1) Size of CPVC Piping by Each Standard

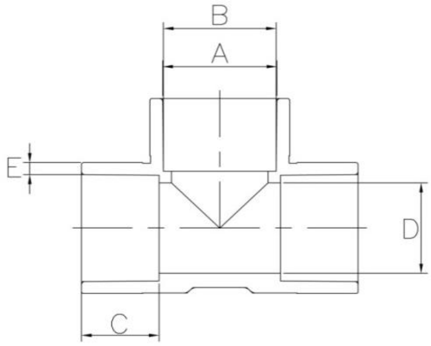
Nominal Diameter	Diameter (Outer) (mm)	Diameter (Inner) (mm)	Thickness (mm)	Weight/1 M (g)	Code
1" (25)	33.40 ~ 33.50 (33.45 ± 0.05)	28.02	2.46 ~ 2.97 (2.46 +0.51)	400.9	1180101
1-1/4" (32)	42.20 ~ 42.30 (42.25 ± 0.05)	35.50	3.12 ~3.63 (3.12 + 0.51)	630.3	1180102
1-1/2" (40)	48.25 ~ 48.35 (48.30 ± 0.05)	40.63	3.58 ~ 4.09 (3.58 + 0.51)	819.2	1180103
2" (50)	60.30 ~ 60.40 (60.35 ± 0.05)	50.88	4.47 ~5.00 (4.47 +0.53)	1265.1	1180104
2-1/2" (65)	73.08 ~ 73.18 (73.13 ± 0.05)	61.65	5.41 ~ 6.07 (5.41 + 0.66)	1858.4	1180105
3" (80)	89.00 ~ 89.10 (89.05 ± 0.05)	75.10	6.58 ~ 7.37 (6.58 + 0.79)	2750.3	1180106
4" (100)	114.40 ~ 114.50 (114.45 ± 0.05)	96.51	8.46 ~ 9.48 (8.46 + 1.02)	4545.5	

2) Size of CPVC fittings by Each Standard

Nominal Fitting size	ΦA	ΦB	C	D	E	Real Size Of Pipe
	Diameter Of End	Inner Diameter	Depth Of Socket	Diameter Of Body	Thickness Of Socket	
1" (25)	33.66±0.10	33.27±0.10	**28.58 (Above)**	23.14 **(Above)**	4.55 **(Above)**	33.45
1-1/4" (32)	42.42±0.10	42.04±0.10	**31.75 (Above)**	31.17 **(Above)**	4.85 **(Above)**	42.25
1-1/2" (40)	48.56±0.10	48.11±0.10	**34.93 (Above)**	36.73 **(Above)**	5.08 **(Above)**	48.30
2" (50)	60.63±0.10	60.17±0.10	**38.1 (Above)**	47.78 **(Above)**	5.54 **(Above)**	60.35
2-1/2" (65)	73.38±0.15	72.85±0.15	**44.45 (Above)**	57.15 **(Above)**	7.01 **(Above)**	73.15
3" (80)	89.31±0.15	88.70±0.15	**47.63 (Above)**	71.63 **(Above)**	7.62 **(Above)**	89.05
4" (100)	114.76±0.20	114.07±0.20	**57.15 (Above)**	94.92 **(Above)**	8.56 **(Above)**	114.45

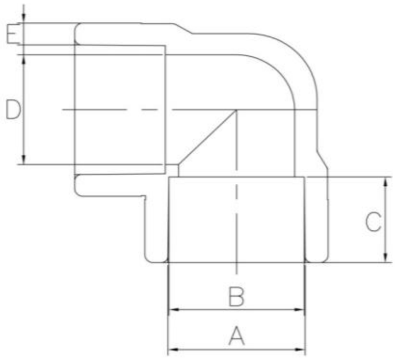
2. CPVC Piping System

1) Tee



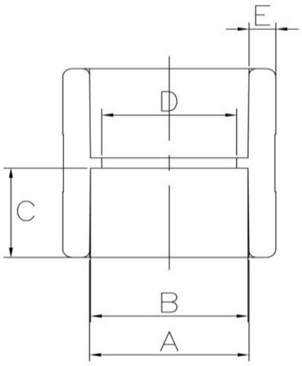
Name	Size	Code
Tee	25mm	1180201
	32mm	1180261
	40mm	1180228
	50mm	1180236
	65mm	1180239
	80mm	1180246

