, bottom liners, centre layers and slotted partitions, if required, shall be made from double wall board of AB or AA fluting with all plies of minimum grammage of 150 g/m² of kraft paper.

5 STYLE
The boxes, with/without interior fitments shall conform to the appropriate styles, given in IS 6481, depending upon the end use. Some of these are mentioned in Table 1.

6 MANUFACTURE, WORKMANSHIP AND FINISH

6.1 The boxes shall be manufactured from not more than two pieces of fibreboard, scored and slotted to form a body piece having 4 flaps for closing each of the opposite ends. The flaps along the longer edge shall form the outer flaps and those along the shorter edge shall form inner flaps. All flaps shall be of equal length and the outer flaps shall meet when closed.
6.2 The blanks shall be properly creased and slotted, so that when the box is assembled, there shall be no holes at the corners. The flaps of the box shall be capable of being folded 180° along the line of creasing without fracture of the board or facings.

6.3 The body joint shall be lapped and lapping shall not be less than 30 mm. The manufacturer's joint shall be secured by staples, taping or glueing which shall be free from rust and not protruding. Each piece shall not have more than two body joints.

7 DIMENSIONS AND TOLERANCES

7.1 The internal dimensions of the assembled box shall be as agreed to between the purchaser and the supplier. It shall always be stated in the sequence of length \((L)\times width (W)\times height (H)\).

7.2 Normal manufacturing tolerances on the individual ordered dimensions of the assembled boxes shall be as under:

a) \(\pm 3\) mm for 3-ply boxes,

b) \(\pm 5\) mm for 5-ply boxes, and

c) \(\pm 7\) mm for 7-ply boxes.

8 MANUFACTURER'S JOINT

The manufacturer's joint shall be stitched or glued as follows.

8.1 Stitched Joint

8.1.1 Stitching Lap

The stitching lap shall be not less than 30 mm wide, and may be inside or outside the box.

8.1.2 Spacing of Stitches

The centre-to-centre spacing of stitches shall not exceed 50 mm. The clear distance from a cut edge of the fibreboard to any stitch shall be not less than 6 mm and not more than 25 mm. The stitches shall be made at an angle of 45° to the cut edge.

8.1.3 Rows of Stitches

Rows of stitches shall be used as ordered by the purchaser.

8.2 Glued Joint

8.2.1 The glueing lap shall be not less than 30 mm wide.

8.2.2 The adhesive used for the joint shall be water resistant type.

8.2.3 The adhesive applied shall be in a strip not less than 15 mm.

8.2.4 The adhesive shall be applied not nearer to a cut edge than 3 mm, and not nearer to a crease at the ends of the lap than 12 mm.

9 PERFORMANCE REQUIREMENTS

9.1 The corrugated fibreboard boxes shall comply with the performance requirements given in Table 1.

9.1.1 Flat Crush Resistance

The flat crush resistance shall be applicable to 3 ply corrugated fibreboard boxes for packing of frozen sea foods and frog legs. When tested as per 6 of IS 7063 (Part 2), its value shall not be less than 2.5 kg/cm².

9.1.2 Compression Test

The complete empty boxes used for packing of cigarettes, soaps and apples, conditioned at a temperature of 27 ± 2° C and 65 ± 5 percent relative humidity shall be tested in assembled condition for compression strength as per method given in IS 7028 (Part 6). The average compression strength of the empty box at a deflection not more than 20 mm shall not be less than 1 kg/cm of base. However, in case of Type 1 boxes for cigarettes (for defence purpose only) it shall be minimum 2 kg/cm of base.

9.1.3 Printability of Outer Surface

The condition of the outer surface of the box shall be such as to allow the marking, stamping or stencilling of the box with the type of ink normally used for the purpose. The ink should not smudge or discolour and it should be water resistant.

10 PACKING AND MARKING

10.1 Packing

Boxes shall be supplied in collapsed condition in bundles of 20 or as agreed to between the purchaser and the supplier.

10.2 Marking

10.2.1 Each box shall be legibly and indelibly marked on the outside with the following particulars:

a) Indication of the source of manufacture,

b) Batch or lot number, and

c) Any other information as required by the purchaser.
Table 1 Performance Requirements for Corrugated Fibreboard Boxes

(Classes 5 and 9.1)

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Product to be Packed</th>
<th>Box Style</th>
<th>Content Weight kg</th>
<th>Bursting Strength, Min kg/cm² (5)</th>
<th>Puncture Resistance, Min kgf.cm (6)</th>
<th>Cobb Value Max (7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i)</td>
<td>Frozen sea foods and frog legs</td>
<td>0201</td>
<td>20</td>
<td>12</td>
<td>175</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0201</td>
<td>30</td>
<td>14</td>
<td>200</td>
<td>80</td>
</tr>
<tr>
<td>ii)</td>
<td>Canned sea foods (exp)</td>
<td>0204</td>
<td>20</td>
<td>12</td>
<td>175</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0204</td>
<td>30</td>
<td>15</td>
<td>200</td>
<td>80</td>
</tr>
<tr>
<td>iii)</td>
<td>Processed foods in glass jars and bottles</td>
<td>0201 or 0204</td>
<td>15</td>
<td>10</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>iv)</td>
<td>Cigarettes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type 1</td>
<td>0201 or 0204</td>
<td>10 000 Cigarettes</td>
<td>—</td>
<td>30.5</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Type 2</td>
<td>0202</td>
<td>—</td>
<td>—</td>
<td>61</td>
<td>100</td>
</tr>
<tr>
<td>v)</td>
<td>Soaps</td>
<td>—</td>
<td>—</td>
<td>6.5</td>
<td>120</td>
<td>80</td>
</tr>
<tr>
<td>vi)</td>
<td>Apples</td>
<td>0320</td>
<td>16 or 20</td>
<td>15</td>
<td>240</td>
<td>80</td>
</tr>
<tr>
<td>vii)</td>
<td>Butter</td>
<td>0201 or 0204</td>
<td>25</td>
<td>14</td>
<td>200</td>
<td>100</td>
</tr>
</tbody>
</table>

