

KS

KOREAN INDUSTRIAL STANDARD

Unplasticized Polyvinyl Chloride Pipes for Water Works

KS M 3401-1995

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1. Scope

This Korean Industrial Standard specifies the unplasticized polyvinyl chloride pipes and the impact resistant unplasticized polyvinyl chloride pipes (hereinafter referred to as "pipes"), for waterworks to be used under hydrostatic head not more than 0.75MPa {7.6kgf/cm²}.

Remark 1. The unit and numerical values given in parenthesis in this Standard are based on the traditional units, and appended for informative reference.

2. Normative references to this Standard are as shown in the **Attached Table**.

2. Classification and Symbol

The classification and symbol of pipes shall comply with **Table 1**, and pipes shall be classified into three classes according to their usages as straight pipes, TS pipes and O-ring collar.

Table 1

Usage	Symbol	Classification
Unplasticized polyvinyl chloride pipes	VP	straight pipes, TS pipes and O-ring collar
Impact resistant unplasticized polyvinyl chloride pipes	HIVP	straight pipes, TS pipes and O-ring collar

2.1 Straight Pipes

The shape, dimension and reference weight of straight pipe shall be as shown in Table 2.

Table 2

Unit : mm

Nominal diameter	Outside diameter(<i>D</i>)			Thickness(<i>t</i>)		Informative weight(kg/m)	
	Basic dimension	Tolerance on max, min outside dia.	Tolerance on average outside dia.	Basic dimension	Tolerance of thickness	VP	HIVP
13	18	±0.20	±0.20	2.5	±0.20	0.174	0.170
16	22	±0.20	±0.20	3.0	±0.30	0.256	0.251
20	26	±0.25	±0.20	3.0	±0.30	0.310	0.303
25	32	±0.30	±0.20	3.5	±0.30	0.448	0.439
30	38	±0.35	±0.20	3.5	±0.30	0.542	0.531
40	48	±0.40	±0.20	4.0	±0.30	0.791	0.774
50	60	±0.50	±0.20	4.5	±0.40	1.122	1.098
65	76	±0.50	±0.20	5.2	±0.40	1.653	1.618
75	89	±0.50	±0.20	5.9	±0.40	2.202	2.156
100	114	±0.65	±0.20	7.1	±0.50	3.409	3.338
125	140	±0.80	±0.30	8.3	±0.60	4.908	4.805
150	165	±1.00	±0.30	9.6	±0.60	6.701	6.561
200	216	±1.30	±0.70	11.1	±0.80	10.213	9.998
250	267	±1.60	±0.90	13.4	±0.80	15.260	14.939
300	318	±1.90	±1.00	16.1	±1.10	21.825	21.367

- Remarks 1.** The maximum and minimum outside diameters refers to the maximum and minimum value of the measured outside diameter at the arbitrary section.
- 2.** The average outside diameter refers to arithmetic mean value $[(D_1 + D_2) / 2]$ of two measured outside diameters D_1 and D_2 , at the right angles to its length at the arbitrary points or the value divided by the ratio of circumference of 3.142 from the measured circumference.
- 3.** The degree of roundness of average outside diameter N shall be calculated in accordance with the following formula, and the values shall be 3% max.

$$N = \frac{D_1 - D_2}{(D_1 + D_2)/2} \times 100$$

Where N : Degree of roundness(%)

D_1 : Maximum measured value of outside diameter(mm)

D_2 : Minimum measured value of outside diameter(mm)

- 4.** The reference weight was calculated using a specified gravity of 1.43 for VP and 1.40 for HIVP.

2.2 TS Pipes

The shape and dimensions of TS pipes shall be as shown in Fig. 1 and Table 3.

Table 3.