2) Elbow



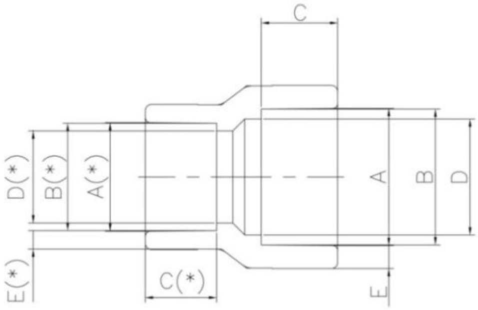
Name	Size	Code
Elbow	25mm	1180205
	32mm	1180206
	40mm	1180207
	50mm	1180208
	65mm	1180238
	80mm	1180245

3) Socket



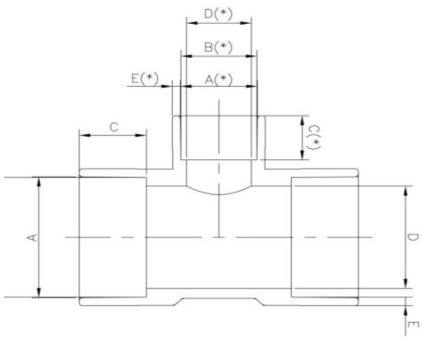
Name	Size	Code
Socket	25mm	1180209
	32mm	1180210
	40mm	1180211
	50mm	1180212
	65mm	1180237
	80mm	1180244

4) Socket Reducer



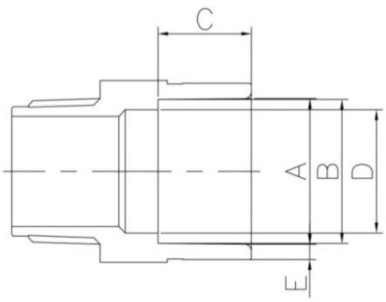
Name	Size	Code
Socket Reducer	32mm×25mm	1180213
	40mm×25mm	1180230
	40mm×32mm	1180214
	50mm×25mm	1180260
	50mm×40mm	1180215
	65mm×40mm	1180274
	65mm×50mm	1180242
	80mm×40mm	1180273
	80mm×50mm	1180272
	80mm×65mm	1180248

5) Branch Reduced Tee (BRT)



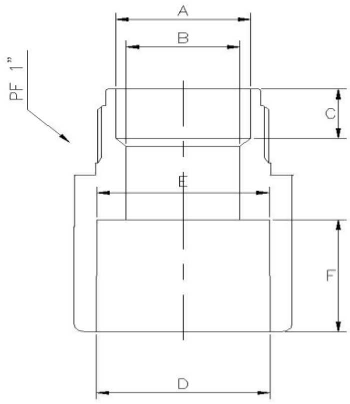
Name	Size	Code
BRT	32mm×25mm	1180202
	40mm×25mm	1180203
	40mm×32mm	1180259
	50mm×25mm	1180204
	50mm×32mm	1180227
	50mm×40mm	1180231
	65mm×25mm	1180251
	65mm×32mm	1180252
	65mm×40mm	1180253
	65mm×50mm	1180241
	80mm×25mm	1180255
	80mm×40mm	1180256
	80mm×50mm	1180257
	80mm×65mm	1180247

6) Valve Socket (PT)



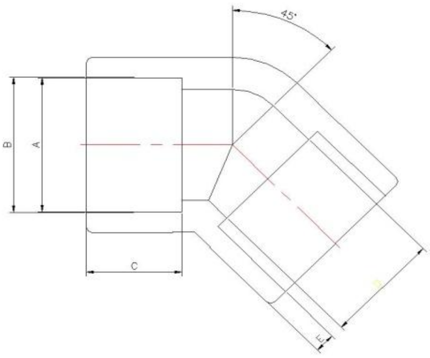
Name	Size	Code
Valve Socket	25mm	1180229
	32mm	1180218
	40mm	1180219
	50mm	1180220
	65mm	1180240
	80mm	1180249

7) Valve Socket (for connecting SP Joint)



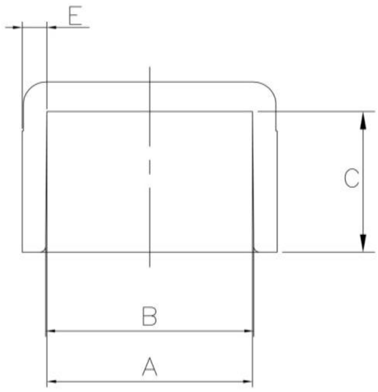
Name	Size	Code
Valve Socket (for SP joint : 11T)	25mm	1180217
Valve Socket (for SP joint : P1.5)	25mm	1180226

