Chlorinated Polyvinyl Chloride (CPVC) Pipe

1. **General:** This document has been prepared as a ready reckoner for SSEs/JEs and Assistant Engineers to assist them in selecting CPVC pipes for their water supply installation. This document fulfills the requirement of CPVC pipes Item No. 131080 to131123 of USSOR-2010 and Item No. 8636 to 8645 of DSR of CPWD 2018. This document has been prepared based on the requirements of CPVC pipes as per IS 15778:2007 and IS 15225:2002.

2. **Introduction of CPVC:** CPVC stands for Chlorinated polyvinyl Chloride (CPVC). It is a thermoplastic which is produced by chlorination of PVC resin. Various additives are also introduced in to the resin in order to make the material more receptive to processing. These additives may consist of stabilizers, impact modifiers, pigments and lubricants. This compound is called chlorinated polyvinyl chloride compound.

   The chlorinated polyvinyl chloride compound used for pipes & fittings shall have performance designation of IS 15225-CPVC-DP.110-2-3-2. It implies a chlorinated poly vinyl chloride compound (CPVC) confirming to IS 15225:2002, having the physical form of powders (D) for the extrusion of pipes (P), with a Vicat softening temperature (VST/B/50) of 110°C (110), Charpy notched impact strength of > 4.0 to 8.0 KJ/M^2 (Kilo Jool per square Meter) (2), tensile strength of > 45 to 55 MPa (Mega paskal) (3) and tensile modulus of > 2000 to 2500 MPa (2).

2.1 Classification of pipes: Pipes shall be classified by pressure rating (Working Pressure) at 27°C and 82°C.

Table-1 Working pressure for pipes

SN	Pressure class	Working pressure in Mpa (Mega Paskal) at		
		SDR	27°C	82°C
I	1	11	2.76	0.68
II	2	13.5	2.18	0.55
III	3	17	1.73	0.42

2.2 Standard Thermoplastic pipe dimension ratio (SDR):

Standard thermoplastic pipe dimension ratio is the ratio of pipe diameter to wall thickness. In case of CPVC pipe, SDR is calculated by dividing the average outer diameter in mm of the pipe by the minimum wall thickness in mm.

3. **Acceptance test:** Acceptance test are carried out on sample selected from a lot for the purpose of acceptance of a lot.

   All CPVC pipes in a single consignment of the same class, same size and manufactured under essentially similar conditions shall constitute a lot. For ascertaining conformity of the lot to the requirements of the specification, samples shall be taken from each lot separately for following tests:-

   a) Dimension and Visual Test
   b) Reversion Test
   c) Vicat Softening Test
   d) Density Test
   e) Resistance to External Blows at 0°C.
   f) Internal Hydrostatic Pressure Test.

   The lot having satisfied visual and dimensional requirement shall be tested for Reversion, Vicat Softening and Density test.

   The lot fulfilling the requirements of test from (a) to (d) shall be further tested for Resistance to External Blows at 0°C. Finally, the lot having satisfied the requirements of all the test from (a) to (e) shall be test for Internal Hydrostatic Pressure test.

4. **Dimensional and Visual Test:**

4.1 Scale of sampling for Dimensional & Visual test:

The number of test samples to be taken from a lot shall depend on the size of the lot and the outside diameter of the pipes, and shall be in accordance with Table 2. These pipes shall be selected at random from the lot and in order to ensure the randomness of selection, a random number table shall be used.

Table 2 - Scale of Sampling for visual appearance and Dimensional requirement

SN	Nos. of pipe in a lot	Sample no.	Sample size	Cumulative sample size	Acceptance no.	Rejection no.
1	2	3	4	5	6	7
I	Up to 1000	First	13	13	0	2
		second	13	26	1	2
II	1001 to 3000	First	20	20	0	2
		second	20	40	1	2
II	3001 to 10000	First	32	32	0	3
		second	32	64	3	4
IV	10001 and above	First	50	50	1	4
		second	50	100	4	5

4.1.1 Criteria for acceptance or rejection: The number of pipes given for the first sample in col-4 of Table 2, shall be taken from the lot and examined for visual and dimensional requirements. A pipe failing to satisfy any of these requirements shall be considered as defective.

If the number of defectives found in the first sample is less than or equal to the corresponding acceptance number given in col 6 of Table 2, the lot shall be deemed to have satisfied these requirements. If the numbers of defectives found in the first sample is greater than or equal to the corresponding rejection number given in col 7 of Table 2, the lot shall be deemed not to have met these requirement.

If, however, the number of defective found in the first sample lies between the corresponding acceptance and rejection numbers given in col 6 and 7, a second sample of the size given in col 4 shall be taken and examined for these requirements. The lot shall be considered to have satisfied these requirements if the cumulative sample is less than or equal to the corresponding acceptance number given in col 6, otherwise not.

4.2 Dimensional and visual requirement:

4.2.1 Dimensions of the Pipe:

(i) **Dimensions and wall thickness:** The outside diameter, outside diameter at any point and wall thickness for different class of pipe shall be as per Table 3 .