Unit:mm

Nominal diameter	d_1	Tolerance of d_1	$1/T$	l	t
50	60.80	± 0.30	1/37	63	4.5
65	76.80	± 0.30	1/41	69	5.2
75	89.80	± 0.30	1/43	72	5.9
100	115.00	± 0.35	1/44	92	7.1
125	141.20	± 0.40	1/45	112	8.3
150	166.50	± 0.50	1/46	140	9.6
200	218.30	± 0.50	1/50	200	11.1
250	269.80	± 0.60	1/50	250	13.4
300	321.30	± 0.70	1/50	300	16.1

Remarks 1. The tolerance of t shall comply with Table 2:

2. The tolerance of l shall be $^{+4}_{-0.5}$ mm.

3. The average outside diameter(D) and its tolerance shall comply with Table 2.

4. The thickness of the processing part of sleeve shall be larger than the minimum value of the straight pipe.

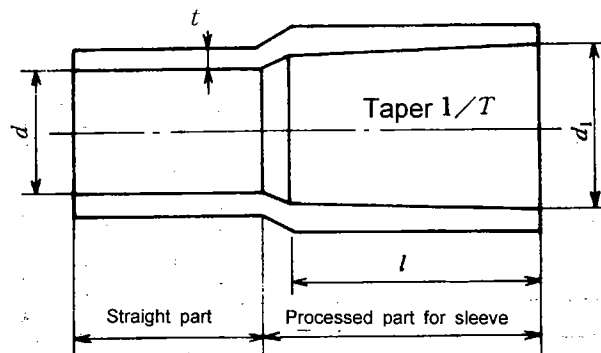


Fig. 1 TS Pipe

2.3 O-ring Collar Pipe

2.3.1 O-ring collar pipes shall be divided to two classes, one is the processed pipe from original(A type) and the other is the pipe reinforced by other pipe other than original pipe to strengthen the processed part(B type).

2.3.2 The shape and dimensions of O-ring collar pipe shall be as shown in Figs. 2 and 3 and Tables 4 and 5.

Table 4 O-ring Collar Pipe(Type A)

Unit : mm

Nominal diameter	d_1	Tolerance of d_1	l	t
50	61.3	± 0.50	90	4.5
65	77.3	± 0.50	95	5.2
75	90.3	± 0.50	95	5.9
100	115.6	± 0.65	115	7.1
125	142.0	± 0.80	130	8.3
150	167.3	± 1.00	135	9.6
200	219.5	± 1.20	155	11.1
250	271.1	± 1.40	180	13.4
300	322.7	± 1.60	210	16.1

Remarks 1. The average outside diameter(D) and its tolerance shall comply with Table 2.

2. The tolerance of l shall be $^{+30}_{-10}$ mm.

3. The tolerance of t shall comply with Table 2.

4. The dimension of t_1 shall be larger than the minimum value of thickness of the straight pipes.

5. The shape of outer part of the processed part of O-ring collar pipe shall not be specified.

6. The shape and dimensions of rubber ring shall not be specified.

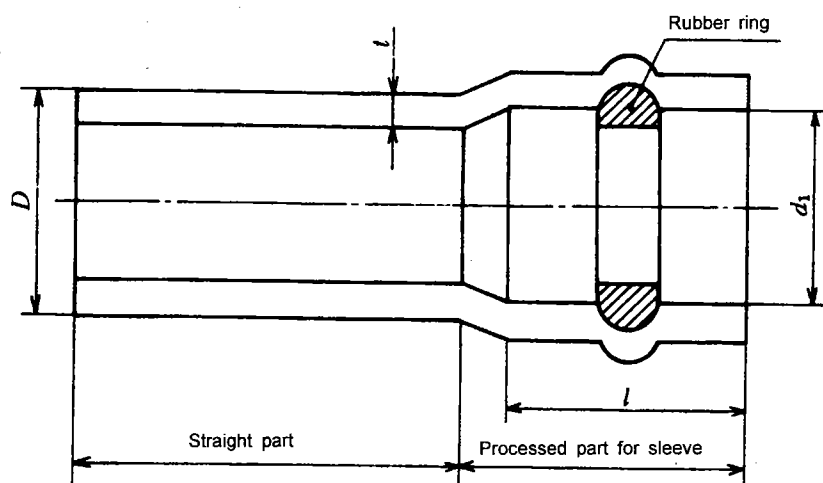


Fig. 2 O-ring Collar Pipe (Type A)