8) 45˚ Elbow



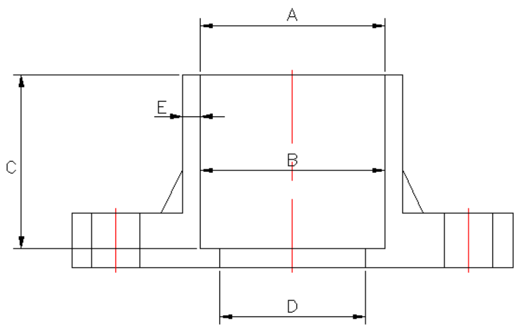
Name	Size	Code
45°Elbow	25mm	1180232
	32mm	1180233
	40mm	1180234
	50mm	1180235
	65mm	1180254
	80mm	1180258

9) Cap



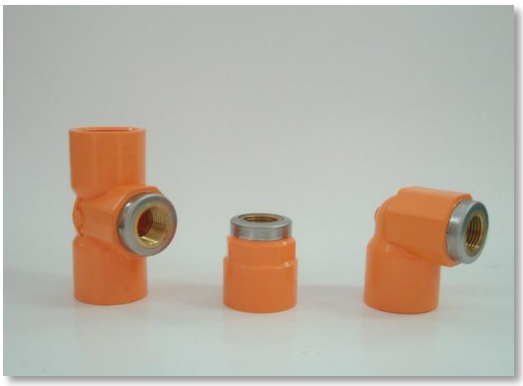
Name	Size	Code
Cap	25mm	1180221
	32mm	1180222
	40mm	1180223
	50mm	1180224

10) Flange



Name	Size	Code
Flange	40mm	1180275
	50mm	1180276
	65mm	1180243
	80mm	1180250

11) Fittigns for PT(1/2″)



Name	Size	Code
Socket	25mm×½″ (15mm)	1180269
Elbow	25mm×½″ (25mm)	1180270
Tee	25mm×½″ (15mm)	1180271

12) 30˚ Elbow / 60˚ Elbow

Name	Size	Code
30˚ Elbow	50mm	1180264
60˚ Elbow	50mm	1180265

13) Gasket

(For use with CPVC Flange)

Name	Size	Code
Gasket (For use with CPVC Flange)	40mm	1180313
	50mm	1180314
	65mm	1180307
	80mm	1180308

14) Solvent Cement

Name	Size	Code
Solvent Cement (Only for use with CPVC)	500g(KOR)	1180311
	1kg(KOR)	1180312
	500g(USA)	1180301
	1kg(USA)	1180302

15) Primer

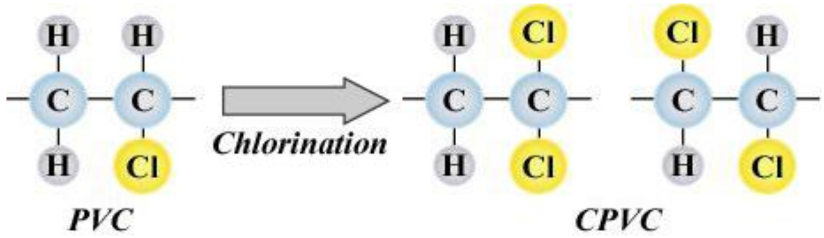
Name	Size	Code
Primer	500g	1180315
	1kg	1180316

3. CPVC Synthetic Resin Utilized Sprinkler Facility Technology

(1) Property of CPVC

1) What's CPVC (Chlorinated Polyvinyl Chloride)?

- CPVC is kind of chloride synthetic resin that marks an epoch in reinforcing thermal resistance, bar tolerance, impact resistance, mechanical strength and corrosion resistance, compared to the existing PVC.



* CPVC is made from ethylene generated from petroleum or natural gas and chloride salt.

2) Utility of CPVC

- Sprinkler Plumbing System (For firefighting) : Wet plumbing of light fire breaking area
- Plumbing System for Industrial Chemistry (For industrial utility)
  : Various kinds of acid and sewage discharging plumbing
- Plumbing System for cold & hot water (For construction) : Piping materials for drinking water

* CPVC has been applied to fire fighting field, construction field and other fields since CPVC used in the USA in 1959.

3) Basic Property of Matter

Property		Unit	Method of Test	PB	C-PVC
Physical Property	Specific Gravity	-	ASTM D1505	0.937	1.53
	Stiffness	D scale	ASTM D2240	60	140
	Absorption rate	mg/㎠	JIS K7209	Below 0.01	0.04~0.06
Mechanical Property	Tensile Strength	kgf/㎠	ASTM D638	170	500~550
	Modulus of Elasticity	kgf/㎠	ASTM D638	2700	30000
	Ratio of Poisson	-	-	0.38	0.38
	Impact Strength	kgf/㎠	JIS K7110	4.5	8.0
Thermal Property	Rate of Expansion	cm/cm℃	D696	1.3×10^{-4}	6.2×10^{-5}
	Specific Heat	cal/(g.℃)	-	0.5	0.2~0.3
	Thermal Conductivity	W/mk	C177	0.38	0.14
	Melting Point	℃	DTA	124~126	150~160
Electrical Property	Bulk Specific Resistance	Ω.cm	ASTM D257	Above 10^{17}	Above 10^{15}
	Withstanding Voltage	kV/mm	ASTM D149	38	Below 40