Table 3 - Dimensions of Chlorinated Polyvinyl Chloride Pipes in mm

SN	Nominal size	Nominal outside diameter	Mean outside diameter		Outside diameter at any point		WALL THICKNESS					
							Class I SDR 11			Class 3 SDR 17		
			Min	Max	Min	Max.	Av. Max	Min	Max	Av. Max	Min	Max
1	15	15.9	15.8	16.0	15.0	16.0	2.2	1.7	2.2	-	-	-
2	20	22.2	22.1	22.3	22.0	22.4	2.5	2.0	2.5	-	-	-
3	25	28.6	28.5	28.7	28.4	28.8	3.1	2.6	3.1	-	-	-
4	32	34.9	34.8	35.0	34.7	35.1	3.7	3.2	3.7	-	-	-
5	40	41.3	41.2	41.4	41.1	41.5	4.3	3.8	4.3	-	-	-
6	50	54.0	53.9	54.1	53.7	54.3	5.5	4.9	5.5	-	-	-
7	65	73.0	72.8	73.2	72.2	73.8	-	-	-	4.8	4.3	4.8
8	80	88.9	88.7	89.1	88.1	89.7	-	-	-	5.9	5.2	5.9
9	100	114.3	114.1	114.5	113.5	115.1	-	-	-	7.5	6.7	7.5
10	150	168.3	168.0	168.6	166.5	170.1	-	-	-	11.1	9.9	11.1

- **Nominal size (DN):** Specified diameter by the manufacturer in millimeter.
- **Nominal outside diameter:** Nominal outside diameter (d_n) for different nominal size is also given in Table 3.

(ii) **Out of roundness (Ovality):** The difference between the measured maximum and measured minimum outside diameter at the same cross section of the pipe. Tolerance on ovality shall not exceed the greater of the following two values:

a) 0.5 mm

b) 0.012 d_n rounded off to the next higher 0.1 mm

(iii) **Length and effective length (Le):** 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 3,5,or 6 meter. The pipes may be supplied in other length where so agreed upon between the manufacturer and the purchaser.

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

The colour of the pipes shall be off-white. Slight variations in the appearance of the colour are permitted.

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

5. Reversion, Vicat Softening Temperature and Density Test: Scale of sampling and performance requirement for Reversion, Vicat Softening Temperature and Density test shall be as per Table 4 & 5 respectively.

Table 4 - Scale of sampling for Reversion, Vicat Softening Temperature and Density test

SN.	Nos. of pipe in a lot	Sample no.	Sample size	Cumulative sample size	Acceptance no.	Rejection no.
1	2	3	4	5	6	7
I	Up to 1000	First	5	5	0	2
		second	5	10	1	2
II	1001 to 3000	First	8	8	0	2
		second	8	16	1	2
III	3001 to 10000	First	13	13	0	2
		Second	13	26	1	2
IV	10001 and above	First	20	20	0	3
		second	20	40	3	4

Table 5 - Performance requirement for Reversion, Vicat Softening Temperature and Density Test

Name of test	Test parameter& relevant code	Acceptance criteria
Reversion Test	IS 12235 part 5 section 1&2	When tested, a length of pipe 200 ±20 mm long shall not alter in length by more than 5%.
Vicat Softening Temperature	IS 12235 part 2	When tested, the Vicat softening temperature of the specimen shall not be less than 110°C.
Density	IS 12235 part 14	When tested, the density of the pipes shall be between 1450 kg/m3 and 1650 kg/m3.

6. Resistance to External Blows at 0°C Test:

Scale of sampling and performance requirement for Resistance to External Blows at 0°C test shall be as per Table 6 & 7 respectively.

Table 6 - Scale of sampling for Resistance to External Blows at 0°C test

SN	Number of pipes in the lot	Sample no.	Sample size	Cumulative sample size	Acceptance no.	Rejection no.
1	2	3	4	5	6	7
I	Up to 3000	First	3	3	0	2
		second	3	6	1	2
II	3001 to 10000	First	5	5	0	2
		second	5	10	1	2
III	10001 and above	First	8	8	0	2
		second	8	16	1	2

Table 7 - Performance requirement for Resistance to External Blows at 0°C test

Name of test	Test parameter& relevant code	Acceptance criteria
Resistant to External blows at °C.	IS 4985	When tested with classified striker mass and drop height. The pipe shall have a true impact rate of not more than 10%.

7. Internal Hydrostatic Pressure Test:

Scale of sampling and performance requirement for Internal Hydrostatic Pressure Test shall be as per Table 8 & 9 respectively.

Table 8 - Scale of sampling for Internal Hydrostatic Pressure Test

SN	Number of pipes in the lot	Sample size	Acceptance no.
I	Up to 3000	2	0
II	3001 to 10000	3	0
III	10001 and above	5	0

Table 9 - Performance requirements for Internal Hydrostatic Pressure

Name of test	Test parameter& relevant code	Acceptance criteria
Hydrostatic characteristics	IS 12235 part 8 section 1	When subjected to internal hydrostatic pressure test in accordance with the procedure , the pipe shall not fail during the prescribed test duration. Of one hour, the minimum test temperatures of 20 °C, and hydrostatic (hoop) stress of 43 Mpa The test shall be carried out not earlier than 24 hour after the pipes have been manufactured.

Note: Table 4 & 6 shall be analyzed in the similar manner as discussed in clause 4.1.1.

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केमटेक/सिविल/2021/ सी.पी.वी.सी. पाइप/1.0
CAMTECH/C/2021/ CPVC Pipe/1.0
नवम्बर / November - 2021

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