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Coninx Industries
DOSHI Enterprises Ltd
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ISOLE Engineering
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General Industries Ltd
Plastico Industries Ltd
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REVISION OF KENYA STANDARDS

In order to keep abreast of progress in industry, Kenya Standards shall be regularly reviewed. Suggestions for improvements to published standards, addressed to the Managing Director, Kenya Bureau of Standards, are welcome.

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FOREWORD

This Kenya Standard was prepared by the Plastics pipes and fittings Technical Committee under the guidance of the Standards Projects Committee, and it is in accordance with the procedures of the Kenya Bureau of Standards.

This standard does not purport to address all the safety problems associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of the regulatory safety and health practices and determine the applicability of regulatory limitation prior to use.

This standard also provides recommendatory information at Annex E regarding storage and guidelines for installation.

During the preparation of this standard, reference was made to IS 15778:2007, ASTM D 2846 2009 and ASTM F441.

Acknowledgement is hereby made for the assistance derived from these sources.
1. Scope

1.1 This standard specification covers requirements, test methods, and methods of marking for chlorinated poly(vinyl chloride) plastic pipes for hot- and cold-water distribution system components made in two standard dimension ratios SDR 11 and 13.5 and in two schedules; SCH 40 and 80 intended for water service up to and including (93°C). These components comprise pipe and tubing, socket-type fittings, street fittings, plastic-to-metal transition fittings, solvent cements, and adhesives. Requirements and methods of test are included for materials, workmanship, dimensions and tolerances, hydrostatic sustained pressure strength, and thermocycling resistance. The components covered by this specification are intended for use in residential and commercial, hot and cold, potable water distribution systems.

1.2 The products covered by this specification are intended for use with the distribution of pressurized liquids only, which are chemically compatible with the piping materials. Due to inherent hazards associated with testing components and systems with compressed air or other compressed gases some manufacturers do not allow pneumatic testing of their products. Consult with specific product/component manufacturers for their specific testing procedures prior to pneumatic testing.

NOTE 1—Pressurized (compressed) air or other compressed gases contain large amounts of stored energy which present serious safety hazards should a system fail for any reason.

This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. References

During the development of this standard reference was made to the following standard, from whose source we acknowledge with thanks.

ASTM D 2846: 2009
ASTM F 441
IS 15778:2007
ASTM D1599:Test Method for short term Hydrostatic failure (Burst pressure)
ASTM D1784:Specification for rigid cpvc compounds
ASTM D 2122:Determination of Dimensions for Thermoplastic plastic pipes
ASTM D 2444:Test Method for Impact Resistance
ASTM D 792: Specific gravity
3. Terminology

For the purpose of this standard, the following definitions shall apply

3.1 **Nominal size (DN)** - The numerical designation for the size of pipe, other than a pipe designated by thread size, which is a convenient round number approximately equal to the manufacturing dimensions in millimeters.

3.2 **Nominal Outside Diameter (dn)** – The specified outside diameter, in millimeters, assigned to a nominal size.

3.3 **Outside Diameter at any Point (de)** – The value of the measurement of the outside diameter of a pipe through its cross-section at any point of the pipe rounded off to the nearest 0.1mm.

3.4 **General**—Definitions used in this specification are in accordance with Terminology ASTM D1600…., unless otherwise specified.

3.5 The abbreviation for chlorinated poly(vinyl chloride) is CPVC.

3.5.1 CTS (copper Tube size) - Pipe size nomenclature conforming to copper tube size

3.5.2 IPS (Iron Pipe size) — Pipe size nomenclature conforming to Iron Pipe size

3.6 Plastic tubing denotes a particular plastic pipe whose outside diameter is given by the following Natem formula;

\[ \text{Tubing outside diameter (mm)} = (F \times C) + 3.18 \]

Where:

- \( F \) = is a constant (25.4)
- \( C \) = Corresponding actual tube outside diameter in inches as per CTS in (ASTM B 88)

3.7 **Relation between standard dimension ratio, stress, and internal pressure**—the following expression is used to relate standard dimension ratio, stress, and internal pressure for pipe and tubing:

\[ \frac{2 \times HDS}{P} = R - 1 \]  \hspace{1cm} (1)

or

\[ 2 \times \frac{HDS}{P} = (D_0/t) - 1 \]  \hspace{1cm} (2)

where:

- \( HDS \) = Hydrostatic design stress or hoop direction, MPa,
- \( P \) = internal pressure, (MPa),
- \( D_0 \) = average outside diameter, mm,
- \( t \) = minimum wall thickness, mm, and \( R \) = standard dimension ratio, SDR
3.8 Pressure Rating (PR)—the estimated maximum pressure that the medium in the pipe can exert continuously with a high degree of uncertainty that failure of the pipe cannot occur.

\[ PR = 2(HDB) \times \text{(design factor)}/(SDR-1) \]

SDR = standard dimension Ratio
\[ = \text{Average Outside diameter/minimum wall thickness} \]

HDB—Hydrostatic design basis at 23°C in psi or bars

3.9 Standard dimension ratio (SDR)—a selected series of numbers in which the average outside diameter to minimum wall thickness dimension ratios are constant for all sizes of pipe and tubing in each standard dimension ratio, SDR fittings shall by definition be equivalent in minimum socket wall thickness to the minimum wall thickness of the corresponding SDR and size of pipe or tubing, and the minimum body wall thickness shall be 125% of that value.

4. Classification

The pipes shall be classified by pressure rating (working pressure) at 23°C and 93°C (see Table 1).

<table>
<thead>
<tr>
<th>SDR</th>
<th>Working Pressure at 23°C</th>
<th>Working Pressure at 93°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>2.76</td>
<td>0.55</td>
</tr>
<tr>
<td>13.5</td>
<td>2.18</td>
<td>0.44</td>
</tr>
</tbody>
</table>

NOTE — The above pipes are recommended for water temperature ranging from +1 to +93°C. The recommended maximum safe working stress for these pipes is 8.6 Mpa at 23°C. At higher temperature up to 93°C, the strength of the pipe reduces and the working pressure shall be modified in accordance with Table 1. Occasional rise in temperature as in summer season with concurrent corresponding reduction in temperature during nights has no deleterious effect on the life/working pressure of the pipes considering the total life of pipes.

5. Materials Composition

5.1 Basic Materials — The materials from which the pipes, tubing, and fittings is produced shall consist substantially of Chlorinated poly (vinyl chloride) to which may be added only those additives that are needed to facilitate the manufacture of the pipe and the
production of sound and durable pipe of good surface finish, mechanical strength and opacity under under conditions of use. None of these additives shall be used separately or together in quantities sufficient to constitute a toxic, organoleptic or microbial growth hazard or materially to impair the chemical, physical or mechanical properties (in particular long-term mechanical strength and impact strength) as defined in this standard. Cpvc 4120 is chlorinated polyvinyl chloride (the cpvc abbreviation is in accordance with ASTM D1600) classified as Type 4, Grade 1 (in accordance with ASTM F 441) which has a 2000psi maximum recommended HDS utilizing a 0.5% design factor at 23°C for water.

5.1.1 MRS-Value

The pipe material shall have a minimum required strength, MRS, as defined in PPI-TR3, ISO 9080 and ISO 12162 of at least 27.5 Mpa. The manufacturer of the compound shall confirm the MRS by testing as described in the above methods.

5.2 Resin

5.2.1 Chlorine Content

The chlorinated polyvinyl chloride polymer from which the pipe are to be manufactured shall have chlorine content not less than 66.5% when tested in accordance with Annex A.

5.3 Compound Properties

The compound shall meet the requirement ASTM D 1784 for chlorinated polyvinyl chloride compound used for pipes and fittings.

5.3.1 Chlorine Content

The chlorinated polyvinyl chloride pipe compounds containing additives such as modifiers, lubricants, fillers, etc, from which the pipes are to be manufactured, shall have a chloride content not less than 60% when tested in accordance with Annex A.

5.3.2 Verification of the Malfunction Temperature, $T_{mal}$

When tested as per the method given in Annex B, at 95±2°C and at a test pressure of 1.0Mpa for 1 000h, the pipe shall not leak during the prescribed test duration.

5.3.3 Density

The chlorinated polyvinyl chloride pipe compounds containing additives such as modifiers, lubricants, filters, etc, from which the pipes are to be manufactured, shall have a density between 1.450 kg/m$^3$ and 1.650 kg/m$^3$, when tested in accordance with ASTM D792.