3. CPVC Synthetic Resin Utilized Sprinkler Facility Technology

(2) Characteristic of CPVC Plumbing

1) Corrosion Resistance and Hygiene

- No corrosion and scale: No rust and pipe clogging
 (Corrosion resistance is proved against various chemical environment such as acid, alkali, salt and halogen)

- CPVC material and conjugating adhesive are harmless to human body and ecology
 (It's used as plumbing for drinking water : Acknowledged by NSF)

- Bacteria is refrained from generating with antibacterial material

Copper Pipe

C-PVC Pipe

2) When CPVC is revealed to fire,

- Function of self-fire extinction is procured.
 (If CPVC burns, three times as much as the amount of oxygen is necessary at the present earth.)

- In case applying heat, CPVC never spreads fire and becomes ash.

- The toxicity of smoke occurs rarely more than common architectural materials
 (From the test result of burning from Pittsburgh University and environment)

Materials	Limited Rate of Oxygen	Remark
CPVC	60	Contents of Oxygen in the Air 21%
Surface	16~17	
PE	17	
PP	18	
PS	18	
PB	18	
White Birch	20	

*** Firing Test of CPVC Plumbing KFITI (Korea Fire Industry Technology Institute)**

- Initial temperature of Flame : 878℃ (1600˚F)
- Head of sprinkler is operated after 1 minute.

Inspection after firing test

- No damage occurred except that the surface of outer wall changed like charcoal.

- No change occurred on the inner wall of pipe and water passage.

- No error has occurred in giving some inner pressure under 12 bar (about 12kgf/㎠) since test for 5 minutes.

3) Low Rate of Friction Loss

- As CPVC plumbing has a greater fluid flowing coefficient(C), loss amount by friction is little.

Hazen – Williams Rule

$$f = 0.2038\left(\frac{100}{C}\right)^{1.852} \times \frac{g^{1.852}}{d^{4.8855}}$$

f: Loss by friction per 100ft of pipe
d: Inner diameter of pipe(inch)
g: Flux(gal/min)
c: Fluid flowing coefficient (degree of smoothness for the inner wall of pipe, no change occurs for the coefficient according to lapse (of time)

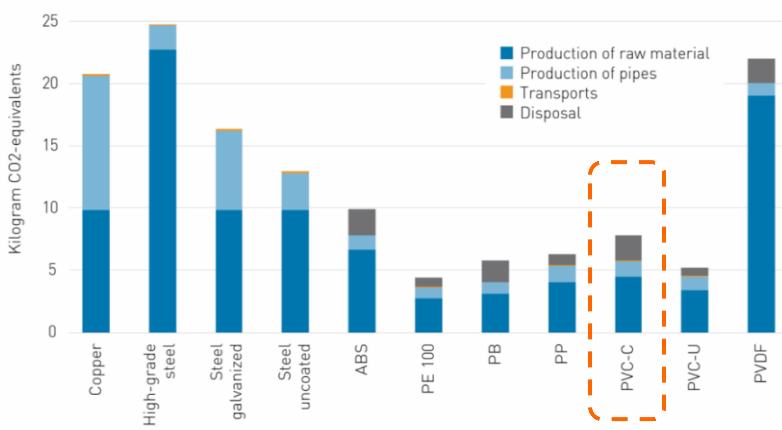
Quality of Material \ Flux (ℓ)	Loss amount by Pressure (m)				C (fluid flowing coefficient)
	3.78	18.92	37,85	75.70	
CPVC Pipe	0.10	1.94	6.99	25.24	150
Coper Pipe	0.13	2.52	9.11	32.90	130
Zinc Alloy Pipe	0.17	3.44	12.42	44.83	120
Cast Iron Pipe	0.21	4.10	14.81	53.48	100

※ Loss amount by pressure means fluidal pressure reduced amount per 1″ 30m.