Methods of Test

- 12.5 of IS 1060 (Part 1)
- 8 of IS 4006 (Part 2)
- 6 of IS 4006 (Part 1)

10.2.2 BIS Certification Mark

Each box may also be marked with the Standard Mark.

10.2.2.1 The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

11 ADDITIONAL REQUIREMENTS FOR ECO-MARK

11.1 General Requirements

11.1.1 The product shall conform to the requirements for quality and performance prescribed under 4 to 9.

11.1.2 The manufacturer shall produce to BIS, the environmental consent clearance from the concerned State Pollution Control Board as per provisions of Water (Prevention and Control of Pollution) Act, 1974 and Air (Prevention and Control of Pollution) Act, 1981 along with the authorization, if required under the Environment (Protection) Act, 1986 and the Rules made thereunder, while applying for ECO-Mark. Additionally the manufacturers shall also comply with the provisions under Prevention of Food Adulteration Act, 1954 and the Rules made thereunder, wherever necessary.

11.2 Specific Requirements

11.2.1 The material shall be of the following two types depending on the raw material used in the manufacture:

   a) Type A — Manufactured from pulp containing not less than 60 percent by mass of pulp made from materials other than bamboo, hardwood, softwood and reed.

   b) Type B — Manufactured from pulp made from 100 percent waste paper or agricultural/industrial waste.

11.2.2 The material, if used for the packaging of food materials, shall be manufactured from virgin pulp and shall be free from dioxins. Printed surface of the paper shall not come into contact with the food and the maximum amount of contaminants in paper intended to come into contact with food shall not exceed the limits prescribed in Table 2 when tested according to the methods given in Annex A.
Table 2 Limits of Contaminants in Paper  
(Clause 11.2.2)

<table>
<thead>
<tr>
<th>SI No.</th>
<th>Contaminant</th>
<th>Paper Intended to Come into Contact with Dry Food (mg/kg of paper)</th>
<th>Paper Intended to Come into Contact with Wet Food and Food with Fatty Surface (mg/kg of paper)</th>
<th>Paper for Filtration (mg/kg of paper)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Cadmium (Cd)</td>
<td>—</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>2)</td>
<td>Chromium (Cr **)</td>
<td>—</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>3)</td>
<td>Lead (Pb)</td>
<td>—</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>4)</td>
<td>Mercury (Hg)</td>
<td>—</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>5)</td>
<td>Pentachlorophenol (PCP)</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>6)</td>
<td>Polychlorinated biphenyls (PCBs)</td>
<td>2.0</td>
<td>2.0</td>
<td>0.5</td>
</tr>
</tbody>
</table>

11.2.3 The corrugated fibreboard boxes for packing and transportation may display in brief the criteria based on which the product has been labelled as environment friendly.

11.2.4 The corrugated fibreboard boxes for packing and transportation shall be sold along with instruction for proper use and mode of safe disposal so as to maximise its performance and minimise wastage.

11.2.5 It shall be suitably marked that ECO-Mark label is applicable only to the corrugated fibreboard boxes for packing and transportation if content is not separately covered under the ECO-Mark scheme.

NOTE — It may be stated that the ECO-Mark is applicable to the product or packaging material or both.

11.2.6 For ECO-Mark, corrugated fibreboard boxes for packing and transportation shall be packed in such packages which shall be recyclable/reusable or biodegradable.

12 SAMPLING, CONDITIONING AND TESTING

12.1 The boxes shall be sampled and tested within 20 days of their receipt by the purchaser. From each consignment of 10 000 boxes or part thereof, 20 boxes shall be selected for testing as follows:

a) If the boxes are bundled, 20 bundles shall be selected at random and from each bundle so selected one box shall be selected at random for testing, and

b) If the boxes are not bundled, 20 boxes shall be selected at random from the total consignment.

12.2 Conditioning

The sample of 20 boxes so selected shall be deemed to represent the whole consignment of boxes and shall be conditioned for testing by the method prescribed in 5 of IS 1060 (Part 1).

12.3 Testing

12.3.1 The types of tests and selection of boxes for testing shall be as indicated in Table 3.

12.3.1.1 The requirements for the material of construction of box as well as method of test for evaluating these requirements shall be as given in relevant clauses and in Table 3.