6. DIMENSIONS OF TUBINGS
The outside diameter, at any point shall be as given in Table 2.

**TABLE 2:** Outside Diameters and Tolerances for cpvc plastic tubing SDR 11 and SDR 13.5 in.(mm)

<table>
<thead>
<tr>
<th>Sr no.</th>
<th>Nominal size</th>
<th>Average Outside Diameter (mm)</th>
<th>(±)Tolerance (mm)</th>
<th>Average Outside Diameter (mm)</th>
<th>(±)Tolerance (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15</td>
<td>15.9</td>
<td>0.08</td>
<td>15.9</td>
<td>0.08</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>22.2</td>
<td>0.08</td>
<td>22.2</td>
<td>0.08</td>
</tr>
<tr>
<td>3</td>
<td>25</td>
<td>28.6</td>
<td>0.08</td>
<td>28.6</td>
<td>0.08</td>
</tr>
<tr>
<td>4</td>
<td>32</td>
<td>34.9</td>
<td>0.08</td>
<td>34.9</td>
<td>0.08</td>
</tr>
<tr>
<td>5</td>
<td>40</td>
<td>41.3</td>
<td>0.10</td>
<td>41.3</td>
<td>0.10</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>54.0</td>
<td>0.10</td>
<td>54.0</td>
<td>0.10</td>
</tr>
</tbody>
</table>

**TABLE 3:** Wall Thicknesses and Tolerances for cpvc plastic tubing SDR 11 and SDR 13.5 in.(mm)

<table>
<thead>
<tr>
<th>Sr no.</th>
<th>Nominal size</th>
<th>Average outside diameter (mm)</th>
<th>Minimum Wall Thickness(mm)</th>
<th>(±)Tolerance</th>
<th>Minimum Wall Thickness(mm)</th>
<th>(±)Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15</td>
<td>15.9</td>
<td>1.73</td>
<td>0.51</td>
<td>1.40</td>
<td>0.51</td>
</tr>
</tbody>
</table>
NOTE: All dimensions indicated above are in millimeters.

For sizes 15.9mm and below, wall thickness minimums are not a function of sdr (pressure Dictates the wall thickness-AWWA Code)

All tolerances are on the plus side of the minimum requirement.

### TABLE 4: Outside Diameters And Tolerances For Cpvc Pipe Sch. 40 And 80

<table>
<thead>
<tr>
<th>Sr no.</th>
<th>Nominal size (mm)</th>
<th>Average outsideDiameter (mm)</th>
<th>Tolerances for schedule 40 and schedule 80 (±)mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>65</td>
<td>73.0</td>
<td>0.18</td>
</tr>
<tr>
<td>2</td>
<td>80</td>
<td>88.9</td>
<td>0.20</td>
</tr>
<tr>
<td>3</td>
<td>90</td>
<td>101.6</td>
<td>0.20</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>114.3</td>
<td>0.23</td>
</tr>
<tr>
<td>5</td>
<td>125</td>
<td>141.3</td>
<td>0.28</td>
</tr>
<tr>
<td>6</td>
<td>150</td>
<td>168.3</td>
<td>0.38</td>
</tr>
<tr>
<td>7</td>
<td>200</td>
<td>219.1</td>
<td>0.38</td>
</tr>
<tr>
<td>8</td>
<td>250</td>
<td>273.1</td>
<td>0.38</td>
</tr>
<tr>
<td>9</td>
<td>300</td>
<td>323.9</td>
<td>0.38</td>
</tr>
</tbody>
</table>

### TABLE 5: Wall Thickness And Tolerances For Cpvc Pipes Sch 40 And Sch 80

<table>
<thead>
<tr>
<th>SR NO.</th>
<th>Nominal size</th>
<th>Schedule 40</th>
<th>Schedule 80</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum</td>
<td>(+)Tolerance</td>
<td>Minimum</td>
</tr>
<tr>
<td>1</td>
<td>65</td>
<td>5.16</td>
<td>0.61</td>
</tr>
</tbody>
</table>
### 6.1 Diameter

The outside diameter for tubes and pipes at any point as given in Tables 2 & 4 shall be measured according to the method given in ASTM D2122.

#### 6.1.1 Diameter at any point

The difference between the measured maximum outside diameter and measured minimum outside diameter in the same cross-section of pipe (also called tolerance on ovality) shall not exceed the greater of the following two values:

a) 0.5 mm, and  
b) \(0.012d_n\), rounded off to the next higher 0.1mm.

### 6.1.2 Wall Thickness

The wall thickness of the pipes shall be as given in Tables 3 & 5. Wall thickness shall be measured by any of the three methods given in ASTM D2122. To check the conformity of the thickness of the pipe throughout its entire length, it is necessary to measure the wall thickness of the pipe at any point along its length. This shall be done by cutting the pipe at any point along its length and measuring the wall thickness as above. Alternatively, to avoid destruction of the pipe, non-destructive testing methods such as the use of ultrasonic wall thickness measurement gauges shall be used at any four points along the length of the pipe.