4) Reduction of Loss of Heat and Greenhouse Gases

- As CPVC pipe has low thermal conductivity, it has excellent heat insulation effect and no dew condensation phenomenon.
- The noise in flowing water through CPVC pipe is rare and pressure occurred by water hammer is approximately 1/3 of steel pipe.
- As CPVC pipe has low discharging rate of CO_2, this pipe contributes to the reduction of greenhouse gases

Quality of Material	Thermal Conductivity (W/mk)
Steel Pipe	42.74
Copper Pipe	320
PB	0.22
PP-R	0.24
PE-X	0.41
CPVC	0.14



CO_2 Discharged Amount

5) Construction and Cost Efficiency

- Easy jointing with solvent bond
- CPVC pipe is light, easy to cut, assemble and install more than the existing plumbing material, so the cost of installation is cheap and there's no cost for replacement because of no corrosion and scale.

(3) Size of Product

1) Pipe

- ASTM 442 (SDR 13.5) suitable for the performance of US NFPA and domestic synthetic resin pipe for firefighting is applied.

Nominal Diameter		**Steel Pipe (KS D 3507)**			**Copper Pipe (KS D 5301)**			**CPVC (ASTM F442)**		
inch	mm	Outer Diameter	Inner Diameter	Thickness	Outer Diameter	Inner Diameter	Thickness	Outer Diameter	Inner Diameter	Thickness
1	25	34	27.5	3.25	28.58	26.04	1.27	33.4	28.48	2.46
1-1/4	32	42.7	36.2	3.25	34.92	32.12	1.4	42.16	35.92	3.12
1-1/2	40	48.6	42.1	3.25	41.28	38.24	1.52	48.26	41.10	3.58
2	50	60.5	53.2	3.65	53.98	50.24	1.78	60.33	51.39	4.47

※ SDR (Standard Volume Rate): Average rate of outer diameter per the thickness of pipe

2) Fittings

- ASTM F438 standard satisfying the size of pipe (ASTM F442) was adapted. (Minimum standard)

Nominal Diameter		**Pipe (F442)**			**Fitting (F438)**			**Remark**
inch	mm	Outer Diameter	Inner Diameter	Thickness	Outer Diameter	Inner Diameter	Thickness	The thickness of connecting fittings is 125% thicker than that of pipe. (Minimum thickness)
1	25	33.4	28.48	2.46	39.55	33.4	3.08	
1-1/4	32	42.16	35.92	3.12	49.96	42.16	3.90	
1-1/2	40	48.26	41.10	3.58	57.21	48.26	4.48	
2	50	60.33	51.39	4.47	71.51	60.33	5.59	

(4) Standard of Quality

- We use the product acknowledged by the standard of performance test for synthetic resin plumbing for firefighting noticed by minister of PAS(Public Administration & Security) [No. 1998-76, Notice of MOPAS (Ministry of Public Administration & Security), 1998. 8. 24]

No	Classification	Detailed Contents	Standard of Test	Remark
1	Shape & Structure	1) Structure & Outlook	Roundness and outlook should be more than standard	
2		1) Tensile Strength	After applying regular standard, The tensile strength should be 16N/㎟ at 15℃.	KS M 3006
3		2) Rupture Test	No crack should exist. (890N x 5min) No abnormality should exist for The inspection of inner pressure after the test.	
4		3) Bending Test	More than 75% of minimum bending radius isn't allowed.	18℃/21℃
5		4) Flame Retardation Efficiency	It's good to be classified into HB.	KS M 3015 C
6		5) Weatherproofing Efficiency	Foam, swelling and peeling aren't allowed.	Refer the standard of test
7		6) Fire Endurance Test	Explosion, separation and leakage aren't allowed.	Refer the standard of test
я		7) Impact Test	After revealing the pipe under -18℃, 0℃ and 20℃ for 24 hours. The pipe should be suitable for the inspection of pressure resistance after test.	The length of 0.9kg steel pole is 0.6m
9	Function & Strength	8) Test of Loss Amount by Impact	Install the barometer on the both sides of 6m pipe	
10		9) Water-hammer Test	After test alternation rate of 3,000 times should be done for the alternating rate of 0~maximum pressure per 10 minutes, no error isn't allowed in the test of inner pressure.	
11		10) Repetitive Test of Temperature	After revealing the pipe for 24 hours according to each temperature from the pressure of 3.5kg/㎠ water at 0 ~ maximum temperatures, test the 1st cycle for 5 times should be performed and satisfies the test of inner pressure.	Plumbing that 10 times of nominal diameter in length
12		11) Vibration Test	After applying water pressure of 1kg/㎠, vibration of 0.5m in amplitude and 25±5/sec for 5 hours, the pipe should satisfy the test condition of inner pressure	Plumbing of 1m
13		12) Internal Pressure Test	After applying 5 times as strong as the maximum utilized water pressure for 1 minute, no leakage or Metamorphosis is allowed.	