12.4 Acceptance and Retesting

12.4.1 Acceptance

The consignment of boxes shall be deemed to comply with the test requirements of the standard if after the specified number of boxes from the test samples as given in Table 3 have been tested as required in relevant clauses and all the boxes pass the test.

12.4.2 Retests

If only one box from the test sample fails to meet one or more of the tests, further boxes shall be selected at random from the consignment of boxes for testing for the defective property or properties. The number of additional boxes to be tested shall be twice the number specified in Table 3 for the test or tests in which the box from the original test sample failed.
Table 3 Testing of Boxes
(Clauses 12.3.1, 12.3.1.1, 12.4.1 and 12.4.2)

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Type of Test</th>
<th>No. of Boxes Selected from Sample for Testing</th>
<th>No. of Test Specimens Obtained from Each Box</th>
<th>No. of Tests on Each Specimen</th>
<th>Method of Test Ref to Clause</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
</tr>
<tr>
<td>i)</td>
<td>Bursting strength</td>
<td>3</td>
<td>1</td>
<td>10 (5 each side)</td>
<td>12.5 of IS 1060 (Part 1)</td>
</tr>
<tr>
<td>ii)</td>
<td>Puncture resistance</td>
<td>3</td>
<td>4</td>
<td>1 (2 each for CD and MD)</td>
<td>8 of IS 4006 (Part 2)</td>
</tr>
<tr>
<td>iii)</td>
<td>Water absorption, 30 min Cobb test</td>
<td>3 (One from)</td>
<td>2</td>
<td>1 (Part 1)</td>
<td>6 of IS 4006</td>
</tr>
<tr>
<td>iv)</td>
<td>Compression strength test</td>
<td>5</td>
<td>1</td>
<td>1 IS 7028 (Part 6)</td>
<td></td>
</tr>
</tbody>
</table>

ANNEX A
(Clause 11.2.2)

DETERMINATION OF CHROMIUM, LEAD, MERCURY, CADMIUM, PENTACHLOROPHENOL AND POLYCHLORINATED BIPHENYLS

A-1 DETERMINATION OF CHROMIUM (as Cr\(^{6+}\))

A-1.1 Principle
The hexavalent chromium is determined colorimetrically by reaction with diphenylcarbazide in acid solution at a wavelength of 550 nm.

A-1.2 Apparatus

A-1.2.1 Spectrophotometer
Any spectrophotometer suitable for measurement at a wavelength of about 550 nm or photoelectric absorption meter fitted with filters giving maximum transmission near 550 nm.

A-1.2.2 Shaker
Any shaker suitable for rotating/moving at 30 ± 2 rev/min.

A-1.3 Reagents

A-1.3.1 Extraction Fluid — Mix 5.7 ml of acetic acid in distilled water.

A-1.3.2 Nitric Acid, concentrated.

A-1.3.3 Sulphuric Acid, approximately 0.2 N.

A-1.3.4 Diphenylcarbazide Solution — Dissolve 0.25 g of diphenylcarbazide in 50 ml acetone. Store in a brown bottle. Discard when solution becomes discoloured.

A-1.3.5 Stock Chromium Solution — Dissolve 0.141 g \(K_2Cr_2O_7\) in distilled water and dilute to 100 ml. One millilitre of this solution contains 500 \(\mu g\) of chromium (as Cr\(^{6+}\)).

A-1.3.6 Intermediate Chromium Solution — Take 10 ml of stock chromium solution and dilute to 1000 ml with distilled water. One millilitre of this solution contains 5.00 \(\mu g\) of chromium (as Cr\(^{6+}\)).

A-1.3.7 Standard Chromium Solution — Take 10 ml of intermediate chromium solution and dilute to 1000 ml with distilled water. One millilitre of this solution contains 0.05 \(\mu g\) of chromium (as Cr\(^{6+}\)).

A-1.3.8 Indicator Paper — Covering the pH range 0.5 to 1.5.
A-1.4 Procedure

A-1.4.1 Preparation of Calibration Curve

Into each of a series of ten 250-ml volumetric flasks, place the quantities of standard chromium solution as indicated below:

<table>
<thead>
<tr>
<th>Standard Chromium Solution</th>
<th>Corresponding to Cr⁶⁺</th>
</tr>
</thead>
<tbody>
<tr>
<td>ml</td>
<td>µg</td>
</tr>
<tr>
<td>1.0</td>
<td>0.05</td>
</tr>
<tr>
<td>2.0</td>
<td>0.10</td>
</tr>
<tr>
<td>3.0</td>
<td>0.15</td>
</tr>
<tr>
<td>4.0</td>
<td>0.20</td>
</tr>
<tr>
<td>5.0</td>
<td>0.25</td>
</tr>
<tr>
<td>6.0</td>
<td>0.30</td>
</tr>
<tr>
<td>7.0</td>
<td>0.35</td>
</tr>
<tr>
<td>8.0</td>
<td>0.40</td>
</tr>
<tr>
<td>9.0</td>
<td>0.45</td>
</tr>
<tr>
<td>10.0</td>
<td>0.50</td>
</tr>
</tbody>
</table>

A-1.4.1.1 Add sulphuric acid to adjust the solution pH to 1.0 ± 0.3 in each flask and dilute to 100 ml. Add 2.0 ml diphenylcarbazide solution, mix thoroughly and wait for 10 min.