Table 5 O-ring Collar Pipe(Type B)

Unit : mm

Nominal diameter	t_2	l_1	C
50	2.5 min.	10	0.5 max.
65	3.0 min.	10	0.5 max.
75	3.0 min.	10	0.5 max.
100	4.0 min.	15	0.7 max.
125	5.0 min.	15	0.9 max.
150	6.0 min.	15	1.0 max.
200	8.0 min.	20	1.8 max.
250	9.0 min.	20	2.2 max.
300	11.0 min.	20	2.6 max.

Remarks 1. The dimensions other than listed in Table 5 shall comply with Table 2 and Table 4.

2. The tolerance of l_1 shall be $\pm 5\text{mm}$.

3. The reinforced material shall be unplasticized PVC pipe identical with original.

4. No gaps shall exist between the reinforced material and the original material.

5. The reinforced material shall be tested by tension and penetration tests under heating, and the results shall comply with Table 6.

(a) The tension test shall be carried out in the same way as the test of the processed part of sleeve in 9.4.2.

(b) The test on vicat softening temperature shall be carried out in the same way as the test method in 9.7.2.

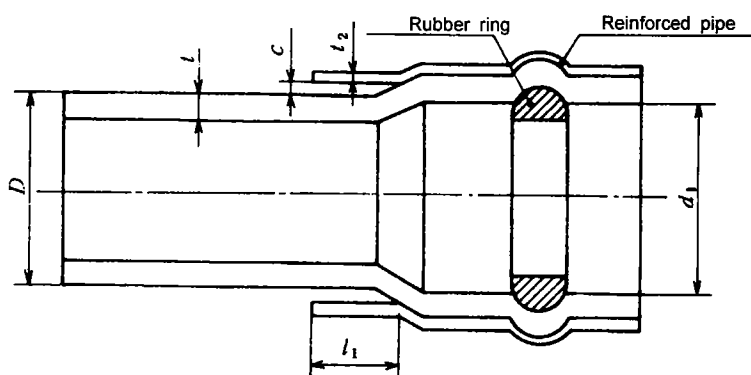


Fig. 3 O-ring Collar Pipe(Type B)

3. Quality

The pipes shall be tested in accordance with 9, and comply with the requirements in Table 6.

Table 6

Test item	Performance	Applicable test subclause
Tensile test	49N/mm ² {500kgf/cm ² } or more of tensile strength at 15℃	9.4
Pressure test	No unusualness such as leakage or the like	9.5
Flattening test	No cracking nor fissures	9.6
Vicat softening temperature	76℃ min.	9.7
Impact resistance ⁽¹⁾	No unusualness	9.8
Leaching property	Turbidity : 0.5 degree max.	9.9
	Chromaticity : 1.0 degree max.	
	Consumption of potassium permanganate : 2ppm max.	
	Lead : 0.008 ppm max.	
	Zinc : 0.5 ppm max.	
	Decrement of residual chlorine: 0.7 ppm max.	
	Odor and taste : No unusualness	

Note⁽¹⁾ Impact resistance test shall be applied to HVP only.

4. Appearance

Pipes shall be smooth both inside and outside surface, and have no harmful to use such as flaw, crack, lateral fissure and warp, etc.

5. Shape

5.1 The pipe shall have a practically perfect round section, and be straight, both ends which shall be at right angles with the axis of pipe.

5.2 The end of pipe shall be processed for sleeve, and then formed to the socket for the adhesive type (TS pipe) and O-ring type(O-ring collar pipe). The end of inserted pipe may be chamfered, if required.