(5) Selection of Piping Diameter

- To calculate the diameter of plumbing and then select excellent diameter of plumbing, all the heads should satisfy the discharging amount of more than 80ℓ /min with a waterproofing pressure standard of 1kg/㎠. (Calculate the flow rate of branch plumbing at less than 6m/sec and the flow rate of other plumbing at less than 10m/sec.)

- The diameter of plumber should be calculated according to [asterisk 1] of fire safety standard for sprinkler.

(Unit of Diameter)

Classification \ Diameter	25	32	40	50	65	80	90	100	125	150
A	2	3	5	10	30	60	80	100	160	Above 161
B	2	4	7	15	30	60	65	100	160	Above 161
C	1	2	5	8	15	27	40	55	90	Above 91

A: The number of head in case of installing lockout-typed sprinkler
B: In case of installing lockout-typed sprinkler and establish the head under the ceiling and inside of the ceiling as an annex.
C: In case of installing the sprinkler to the place where the stage or specific inflammables are stored and managed.

(6) Thermal Expansion and Treatment of Expansions & Contractions

1) Formula about thermal expansion (△L)

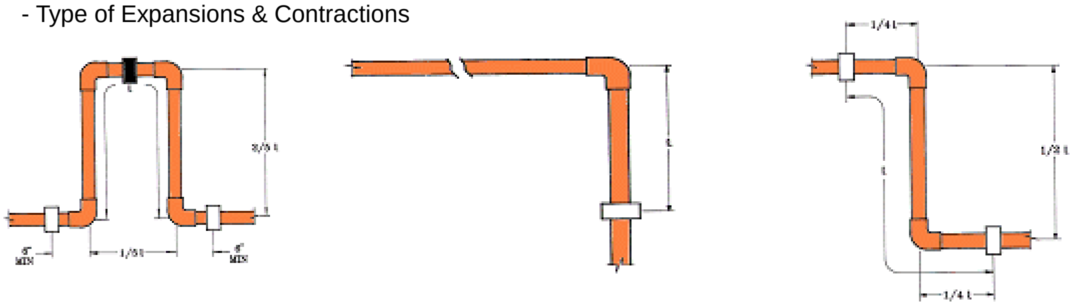
* CPVC pipe expands and contracts according to temperature like other quality of pipes.
(The coefficient of linear expansion is 0.000062cm/cm℃ and the efficient is applied to the dimension of CPVC pipe identically.)

△L = e · L · △T　　e : 6.2×10^{-5} cm/cm℃　　L : Length of Plumbing　　△T : Changing of Temperature

Changing of Temperature	Length of Plumbing(m)						
	1	2	4	10	20	30	40
	Thermal △L (cm)						
10	0.06	0.12	0.25	0.62	1.24	1.86	3.10
20	0.12	0.25	0.5	1.24	2.48	3.72	6.20
30	0.19	0.37	0.74	1.86	3.72	5.58	9.30
40	0.25	0.50	0.99	2.48	4.96	7.44	12.40
50	0.31	0.62	1.24	3.10	6.20	9.30	15.50

2) Calculation of Expansions & Contractions

- Type of Expansions & Contractions



- Pipe Outside Diameter

Dimension(Inch) / Classification	1/2	3/4	1	1-1/4	1-1/2	2
Inch	0.84	1.05	1.32	1.66	1.90	2.38
cm	2.1	2.7	3.3	4.2	4.8	6.0

- Allowable Stress and Expansion & Contraction

Temperature(℃) / Classification	23	38	49	60	71	82
E	25.664	25.032	24.329	23.203	21.656	19.688
S	141	113	91	70	53	35

- Formula

$\ell = (3 E D \triangle L / 2S)1/2$	
ℓ = Length of Expansion & Contraction (㎝) E = Coefficient of Expansion & Contraction (kgf/㎠) D = The average outer diameter of the pipe (㎝)	△L = Change of Length According to Temperature (㎝) S = Maximum Allowable Pressure (kgf/㎠) △

- Example of Expansion & Contraction by Temper
If △T=15℃, (23℃ - 38℃)

Classification / Dimension	Length of Plumbing (m)												
	3	6	9	12	15	18	21	24	27	30	36	42	48
	(㎝) : ℓ												
½"	14	19	24	28	31	34	37	39	42	44	48	52	56
¾"	15	22	27	31	35	38	41	44	47	49	54	58	62
1 "	17	24	30	35	39	42	46	49	52	55	60	65	70
1 ¼"	19	27	34	39	44	48	52	55	59	62	68	73	78
1 ½"	21	29	36	42	47	51	55	59	63	66	73	78	84
2 "	23	33	40	47	52	57	62	66	70	74	81	88	94

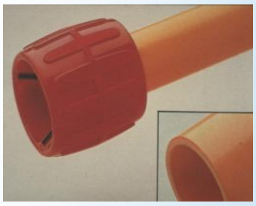
(7) Plumbing Installation

1) Assembling & Connecting Method of CPVC Pipe

1) Cut the pipe.