A-1.4.1.2 Carry out the measurement on the spectrophotometer or on a photoelectric colorimeter using appropriate filter with a 1 cm cell at a wavelength of 550 nm. As references use extraction fluid, correct the absorbance readings of standard solution by subtracting absorbance of a reagent blank carried through the above method.

A-1.4.1.3 Construct a calibration curve by plotting corrected absorbance values against chromium content in microgram per 102 ml.

A-1.4.2 Determination

A-1.4.2.1 Sample preparation

Tear the air dry sample into pieces of suitable size. Do not use cut or punched edges or other parts where metallic contamination may have occurred.

A-1.4.2.2 Preparation of test solution

Weigh to the nearest 0.01 g about 20 g of paper, leach the paper with about 200 ml of extraction fluid for 18 ± 2 h using shaker rotating/moving at 30 ± 2 rev/min. Filter the extract through glass fibre filter with 0.45 micron pore size. Add sufficient amount of aluminium sulphate and filter, if any precipitate appears. Transfer the solution quantitatively to a volumetric flask of suitable capacity, dilute to the mark and mix.

A-1.4.2.3 According to the expected chromium content, take an aliquot portion of the test solution containing 10 to 100 µg of chromium to a 100-ml volumetric flask. Adjust the pH of the solution to 1.0 ± 0.3 by adding 0.2 N sulphuric acid. Dilute to 100 ml. Add 2 ml diphenylcarbazide solution, mix thoroughly, and wait for 10 min.

A-1.4.2.4 Photometric measurement

Carry out the photometric measurements of the test solution according to the methods given in A-1.4.1.1.

A-1.4.3 Calculation

By means of the calibration curve (see A-1.4.1.3) determine the quantity of chromium present:

Chromium (as Cr⁶⁺), ppm = \( \frac{m \times D}{M} \)

where

- \( m \) = mass of chromium determined in the aliquot of the sample solution, in µg;
- \( D \) = ratio of the volume of test solution to the volume of aliquot portion taken for the colour development; and
- \( M \) = mass of paper sample taken for testing, in g.

A-2 DETERMINATION OF MERCURY (as Hg)

A-2.1 Principle

The flameless atomic absorption procedure is a physical method based on the absorption of radiation at 253.7 nm by mercury vapour. The mercury is reduced to the elemental state and aerated from solution in a closed system. The mercury vapour passes through a cell positioned in the light path of mercury hollow cathode lamp of an atomic absorption spectrophotometer. Absorbance (peak height) is measured as a function of mercury concentration and record.

A-2.2 Apparatus

A-2.2.1 Atomic Absorption Spectrometer (AAS) and Associated Equipment — Instrument settings recommended by the manufacturer shall be followed. Instruments designed specifically for the measurement of mercury using the cold vapour technique may be substituted for the AAS.

A-2.2.2 Mercury Vapour Generation Assembly — Consists of an absorption cell, peristaltic pump, flow meter, aeration tubing and a drying tube containing magnesium perchlorate.

A-2.2.3 Mercury Hollow Cathode Lamp
A-2.2.4 Recorder/Printer/Display Meter — Any multi-range variable recorder that is compatible with the UV detection system is suitable.

A-2.3 Reagents

A-2.3.1 Sulphuric Acid, concentrated.

A-2.3.2 Nitric Acid, concentrated.

A-2.3.3 Stannous Chloride Solution — Dissolve 25 g of stannous chloride (SnCl₂) in water containing 50 ml of concentrated hydrochloric acid and dilute to 250 ml. If a suspension forms, stir reagent continuously during use.

A-2.3.4 Sodium Chloride — Hydroxylamine Sulphate Solution — Dissolve 12 g of sodium chloride and 12 g of hydroxylamine sulphate (NH₂OH)₂H₂SO₄ in distilled water and dilute to 100 ml.

A-2.3.5 Potassium Permanganate Solution — Dissolve 5 g of potassium permanganate in distilled water and dilute to 100 ml.

A-2.3.6 Potassium Persulphate Solution — Dissolve 5 g of potassium persulphate in distilled water and dilute to 100 ml.

A-2.3.7 Stock Mercury Solution — Dissolve 1.354 g of mercuric chloride in about 700 ml of distilled water. Add 10 ml of concentrated nitric acid and make up to 1000 ml. One millilitre of the solution contains 1 mg of mercury as Hg.

A-2.3.8 Standard Mercury Solution

Prepare a series of standard mercury solutions containing 0 to 5 µg/l by appropriate dilution of stock mercury solution (see A-2.3.7) with water containing 10 ml of concentrated nitric acid per litre. Prepare standards daily.

NOTE — Use mercury free distilled water for the preparation of reagents and standards.

A-2.4 Procedure

A-2.4.1 Instrument Operation

Follow the procedure of the manufacturer’s operating manual. Connect the mercury vapour generating assembly as shown in Fig. 1.