#### 6.1.2.1 Tolerance on wall thickness

a) For pipes of minimum wall thickness 6mm or less, the permissible variation between the minimum wall thickness \(e_{min}\) and the wall thickness at any point \(e\), \((e - e_{min})\) shall be positive in the form of \(+y\), where \(y = 0.1e_{min} + 0.2\text{mm.}\)

b) For pipes of minimum thickness wall thickness greater than 6 mm, the permissible variation of the wall thickness shall again be positive in the form of \(+y\), where \(y\) would be applied in two parts.

c) The average wall thickness shall be determined by taking at least six measurements of wall thickness round the pipe and including both the absolute minimum and
absolute maximum measured values. The tolerances applied to this average wall thickness from these measurements shall be within the range $0.1e_{\text{min}} + 0.2 \text{ mm}$ (see table 2).

d) The maximum wall thickness at any point shall be within the range $0.15e_{\text{min}}$ (see Table 2)
e) The results of these calculations for checking tolerances shall be rounded off to the next higher 0.1 mm.

6.1.3 Length

6.1.3.1 Effective length

If the length of a pipe is specified, the effective length shall not be less than that specified. The preferred effective length of pipes shall be 5m.

7. PIPE ENDS

The ends of the pipes meant for solvent cementing shall be cleanly cut and shall be reasonably square to the axis of the pipe or may be chamfered at the plain end.

8 PHYSICAL AND CHEMICAL CHARACTERISTICS

8.1 Visual Appearance
The colour of the pipes shall be cream. Slight variations to the appearance of the colour are permitted.

8.1.1 The internal and external surfaces of the pipe shall be smooth, clean and free from grooving and other defects.

8.2 OPACITY

The wall of the pipe shall not transmit more than 0.1% of the visible light falling on it when tested in accordance with ASTM D2729

8.3 EFFECT OF WATER

The pipes shall not have any detrimental effect on the composition of the water flowing through them, when tested as per ANSI/NSF std number 14 or 61

8.4 Reversion Test

When tested by the method prescribed in ASTM D638, a length of pipe 200±20mm long shall not change in length by more than 5 percent.

8.5 Vicat Softening Temperature
When tested by the method prescribed in ASTM D1525, the vicat softening temperature of the specimen shall not be less than 110°C. Annealing of the test samples prior to testing shall be permitted.

8.6 Density

When tested by the method prescribed in ASTM D792, the density of the pipes shall be between 1.450 kg/m³ and 1.650 kg/m³

9 MECHANICAL PROPERTIES

9.1 Hydrostatic Characteristics

When subjected to internal hydrostatic pressure test in accordance with the procedure given in ASTM D1598, the pipe shall not fail during the prescribed text duration. The temperatures, duration and hydrostatic (hoop) stress for the test shall conform to the requirements given in Table 6. The test shall be carried out not earlier than 24 h after the pipes have been manufactured.

**Table 6: Requirements for Internal Hydrostatic Pressure Test**

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Temperature Min °C</th>
<th>Test Period h</th>
<th>Hydrostatic (Hoop) Stress MPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptance</td>
<td>23</td>
<td>1</td>
<td>43.0</td>
</tr>
<tr>
<td>Type</td>
<td>95</td>
<td>165</td>
<td>5.6</td>
</tr>
<tr>
<td>Type</td>
<td>95</td>
<td>1 000</td>
<td>4.6</td>
</tr>
<tr>
<td>Type</td>
<td>95</td>
<td>8 760</td>
<td>3.6 (Test the thermal Stability)</td>
</tr>
</tbody>
</table>

9.1.1 SUSTAINED PRESSURE AT 23°C FOR SCH 40 AND SCH 80

**Table 7: Sustained pressure at 23°C for SCH 40 and SCH 80**

<table>
<thead>
<tr>
<th>Nominal Pipe size(mm)</th>
<th>Schedule 40 (Mpa)</th>
<th>Schedule 80 (Mpa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>65</td>
<td>4.41</td>
<td>6.13</td>
</tr>
<tr>
<td>80</td>
<td>4.06</td>
<td>5.44</td>
</tr>
<tr>
<td>90</td>
<td>3.44</td>
<td>5.03</td>
</tr>
</tbody>
</table>
9.1.2 Burst Pressure Requirements at 23°C for SCH 40 and 80