• Don’t use the pipe or connect fittings having grooves or scratches.

• Don’t cut the cut part at an angle.



2) Remove burrs.

• Remove the inside or outside part of the pipe and impurities.

3) Apply adhesive.(Pipe)

• Apply the adhesive on the area of 1/2 of pipe.

•Apply the adhesive on the end of pipe thickly.

•Apply the adhesive on the pipe with the brush 2 or 3 times.

4) Apply adhesive.
(Connecting fittings)

• Apply the adhesive on the inside of fittings thinly and evenly.

•Apply the adhesive on the fittings with the brush 2 or 3 times.

5) Assemble the pipes.

• When inserting the pipe into the fittings, insert and turn the pipe 1/4 circle, and leave the pipe for 10~15 seconds.

•Confirm if bubbles exist on the assembled parts.

•In case of assembling nut/bolt, wind teflon tape on the bolt enough.

6) Observe hardening period.

•Observe the initial Hardening and full hardening time by all means.

•In case of applying any treatment and pressure, any breakage may occur.

How to Treat exclusive CPVC Adhesive

- Keeping the pipes and fittings, clean, apply the adhesive after removing any moisture.
- Don’t use the adhesive excessively. (Resistance of flowing)
- Don’t use the solid or jelly type adhesive.
- Be careful of sparks and flames.
- Close the cap after using the adhesive.
- Avoid contact from eyes/skin from the adhesive.
- Observe the minimum lapse time after connecting the pipe to the fittings.

2) Construction of Pipe

* Data of Hardening & Using Amount of Adhesive

• Initial Hardening Period (Average Initial Setting Schedule)

Coverage of Temperature	Dimension of Pipe	Dimension of Pipe
	½″~1 ¼″	1 ½″~2″
15~38℃	2 Minutes	5 Minutes
4~15℃	5 Minutes	10 Minutes
-17~4℃	10 Minutes	15 Minutes

Note : Initial hardening period means the period that you should observe before moving the connected part after connecting the initial pipe to the fittings. Namely, you can move the connected parts after observing the initial hardening time according to each size.
Only, you should apply the period of one and half times to each initial hardening period in the humid weather.

• Average Hardening Period (Average Joint Cure Schedule)

Less than relative humidity of 60%	Hardening Period ½″~1 ¼″		Hardening Period 1 ½″~2″	
Peripheral Temperature in Connecting the Pipe & Fittings	~11kg/㎠	11~26 kg/ ㎠	~11 kg/㎠	11~22 kg/㎠
15~38℃	15 Minutes	6 Hours	30 Minutes	12 Hours
4~15℃	20 Minutes	12 Hours	45 Minutes	24 Hours
-17~4℃	30 Minutes	48 Hours	1 Hours	96 Hours

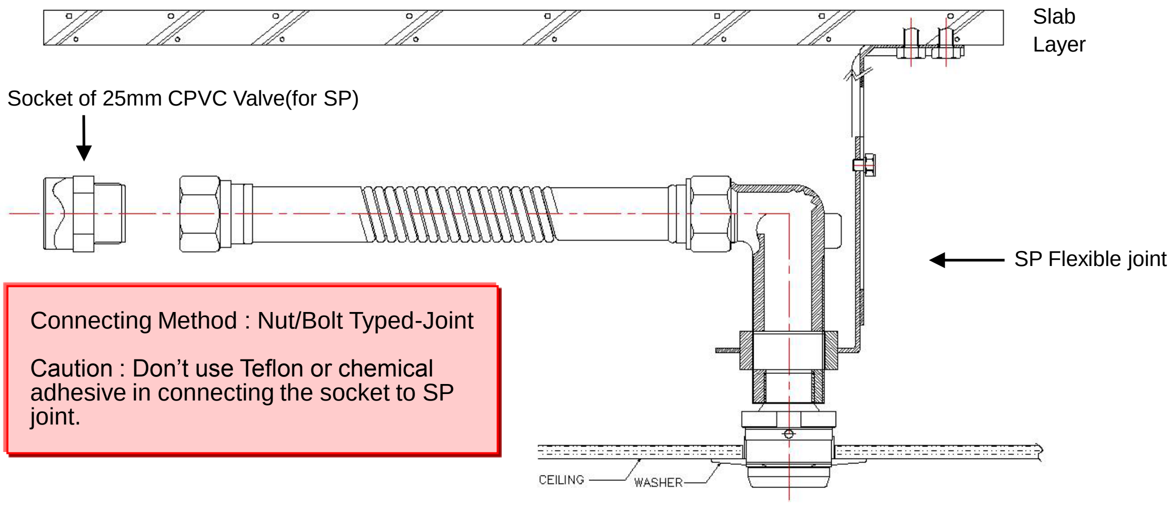
Note : Hardening period of connected part means the minimum time before applying any pressure to the pipe. Only, you should apply the period of one and half times to each initial hardening period in the humid weather.
*This value came from the laboratory, not from the site. In case you use the pipe for convoying chemicals, above values may be incorrect and the hardening period needs mostly more than the above values. As there are different variables at the real site, you should make use of the above h ardening period as general guidance. (Namely, minimum due hardening period)