6. Dimensions and Informative Weight

6.1 Nominal diameter, outer diameter, thickness and informative weight of the straight pipe shall be given in Table 2.

6.2 The standard length for straight pipe shall be $4000 \pm_{10}^{30}$ mm, and the standard length of O-ring collar pipe shall be $6000 \pm_{10}^{30}$ mm. The length of others shall be subjected to the agreement between the interested parties.

6.3 The dimensions of TS pipe and O-ring collar pipe are given in Tables 3, 4, 5 and Figs. 1, 2 and 3.

7. Color of Pipe

VP shall be colored as gray, and HVP be colored as dark grayish blue.

8. Materials and Manufacturing Methods

- 8.1 Material of pipe shall mainly be polymer of vinyl chloride. In case of VP, stabilizer, pigment and others are added in vinyl chloride polymer, and in case of HVP, stabilizer, pigment, modifier⁽²⁾ and others are added in vinyl chloride polymer, and its quality after being molded shall be uniform, water resistant, and not give harmful influence on water quality. In this case, plasticizer shall not be added.

Note⁽²⁾ The modifier likely giving bad influence on weather resistance shall not be used.

- 8.2 The production of pipe shall be the extrusion molding by using of the materials specified in 8.1.
- 8.3 The socket for TS pipe and O-ring collar pipe shall be the sleeve processed molding at the end of straight pipe.
- 8.4 The quality of rubber ring attached on the socket of O-ring collar pipe shall comply with the Class 1, No. 1 in **KS M 6613**.

9. Testing Methods

9.1 Test Piece

The test piece shall be made from pipe in accordance with **Table 7**. The test pieces for the tensile test and the flattening test shall be exposed at $23 \pm 2^\circ\text{C}$ in temperature for 1h or longer before test.

Table 7

Test item	Shape of sample	Sampling method	Number of sample		Test result
			Straight pipes	TS pipes, O-ring collar pipes	
Appearance and shape	Pipe	Specified length of pipe	-	-	-
Dimension	Pipe	Specified length of pipe			
Tensile strength	Dumb el	By the method specified in Fig.4 and Table8 from pipe	3	6	take mean value
Pressure test	Pipe	Take length of 1000mm or longer from pipe	1	1	-
Flattening test	Pipe	Take 50mm length of pipe-shaped sample from pipe	1	1	-
Vicat softening temperature	Arc	Take 10mm or over in length, 10mm or over in width. If thickness exceeds 6mm, cut out the outside surface and make to approx. 3mm.	3	6	take mean value
Impact resistance	Pipe	Nominal diameter	5	5	-
		Length (mm)			
		13 to 65 75 to 300			
Leaching property	pipe	Nominal diameter	1 per testing solution	1 per testing solution	-
		Length (m)			
		13 to 20			
		25 to 30			
		40 to 50			
		65 to 300			

Remark If the samples for leaching test are 4m and 2m in length, these may be divided to 2m or 1m.

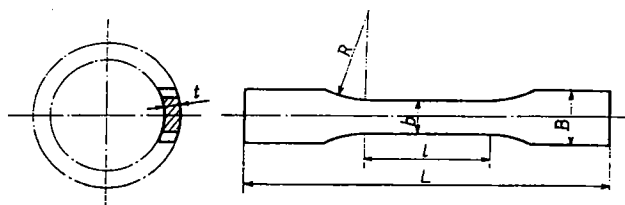


Fig. 4

Table 8

Unit : mm

Nominal diameter	<i>L</i>	<i>l</i>	<i>B</i>	<i>b</i>	<i>R</i>
25 max.	90	25	8	5	6
30 min.	100	35	15	10	25

9.2 Appearance and Shape

The appearance, color and shape of pipe shall be examined with naked eyes.

9.3 Dimension

The dimension shall be measured with KS B 5205 and KS B 5203 or superior in accuracy.