Table 8. Burst Pressure requirements at 23°C for SCH 40 and SCH 80

<table>
<thead>
<tr>
<th>Nominal Pipe Size (mm)</th>
<th>Schedule 40 (Mpa)</th>
<th>Schedule 80 (Mpa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>65</td>
<td>6.68</td>
<td>9.37</td>
</tr>
<tr>
<td>80</td>
<td>5.79</td>
<td>8.27</td>
</tr>
<tr>
<td>90</td>
<td>5.31</td>
<td>7.65</td>
</tr>
<tr>
<td>100</td>
<td>4.89</td>
<td>7.17</td>
</tr>
<tr>
<td>125</td>
<td>4.27</td>
<td>6.41</td>
</tr>
<tr>
<td>150</td>
<td>3.86</td>
<td>6.13</td>
</tr>
<tr>
<td>200</td>
<td>3.44</td>
<td>5.44</td>
</tr>
<tr>
<td>250</td>
<td>3.10</td>
<td>5.17</td>
</tr>
<tr>
<td>300</td>
<td>2.89</td>
<td>5.03</td>
</tr>
</tbody>
</table>

9.2 Thermal stability by Hydrostatic Pressure Testing

When subjected to internal hydrostatic pressure test in accordance with the procedure given in ASTM C 177 and as per requirement given in Table 8, pipe shall not burst or leak during the prescribed test duration.

9.3 Resistance to External Blow at 0°C

When tested by the method prescribed in ASTM D256, with classified strike mass and drop height as given in Table 9, the pipe shall have a true impact rate of not more than 10 percent.

Table 9: Classified Striker Mass and Drop Height Conditions for the Falling Weight Impact Test

<table>
<thead>
<tr>
<th>Nominal Size</th>
<th>Mass of Falling Weight</th>
<th>Falling Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working Temperature(°C)</td>
<td>23-27</td>
<td>32</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------</td>
<td>----</td>
</tr>
<tr>
<td>Pipe derating factor</td>
<td>1.00</td>
<td>0.91</td>
</tr>
<tr>
<td>Valve derating factor</td>
<td>1.00</td>
<td>0.95</td>
</tr>
</tbody>
</table>

### 10.0 CRITERIA FOR CONFORMITY

The sampling procedure and criteria of conformity shall be as given in Annex C.

### 11 MARKING

#### 11.1 Each pipe shall be clearly and indelibly marked in ink/paint or hot embossed on which base at intervals of not more than 1.5 m. The marking shall show the following:

a) Manufacturer’s name or trade mark.

b) Nominal size
c) Class of pipe/tube and pressure rating, and
d) Batch or lot number

11.2 Number of this Kenya standard.
METHOD FOR THE DETERMINATION OF THE CHLORINE CONTENT

A-1 COMPOUND IN BOMB TECHNIQUE METHOD

A-1.1 Scope

This test method covers the determination of chlorine in CPVC materials by combustion in bomb technique.

A-1.2 Principle

The test sample is oxidized with sodium peroxide followed by potentiometric or volumetric titration of resulting chlorides.

A-1.3 Reagents

A-1.3.1 Silver Nitrate, standard volumetric solution (0.1 mol/l or 0.05 mol/l)

A-1.3.2 Nitric acid, solution 2 mol/l

A-1.3.3 Sodium Peroxide, granulated

A-1.3.4 Starch, sucrose or ethylene glycol, as combustion aids.

A-1.4 Apparatus

A-1.4.1 Drying Oven, capable of being maintained at 50±2°C or 75±2°C

A-1.4.2 Equipment for Volhard titration or for Potentiometric Titration, with a burette having a capacity and accuracy appropriate to the chosen method.

A-1.4.3 Combustion Bomb (for example parr bomb or another bomb which gives the same results), gas or electrically fired. An example of suitable gas fired bomb is shown in Fig. 2.

A-1.4.4 Nickel Crucible with lid, to fit onto the bomb (gas fired) suitable dimensions are 25 mm dia and 40 mm height. An example of suitable gas fired bomb is shown in Fig. 2.

A-1.4.5 Safety Oven

A-1.4.6 Beaker, capacity 600 ml

A-1.4.7 Balance, accuracy 0.1 mg
A-1.5 TEST Sample

The sample to be in powdered or granular form, and if necessary shall be cut into pieces 1 mm to 3 mm in size. The sample shall be oven dried for 2 h at 75°C or 16 h at 50°C.