A-2.4.2 Standardization

Transfer 100 ml each of the 1.0, 2.0 and 5.0 µg/l standard mercury solution and a blank of 100 ml water to 300 ml +30D bottles. Add 5 ml of concentrated sulphuric acid and 2.5 ml of concentrated nitric acid to each bottle. Add 15 ml of potassium permanganate solution to each bottle and let stand for at least 15 min. Add 8 ml of potassium persulphate (K₂S₂O₈) solution to each bottle and heat for 2 h in a water bath at 95°C. Cool and add 6 ml of sodium chloride-hydroxylamine sulphate solution to reduce the excess permanganate. After decolourization add 5 ml of stannous chloride solution and attach the bottle immediately to the aeration apparatus forming a closed system. As mercury is volatilized and carried into the absorption cell, absorbance will increase to a maximum within a few seconds. As soon as recorder returns...
A-2.4.3 Determination

A-2.4.3.1 Sample preparation

Tear the air dry sample into pieces of suitable size. Do not use cut or punched edges or other parts where metallic contamination may have occurred.

A-2.4.3.2 Preparation of test solution

Weigh to the nearest 0.01 g about 20 g of paper, leach the paper with about 200 ml of extraction fluid for 18 ± 2 h using shaker rotating/moving at 30 ± 2 rev/min. Filter the extract through glass fibre filter with 0.45 micron pore size. Transfer the solution quantitatively to a volumetric flask of suitable capacity, dilute to the mark and mix.

A-2.4.3.3 According to the expected mercury content, take an aliquot portion of the test solution containing not more than 5 µg/l of mercury to a 300 ml BOD bottle and treat as in A-2.4.2.

A-2.5 Calculation

Determine peak height of sample from recorder chart, read mercury value from standard curve and determine the mercury content of the sample using the following formula:

Mercury (as Hg), ppm = \( \frac{C \times V}{M \times 1\,000} \)

where

- \( C \) = concentration of mercury from the calibration curve;
- \( V \) = volume of test solution prepared, ml; and
- \( M \) = mass of paper sample taken for testing, g.

A-3 DETERMINATION OF LEAD (AS Pb)

A-3.1 Principle

The lead content of the sample is determined by electrothermal atomic absorption spectrometric method.

A-3.2 Apparatus

A-3.2.1 Atomic Absorption Spectrometer, with graphite oven technique in place of conventional burner assembly.

A-3.2.2 Lead Hollow-Cathode Lamp or Multielement Hollow-Cathode Lamp, for use at 283.3 nm.
increasing concentration. Analyze each standard solution and measure the absorbances.

**A-3.4.6 Calculation**

Construct a standard calibration graph by plotting the absorbance versus lead concentration of each standard in milligram. Read the concentration of the sample from the graph and determine the lead content of the sample from the calibration graph using the following formula:

\[
\text{Lead (as Pb), ppm} = \frac{C \times F \times 100}{M}
\]

where

- \( C \) = concentration of lead from the calibration curve;
- \( F \) = dilution factor; and
- \( M \) = mass of paper sample taken for testing, in g.

**A-4 DETERMINATION OF CADMIUM (AS Cd)**

**A-4.1 Principle**

The cadmium content of the sample is determined by electrothermal atomic absorption spectrometric method.

**A-4.2 Apparatus**

**A-4.2.1 Atomic Absorption Spectrometer,** with graphite oven technique in place of conventional burner assembly.

**A-4.2.2 Cadmium Hollow-Cathode Lamp or Multielement Hollow-Cathode Lamp,** for use at 228.8 nm.

**A-4.3 Reagents**

**A-4.3.1 Nitric Acid,** concentrated.

**A-4.3.2 Nitric Acid, 1 : 1.**

**A-4.3.3 Dilute Nitric Acid, 1 : 499.**

**A-4.3.4 Stock Cadmium Solution** — Dissolve 1.0 g of pure cadmium metal in minimum quantity of concentrated nitric acid and dilute to one litre with distilled water. One millilitre of this solution contains 1 mg of cadmium (as Cd).

**A-4.3.5 Intermediate Cadmium Solution** — Add 1 ml of concentrated nitric acid to 50 ml of stock solution and dilute to one litre with distilled water. One millilitre of this solution contains 50 μg of cadmium (as Cd).

**A-4.3.6 Standard Cadmium Solution** — To 10 ml of cadmium intermediate solution add 1 ml of concentrated nitric acid and dilute to one litre with distilled water. One millilitre of this solution contains 0.5 μg of cadmium (as Cd).

**A-4.4 Procedure**

**A-4.4.1 Sample Preparation**

Tear the air dry sample into pieces of suitable size. Do not use cut or punched edges or other parts where metallic contamination may have occurred.

**A-4.4.2 Preparation of Test Solution**

Weigh to the nearest 0.01 g about 20 g of paper, leach the paper with about 200 ml of extraction fluid for 18 ± 2 h using shaker rotating/moving at 30 ± 2 rev/min. Filter the extract through glass fibre filter with 0.45 micron pore size.

**A-4.4.3 Transfer the extract to a 250-ml conical flask.** Add 5 ml concentrate nitric acid and a few boiling chips or glass beads. Slowly evaporate on a hot plate to about 10 to 20 ml. Continue heating and adding concentrated nitric acid until digestion is complete. Wash down with distilled water and then filter if necessary. Quantitatively transfer filtrate to a 100-ml volumetric flask, dilute to the mark and mix thoroughly.