9.4 Tensile Strength Test

9.4.1 Straight Pipe

Obtain 3 test pieces according to Table 8 and Figure 4, and test its tensile at speed of 10 ± 2 mm/min at the ordinary temperature⁽³⁾ and take the average value in accordance with KS M 3006, and calculate the tensile strength on 15°C with following formula.

$$f = f_t + 0.652 (t-15) \quad \{ f = f_t + 6.65 (t-15) \}$$

Where f : Tensile strength on 15°C (N/mm²) {kgf/cm²}

f_t : Tensile strength on t °C (N/mm²) {kgf/cm²}

t : Temperature during test (°C) (Applicable range of temperature: 5 to 30°C)

Note⁽³⁾ Ordinary temperature refers to 20 ± 15 °C (Grade 15 of temperature in KS A 0006)

9.4.2 TS pipe and O-ring collar pipe : Take 3 test pieces proper to Fig. 4 and Table 8 from the sleeve processed part, and another 3 pieces according to 9.4.1 from straight part, and test in accordance with 9.4.1.

9.5 Pressure Test

9.5.1 Straight Pipe

Apply the water of ordinary temperature to the test specimen until the hydraulic pressure reaches 4.0MPa {40.8kgf/cm²} and stand still for 1 min, and then examine leaks or other defects with naked eyes.

9.5.2 TS Pipe and O-ring Collar Pipe

Cut 700 mm of opposite side(straight pipe) of the sleeve processed part and connect it to the processed part, and cut 500mm from the end of sleeve processed part, then test in accordance with 9.5.1.

9.6 Flattening Test

9.6.1 Straight Pipe

Insert the test piece between two flat plates, apply the load at speed of 10 ± 2 mm/min from the right angle of the axis of pipe until the outside diameter of the specimen reaches 1/2 of the original diameter, then examine the existence of cracks, break or bubbles, etc. with naked eyes

9.6.2 TS Pipe and O-ring Collar Pipe

Take the test piece from the straight part of the pipe specified in 9.6.1 and carry out test on it.

9.7 Vicat Softening Temperature Test

9.7.1 Straight Pipe

The test piece for straight pipe shall be placed on $23 \pm 2^\circ\text{C}$, and comply with **KS M 3076**. In this case, the test load applied to the test piece shall be 50.0 ± 1 { $5.1 \pm 0.1\text{kgf}$ } and the temperature of heat transmission media shall be elevated by the velocity of $50 \pm 5^\circ\text{C}$ per hour.

9.7.2 TS Pipe and O-ring Collar Pipe

Take three test pieces respectively from centre of sleeve for the sleeve processed part, and from straight part, then carry out test in accordance with 9.7.1.

9.8 Impact Test

The impact test by dropping weight shall comply with **Annex 1**.

9.9 Leaching Property Test

9.9.1 Straight Pipe

The test method for leaching property and the preparation method of test water shall comply with **Annex 2**. In this case, the preparation methods for sample water and blank test water are as follows.

- (1) Take the test pipe cut by the length specified in **Table 4**, and wash for 1h in the clean water at a flow speed of about 5 m per minute or less.
- (2) For the sample water, cover the end of test pipe with the washed polyethylene film and wash once with the test water, and fill with the test water and plug the other end tightly. then stand still it at room temperature for 24h.
- (3) For the blank test water, fill the test water in the bottle with hard glass cork (500ml) ⁽⁴⁾, seal and intercept the light, and store the same place of test water for 24h.

Note⁽⁴⁾ The bottle with hard glass cork to be used shall be washed with nitric acid (1 to15) previously, and then with water specified in **Annex 2**.

Remark The nitric acid (1 to 15) is mixed with nitric acid (concentration of 60.0 to 62.0%) specified in **KS M 8104** and water by the volume rate of 1 to 15 according to one of the concentration identification method specified in 7.2 of **KS M 0001**.

9.9.2 TS Pipe and O-ring Collar Pipe

Take the test pieces from the sleeve part of pipe and test in accordance with 9.9.1.

10. Rounding of Numerical Values for Test Results

The test results shall be obtained down to one more place than the specified value, and be rounded off in accordance with **KS A 0021**.

11. Inspection