Fig. 2 Combustion Bomb, Gas –fired Type

A-1.6 Procedure

A-1.6.1 First place 7 g to 7.5 g of sodium peroxide in the nickel crucible (for the gas fired bomb) or in the fusion cup of the bomb (for the electrically fired bomb), then add a test portion of about 0.25 g (weighed to 0.1 mg) mixed with 0.16 g to 0.17 g of combustion aid, then a further 7 g to 7.5 g of sodium peroxide. The placing of sodium peroxide in the crucible or fusion cup shall be done behind a shield protecting the operator. Mix by stirring, then place the crucible, with the lid in position, inside the bomb and close the bomb tightly. If an electrically fired bomb is used, assemble the bomb and tap it to settle the charge. A smaller crucible and test portion could be used.

A-1.6.2 Fire the bomb, if the gas fired bomb is used, place it in the safety oven. Adjust the flame beforehand, using an empty bomb in the safety oven so that the top of the flame is a few millimeters from the base of the bomb. Then remove the empty bomb. Heat the test bomb at 300°C to 400°C for about 10 min. Ignition usually start at 50°C to 60°C, and is detected by a cracking sound, and the fact that the bottom of the bomb starts to glow.

A-1.6.3 Cool the bomb, open it and if gas fired bomb is used, remove the crucible and carefully place it in 100 ml of distilled water in 600 ml beaker and immediately cover the beaker with a watch glass. When the reaction has subsided, wash down the inside of the bomb and the plug, collecting the washings in the beaker.

If the electrically fired bomb is used, dismantle it after cooling, remove the head and tip the contents in 100 ml of distilled water in the beaker. Lay the fusion cup in the same beaker and immediately cover with a watch glass.

WARNING:- If the bomb is cooled in water, take care that the water does not reach the joint between the plug and the bomb.

A-1.6.4 Heat the beaker and its content to boiling, then cool. Remove the crucible and lid, or the fusion cup and head, rinsing them with water and collecting water the washings in the beaker.

A-1.6.5 Slowly add 20 ml of concentrated nitric acid, stirring constantly, followed by nitric acid solution until the mixture is neutral. Then add a further 2 ml of nitric acid solution.
NOTE: Methyl orange is a suitable indicator for the neutralization.

A-1.6.6 Dilute the content of beaker to about 200 ml with water and titrate potentiometrically or by Volhard method with silver nitrate solution.

A-1.6.7 Carry out a blank test by firing the same amount of sodium peroxide and combustion aid as was used with the test portion, and repeating the procedure (but without the test sample) described in 1.6.4 to 1.6.7.

A-1.6.8 When doubt exists as to the whether the reaction has taken place, do not dissolve the contents of the bomb in water by the normal procedure because this might cause the violent explosion. The contents of the bomb should be spread out on dry sand, after which they should be sprayed with water from a safe distance and then washed with more water.

A-1.7 Calculations

A-1.7.1 The chlorine content of the dry material expressed as a percentage by mass is given by the following formula:

\[
3.5453 \times 0.1 \times \frac{(V_1 - V_2)}{m}
\]

Or

\[
3.545 \times 0.05 \times \frac{(V_1 - V_2)}{M}
\]

depending upon the concentration of the silver nitrate solution.

Where

\( V_1 \) = volume of AgNO₃ used for determination, in ml.
\( V_2 \) = volume of AgNO₃ used for blank test, in ml; and
\( M \) = mass of test sample, in g.

A-1.7.2 Express the result as the arithmetic mean of the two determinations that do not differ by more than 0.2 percent (absolute).

A-2 OXYGEN FLASK METHOD

A-2.1 Scope

This test method covers the determination of chlorine in CPVC materials by the oxygen flask technique.

A-2.2 Principle
The test sample is oxidized with gaseous oxygen followed by potentiometric or volumetric titration of the resulting chlorides.