**A-4.4.4 Inject a measured portion of the digested solution into the graphite oven.** Dry, char and atomize according to the preset programme. Measure the absorbance.

**A-4.4.5 Prepare a reagent blank and sufficient standards containing 5.0, 7.5 and 10.0 mg/l of cadmium by diluting suitable volume of the standard cadmium solution with nitric acid (1 : 499).** Inject a suitable portion of each standard solution in order of increasing concentration. Analyze each standard solution and measure the absorbances.

**A-4.4.6 Calculation**

Construct a standard calibration graph by plotting the absorbance versus mg of cadmium concentration of each standard. Read the concentration of the sample from the graph and determine the cadmium content of the sample from the calibration graph using the following formula:

\[
\text{Cadmium (as Cd), ppm} = \frac{C \times F \times 100}{M}
\]

where

- \( C \) = concentration of cadmium from the calibration curve;
- \( F \) = dilution factor; and
- \( M \) = mass of paper sample taken for testing, in g.
A-5 DETERMINATION OF PENTA CHLOROPHENOL (PCP)

A-5.1 Principle
PCP is extracted with acetone by Soxhlet extraction. Acetone extract is evaporated to dryness and subjected to acetylation. The acetylated PCP is determined quantitatively by Gas Chromatograph-Electron Capture Detector (GC-ECD).

A-5.2 Apparatus
A-5.2.1 Round Bottom Flask, 250 ml.
A-5.2.2 Soxhlet Extractor
A-5.2.3 Water Bath
A-5.2.4 Separating Funnels, 60 ml and 100 ml.
A-5.2.5 Injection Syringes, 1 µl, 5 µl and 10 µl.
A-5.2.6 Gas Chromatograph with ECD, capillary columns.
A-5.2.7 Glass Columns — Length 20 cm, internal diameter 12 mm filled with 5 cm of silica gel having particle size 63 µm x 200 µm.

A-5.3 Reagents
A-5.3.1 Acetone
A-5.3.2 n-Hexane
A-5.3.3 Acetic Anhydride
A-5.3.4 Sodium Sulphate Anhydrous
A-5.3.5 PCP Stock Solution — Dissolve 10 mg of pentachlorophenol in 100 ml of acetone. One millilitre of this solution contains 0.1 mg of pentachlorophenol.
A-5.3.6 PCP Standard Solution — Dilute 10 ml of stock solution with acetone to 100 ml. One millilitre of this solution contains 0.01 mg of pentachlorophenol.
A-5.3.7 Internal Standard Stock Solution — Dissolve 1 g of 2, 4 dibromophenol in 1 l of acetone. One millilitre of this solution contains 1 mg of dibromophenol.
A-5.3.8 Internal Standard Solution — Dilute 1 ml of the stock solution (see A-5.3.7) with acetone to 100 ml. One millilitre of this solution contains 10 µg of dibromophenol.

A-5.4 Procedure
A-5.4.1 Determine the moisture content of the sample as given in 9 of IS 1060 (Part 1).
A-5.4.2 Weigh accurately about 1 g of the paper sample pieces up to two decimal places and put into a thimble. Extract with about 150 ml of acetone by Soxhlet extraction for 6 h. Filter the acetone extract, dry over anhydrous sodium sulphate, and evaporate under vacuum to a small volume approximately to 5 ml and cool.
A-5.4.3 Clean-Up
Transfer the extract (see A-5.4.2) to the silica gel packed column and elute with about 25 ml of n-hexane at the rate of 2 ml/min. Collect the eluent in a flask. Dry over anhydrous sodium sulphate and evaporate nearly to dryness.
A-5.4.4 Treat the residue (see A-5.4.3) with 1 ml of acetic anhydride, and heat on a water bath for about 30 min. Remove the flask from the water bath and cool the acetylated product. Transfer the content in a separating funnel and add 10 ml of hexane and 5 ml distilled water. Shake well for 2 min and let the layers be separated. Collect the hexane layer, dry over anhydrous sodium sulphate and evaporate nearly to dryness. Cool for at least 10 min, add 1 ml of internal standard solution and adjust the volume to 5.0 ml with n-hexane.
A-5.4.5 Inject 2 µl of the solution into the gas chromatograph. Record the peak size in area and peak height units. If peak response exceeds linear range of the system, dilute the concentration of the extract and reanalyze.
A-5.4.6 Calibration
Prepare three calibration standards from the PCP standard solutions. Add 1 ml of internal standard solution and follow the steps as above (see A-5.4.3 to A-5.4.5). Tabulate peak height or area responses against calculated equivalent mass of underivatized pentachlorophenol injected. Prepare a calibration curve.
A-5.5 Calculation
Determine the PCP content of the sample from the calibration graph using the following formula:

\[
\text{PCP content, mg/kg on dry matter} = \frac{A \times B \times V_i \times 100}{M \times C \times V_i \times (100 - X)}
\]

where

- \(A\) = PCP content from the graph, in µg;
- \(B\) = total volume of hexane extract before derivatization, in ml;
- \(V_i\) = volume of eluent injected, in ml;
- \(M\) = total volume of hexane extract before derivatization, in ml;
- \(C\) = volume of eluent injected, in ml;
$M = \text{mass of the paper sample taken for testing, in g;}$

$C = \text{volume of hexane extract carried through derivatization, in ml;}$

$V_r = \text{volume of total eluent, in ml; and}$

$X = \text{moisture content, percent by mass.}$

**A-6 DETERMINATION OF POLYCHLORINATED BIPHENYLS (PCBs)**

**A-6.1 Principle**

PCB is extracted with boiling ethanolic potassium hydroxide solution. An aliquot of the extract is mixed with distilled water and subjected to extraction with hexane. The PCB content is determined quantitatively by GC-ECD by comparing the pattern of the peaks with the pattern of a suitable technical PCB.