A-2.3 Reagents

A-2.3.1 Silver Nitrate, standard volumetric solution (0.1 mol/l or 0.05 mol/l)

A-2.3.2 Nitric Acid Solution, 2 mol/l

A-2.3.3 Oxygen, gaseous

A-2.3.4 Sodium Nitrate

A-2.3.5 Potassium

A-2.3.6 Hydrogen Peroxide Solution, 300 g/l

A-2.4 Apparatus

A-2.4.1 Drying Oven, capable of being maintained at 50±2°C or 75±2°C

A-2.4.2 Balance, to weigh to an accuracy of 0.01 g

A-2.4.3 Equipment for Volhard Titration or Potentiometric Titration, with a burette having a capacity and accuracy appropriate to the chosen method

A-2.4.4 Round or Flat Bottom Flask, capacity 500 ml to 1000 ml

A-2.4.5 Filter Paper, about 3 cm x 3.5 cm, free from halogen and ash

A-2.4.6 Beaker, capacity 250 ml

A-2.5 Test Sample

The sample shall be in powdered or granular form, and if necessary shall be cut into pieces of 1 mm to 3 mm in size. The sample shall be oven dried for 2 h at 75°C or 16 h at 50°C.

A-2.6 Procedure

A-2.6.1 Place a test portion of about 25 mg and 35 mg weighed to 0.01 mg on a filter paper cut as shown in Fig. 4 and having previously marked folds. Then fold the paper as shown in Fig. 4 (b), (c) and (d) and clamp it in the platinum spiral (see Fig. 3) with the paper fail protruding.
Fig 3. Flask for Oxygen Combustion with Platinum Wire Attached to Stopper.

-2.6.2 Introduce about 20 ml of water, 1 ml of potassium hydroxide solution and 0.15 ml of hydrogen peroxide solution in to the flask pas oxygen through a glass tube at 250 ml/min to 350 ml/min for 5 min to displace the air.

-2.6.3 Ignite the filter paper tail with a gas flame and quickly insert the stopper carrying the platinum wire and burning filter paper into the flask.

-2.6.4 During combustion, keep the flask inverted so that the liquid covers the bottom of the stopper and leakage through the stopper and escape of gas are avoided when combustion is finished, turn the flask up right gently shake under a stream of cold water to cause rapid complete absorption of the hydrochloric acid produced.

-2.6.5 After 30 min open the flask and transfer the contains quantitatively to a 250 ml beaker, rinsing so that the final volume is about 60 ml, add about 1 g of sodium nitrate and 2.5 ml of nitric acid solution, and boil the solution for 5 min. After cooling, determine the chlorine content by potentiometric titration or by the Volhard method with silver nitrate solution.

-2.6.6 Carry out a blank test following the procedure described in B-2.6.1 to B-2.6.5 and using the same quantities of all the reagents used in the determination, but without the test portion.

-2.7 Calculations

-2.7.1 The chlorine content of the dry material, expressed as a percentage by mass is given by the following formula:

\[
\frac{3.5453 \times 0.1 \times (V_1 - V_2)}{m}
\]

Or

\[
\frac{3.545 \times 0.05 \times (V_1 - V_2)}{M}
\]

depending upon the concentration of the silver nitrate solution used.

Where

\[V_1 = \text{volume of silver nitrate solution used for determination, in ml.}\]
\[V_2 = \text{volume of silver nitrate solution used for blank test, in ml, and}\]
\[m = \text{mass of the test sample, in g}\]
A -2.7.2 Express the result as the arithmetic mean of two determinations that do not differ by more than 0.2 percent (absolute)

Fig. 4 Folding or Filter paper containing test procedure
ANNEX B  
TEST METHOD FOR THE VERIFICATION OF THE MALFUNCTION TEMPERATURE  
\((T_{mal})\) OF CPVC MATERIAL  

C-1  **SCOPE**  
This annex specifies a test method for verifying the malfunction temperature, \(T_{mal}\) of chlorinated polyvinyl chloride material for piping system included to be used for hot and cold water installation.

C-2  **PRINCIPLE**  
An assembly of pipes and fittings (see Fig. 5) for testing the material subjected to a given internal water pressure under temperature for a given period during which the leak tightness of the system is verified by the inspection.

C-3  **APPARATUS**  
C-3.1 **Pump**, capable of applying and maintaining the required pressure

C-3.2 **Pressure Measurement Devices**, capable of checking conformity to the required test pressure

C-3.3 **Heating Devices**, capable of applying and maintaining the required temperature

C-3.4 **Thermometer or Equivalent**, capable of checking conformity to the require test temperature

C-3.5 **Timer**, capable of recording the duration of the pressure application

C-4  **TEST PIECES**  
The assembly shall comprise test pieces of the following type:

   a. 10 pipe sections of the same lengths, each of them at least 300 mm and with a nominal outside diameter specified by the manufacture and capable of withstanding a hydrostatic stress of 4.6 MPa.

   b. 7 double sockets (couplers) of the same outside diameter as the pipe section; and

   c. 4 elbows, each of them with an angle of 90°

The test pieces shall be joined to each other according to Fig. 5.
C-5 PROCEDURE

C-5.1 Conduct the following procedure using an assembly as given in Fig. 5 set up by solvent cementing the components. Store the components which have been connected by solvent cement for setting for at least 24 h at ambient temperature. Then condition the solvent cemented joints by filling the assembly with water at a temperature of 95 ± 2° C for 48 h without applying the pressure. After the conditioning drain the water off.

C-5.2 Refill the assembly with water at 95 ± 2° C which is circulated by a pump and apply a test pressure of 1.0 MPa to the assembly.

C-5.3 Maintain the water temperature at 95 ± 2° C, test pressure of 1.0 MPa for at least 1 000 h during which the assembly shall be continuously monitored for leak tightness.

C-6 TEST REPORT

The test report shall include the following information:
  a) Reference to the annex of this standard;
  b) Complete identification of the sample;
c) Test pressure, in MPa;
d) Test temperature, in degree Celsius
e) Time under pressure, in hour;
f) Type(s) of failure, if any;
g) Any factors which may have affected the results such as any incidents or any
   operating details not specified in this Annex, and
h) Date of the test
ANNEX D

GUIDELINES FOR STORAGE AND INSTALLATION

D-1 STORAGE

CPVC pipes of all sizes are packed in polyethylene packing rolls and both the ends of the packed roll are sealed with air bubble film cap in order to provide protection during handling and transportation. After packing, the whole bunch of pipes is tightened with polypropylene/HDPE strapping. Each role is then marked with sizes/ type of the pipe, lot number and quantity. The packed pipe rolls are stored in their respective racks to properly covered storage area. Apart from providing protection during, handling and transportation, the packing rolls also protect the pipe from ultr-violet rays.

D-2 INSTALLATION GUIDELINES

D-2.1 Visually inspect the pipe ends before making the joint. Use of a chamfering tool will help identify any cracks, as it will catch on to any crack.

D-2.2 Pipe may be cut quickly and efficiently by several methods. Wheel type plastic tubing cutters are preferred. Ratchet type cutter or fine tooth saw are another options. However, when using the ratchet cutter be certain to score the exterior wall by rotating the cutter blade in circular motion around the pipe. Do this before applying significant downward pressure to finalize the cut. This step leads to a square cut. In addition, make sure ratchet cutter blades are sharp. Cutting tubing as squarely as possible provides optimal bonding area within a joint.

D-2.3 Burrs and filings can prevent proper contact between the tube and fittings during the assembly, and should be removed from the outside and inside of the tube. A chamfering tool is preferred, but a pocket knife or file is also suitable for this purpose.

D-2.4 Use only CPVC cement jointing. Use CPVC cement, which is duly recommended by the manufacturer.

D-2.5 When using adhesive solution/solvent cement be certain of proper ventilation.

D-2.6 When making a joint, apply a heavy, even coat of cement to the pipe end. Use the same applicator without additional cement to apply a thin coat inside the fittings socket. For pipe sizes greater than 50 mm, apply a second full, even layer of cement on the pipe. Too much cement can cause clogged waterways. Do not allow excess cement to puddle in the fitting and pipe assembly. This could result in a weakening of the pipe wall and possible pipe failure when the system is pressurized.

D-2.7 Rotate pipe one-quarter to one-half turn while inserting it into the fitting socket and remove the excess adhesive solution/solvent cement from the joint with clean rag. Once the pipe end is seated, hold it in place for 5 s to 10 s to allow the joint to set.
D-2.8 When making a transition connection to metal threads, use a special transition fitting or CPVC male threaded adapter whenever possible. Do not over-torque plastic threaded connections. Hand tight plus one-half turn should be adequate.

D-2.9 Hang or strap CPVC systems loosely to allow for thermal expansion. Do not use metal straps with sharp edges that might damage the tubing.

D-2.10 CPVC stub outs for lavatories, closets and sinks are appropriate. However, on areas where there is a likelihood that movement or impact abuse will occur, metal pipe nipples may be a more appropriate stub-out material. Showerheads, tub spouts and outside sill cocks are examples.

D-2.11 When connected to a gas water heater, CPVC tubing should not be located within 50 cm of the flue. For water heaters lacking reliable temperature control, this distance may be increased up to 1 m a metal nipple or flexible appliance connector should be utilized. This measure eliminates the potential for damage to plastic piping that might result from excessive radiant heat from the flue.