**A-6.2 Apparatus**

- **A-6.2.1 Erlenmeyer Flask, 200 ml.**
- **A-6.2.2 Water Bath**
- **A-6.2.3 Separating Funnel, 60 ml and 100 ml.**
- **A-6.2.4 Injection Syringes, 1 µl, 5 µl and 10 µl.**
- **A-6.2.5 Gas Chromatograph with ECD, capillary columns.**
- **A-6.2.6 Glass Columns — Length 20 cm, internal diameter 12 mm filled with 5 cm of silica gel having particle size 63 µm x 200 µm.**

**A-6.3 Reagents**

- **A-6.3.1 Ethanolic Potassium Hydroxide Solution —** Prepare 1 N ethanolic potassium hydroxide solution by dissolving the required amount of potassium hydroxide in absolute ethanol that has been purified as follows:

  Dissolve 1.5 g of silver nitrate in 3 ml of water and add it to one litre of alcohol. Dissolve 3 g of potassium hydroxide in the smallest amount of hot distilled water, cool, and add it to the silver nitrate solution. Shake thoroughly, allow the solution to stand for at least 24 h, filter and distill.

  **NOTE —** Absolute alcohol denatured with 10 percent by volume of methanol may also be used.

- **A-6.3.2 n-Hexane**

- **A-6.3.3 Sodium Sulphate Anhydrous**

- **A-6.3.4 PCB Stock Solution —** Dissolve 10 mg of any PCB technical in 100 ml of hexane. One millilitre of this solution contains 0.1 mg of PCB.

**A-6.3.5 PCB Standard Solution —** Dilute 10 ml of stock solution with hexane to 100 ml. One millilitre of this solution contains 0.01 mg of PCB.

**A-6.3.6 Internal Standard Stock Solution —** Dissolve 1 g of 2,4 dibromophenol in 1 l of n-hexane. One millilitre of this solution contains 1 mg of dibromophenol.

**A-6.3.7 Internal Standard Solution —** Dilute 1 ml of the stock solution (see A-6.3.6) with hexane to 100 ml. One millilitre of this solution contains 10 µg of dibromophenol.

**A-6.4 Procedure**

**A-6.4.1** Determine the moisture content of the sample as given in 9 of IS 1060 (Part 1).

**A-6.4.2** Weigh accurately about 1 g of the paper sample pieces up to two decimal places and take into a 200-ml Erlenmeyer flask. Add 50 ml of ethanolic potassium hydroxide solution and heat under reflux condenser for 4 h, filter and dilute to the mark with alcohol in a 250-ml volumetric flask. Take an aliquot portion of the test solution in a separating funnel, add sufficient distilled water and 15 ml hexane. Shake well for 5 min and wait for 15 min. Collect the hexane phase.

**A-6.4.3** Filter the hexane extract. Dry the filtrate over anhydrous sodium sulphate, and evaporate under vacuum to approximately 5 ml. Take the residue for clean-up.

**A-6.4.4 Clean-Up**

Transfer the hexane extract (see A-6.4.3) to the silica gel packed column and elute with about 25 ml of n-hexane at the rate of 2 ml/min. Collect the eluent in a flask and evaporate to a small volume. Add 1 ml of internal standard solution and make up to 10 ml with hexane.

**A-6.4.5** Inject 2 µl of the solution to the gas chromatograph. From the peaks obtained, PCB and internal standard are identified by their retention times as well as relative retention time.

**A-6.4.6 Calibration**

Prepare three calibration standards from the PCB standard solutions and follow the steps as above (A-6.4.3 to A-6.4.5). Tabulate peak height or area responses against calculated equivalent mass of underivatized pentachlorophenol injected. Prepare a calibration curve.

**A-6.5 Calculation**

Determine the PCB content of the sample from the calibration graph using the following formula:
PCB content, mg/kg
on dry matter = \frac{A \times V_x \times 100}{M \times V_t \times (100 - X)}

where

A = PCB content from the graph, in μg;
V_x = volume of eluent injected, in ml;
M = mass of the paper sample taken for testing, in g;
V_t = volume of total eluent, in ml; and
X = moisture content, percent by mass.

ANNEX B
(Foreword)

COMMITTEE COMPOSITION

Paper and Its Products Sectional Committee, CHD 15

Organization

Central Pulp & Paper Research Institute, Saharanpur
All India Federation of Master Printers, New Delhi
B & A Multiwall Packaging Ltd, Kolkata
Ballarpur Industries Ltd, New Delhi
Central Forensic Science Laboratory, New Delhi
Century Pulp and Paper Mills, Nainital
Central Pulp & Paper Research Institute, Saharanpur
Central Revenues Control Laboratory, New Delhi
Crop Care Federation of India, New Delhi
Defence Materials & Stores, R & D Establishment, Kanpur
Department of Industrial Policy & Promotion, New Delhi
Directorate General of Supplies & Disposals, New Delhi
Directorate of Printing (Ministry of Urban Development), New Delhi
Federation of Corrugated Box Manufacturers of India, Mumbai
Federation of Paper Traders Association of India, Mumbai
Forest Research Institute, Dehra Dun
Hindustan Lever Limited, Mumbai
Hindustan Paper Corporation Ltd, Kolkata

Representative(s)

Dr. A. G. Kulkarni (Chairman)
Shri S. R. Sharma
Shri V. K. Malik (Alternate)
Shri Ronodurjoy Roychoudhury
Dr. S. C. Shienoy
Shri K. D. Prasad (Alternate)

Shri S. L. Mukhi
Shri D. P. Chandarana
Dr. S. K. Kapoor
Dr. Y. V. Sood (Alternate)

Dr. Y. K. S. Rathore
Shri J. C. Varshney (Alternate)

Dr. D. K. Jain
Shri S. P. Bajpai
Shri V. K. Singh (Alternate)

Shri P. K. Jain
Dr. K. R. Murthy (Alternate)

Shri H. M. Rathe
Shri Jaginder Singh

Shri Pankaj D. Shah
Shri M. L. Mehra (Alternate)

Shri Satya Pal Gupta
Shri Badal Chaudhuri (Alternate)

Dr. K. S. Bhandari
Shri M. V. Prabhakaran
Shri M. K. Lakshmi (Alternate)

Shri Raj Philip
Shri J. D. Fernandes (Alternate)
Organization

India Security Press, Nasik

Indian Paper Manufacturers Association, New Delhi

Indian Pulp and Paper Technical Association, Saharanpur

Indian Institute of Packaging, Mumbai

Indian Institute of Technology, Roorkee Campus, Saharanpur

Indian Recycled Paper Mills Association, Delhi

JK Paper Ltd, New Delhi

Ministry of Defence (DGQA), New Delhi

NEPA Limited, Neapanagar

Regional Research Laboratory (CSIR), Jorhat

Security Printing Press, Hyderabad

Stationery Office, Government of India, Kolkata

Voluntary Organization in Interest of Consumer Education (VOICE), New Delhi

BIS Directorate General

Representative(s)

SHRI SWAPAN KUMAR GHOSH
SHRI MANISH SHANKAR (Alternate)

SHRI R. VARDHAN
SHRI R. N. MOORTHY (Alternate)

SHRI ANIL KUMAR
DR M. PATEL (Alternate)

SHRI RAJIV DHAR
SHRI K. B. GUPTA (Alternate)

DR J. S. UPADHYAYA
DR A. K. RAY (Alternate)

SHRI R. C. RASTOGI

SHRI S. C. MAJUMDAR

SHRI K. N. PATIL
SHRI P. H. KULKARNI (Alternate)

SHRI MANU RASTOGI
SHRI NIAZI R. A. KHAN (Alternate)

SHRI S. K. GHOSH
DR FARID ALI (Alternate)

SHRI P. N. RADKAR
SHRI S. G. K. ACHARYULU (Alternate)

SHRI R. K. ROY

Representative

Dr. U. C. SRIVASTAVA, Director & Head (Chem)
[Representing Director General (Ex-officio)]

Member Secretary

SHRI S. N. CHATTERJEE
Director (Chem), BIS
Bureau of Indian Standards

BIS is a statutory institution established under the Bureau of Indian Standards Act, 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publications), BIS.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

This Indian Standard has been developed from Doc: No. CHD 15 (1344).

Amendments Issued Since Publication

<table>
<thead>
<tr>
<th>Amend No.</th>
<th>Date of Issue</th>
<th>Text Affected</th>
</tr>
</thead>
</table>

BUREAU OF INDIAN STANDARDS

Headquarters:
Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephone: 2323 0131, 2323 3375, 2323 9402
Website: www.bis.org.in

Regional Offices:
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg
          NEW DELHI 110002
          Telephone: 2323 7617, 2323 3841

Eastern : 1/14 C.I.T. Scheme VII M, V.I.P. Road, Kankurgachi
          KOLKATA 700054
          Telephone: 2337 8499, 2337 8561

Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022
           Telephone: 260 3843, 260 9285

Southern : C.I.T. Campus, IV Cross Road, CHENNAI 600113
           Telephone: 2254 1216, 2254 1442

Western : Manakalaya, E9 MIDC, Marol, Andheri (East)
          MUMBAI 400093
          Telephone: 2832 9295, 2832 7858

Branches : AHMEDABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COMBATORE. FARIDABAD.
           GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. NAGPUR.
           PARWANOO. PATNA. PUNE. RAJKOT. THIRUVANANTHAPURAM. VISAKHAPATNAM.

Printed at Simco Printing Press, Delhi