• Number of Connectable Fittings per 1 unit (solvent cement) (Average Number or Joint/Qt.)

Dimension of Pipe	½″	¾″	1″	1 ½″	2″	3″	4″	6″	8″	10″
Number of Connections	300	200	125	90	60	40	30	10	5	2~3

Note (In Case of Primer) **:** Primer can be used twice as much as solvent cement on the connections by each dimension. The above values came from the laboratory, not from the site. As there are different variables at the real site, you should make use of the above hardening period as general guidance.

3) Method of Connecting Sprinkler (In case of connecting SP Flexible Joint)



Connecting Method : Nut/Bolt Typed-Joint

Caution : Don't use Teflon or chemical adhesive in connecting the socket to SP joint.

1) In case of connecting SP flexible joint in a household, connect CPVC to nut typed joint.
2) Connect CPVC 25mm valve socket to CPVE directly after remove the nipple of SP flexible joint.
3) CPVC valve socket can be classified in accordance with the type of SP jointing nut
   ▶ 'inch' dimension of SP joint: 11 threaded CPVC (25mm) valve socket
   ▶ 'mm' dimension of SP joint: P1.5 CPVC (25mm) valve socket
4) Don't use Teflon or chemical adhesive in connecting the socket to SP joint.
   ▶ In case of applying Teflon, any leakage may happen because the valve socket doesn't stick to the o-ring of SP joint.

4) Connecting to the Other Material

1) In case of connecting to the other material (steel pipe), joint the pipe, connecting CPVC valve socket (PT bolt type) to a steel socket.

2) In case of connecting CPVC valve socket to a steel socket, connect them after applying Teflon to the valve socket.

5) Hanger & Backstay Device (NFPA 13, NFPA 13R)

-According to the standard of NFPA 13 and NFPA 13R Design the hanger to bear the weight that 250ℓb (113kg) is added to the weight of 5 times as heavy as the pipe of sprinkler filled with water at each back stay point.

- Recommendable minimum area of hanger is 12.2mm (0.5in).

- In case of operating a sprinkler, determine the interval of backstay for the synthetic resin pipe narrowly, considering the reactive power of discharged water.

※ Interval of Backstay by pipe

Material of Sprinkler	Dimension * (mm)						
	DN20	DN25	DN32	DN40	DN50	DN65	DN80
	Interval of Backstay * (M)						
Steel Pipe (Connected by Welding)	N/A	3.7	3.7	4.6	4.6	4.6	4.6
Steel Pipe (Connected by Bolt/Nut)	N/A	3.7	3.7	3.7	3.7	3.7	3.7
Copper Pipe	2.4	2.4	3.0	3.0	3.7	3.7	3.7
CPVC Pipe	1.7	1.8	2.0	2.1	2.4	2.7	3.0

6) Test of Water Pressure

- Keep the hydraulic pressure test at 20kg/㎠ which is one and half times of 12.3kg/㎠, maximum utilized pressure.

- Maintain the hydraulic pressure for test below 3kg/㎠ in case of applying air or compressed air in winter.

- Use glycerin as anti-freezing solution for the test of water pressure in winter.

7) Preventive Countermeasure of Freeze

To prevent freezing, you can refer several methods such as pipe design, insulating materials, lagging materials and self-regulating heat cable. However, as it's difficult to apply lagging materials fo r indoor/outdoor piping, you'd better use an engineering with self-regulating heat cable preventing Dew condensation, providing regular amount of thermal energy. You don't need to apply lagging treatment for the pipes inside of household and should observe the depth of Dew condensation for the pipe installed under the ground.

8) Cautions in Treating the Products

◆ In processing CPVC pipe with heat, higher temperatures more than PVC pipe and thermal processing at the site makes the surface of pipe deteriorate, so you should process the sleeve and band with heat after consulting with the related main office.

◆ In case of maintaining CPVC pipe and fittings, cover with a pavilion to avoid a direct ray of light and heat.

◆ Don't use grooved or scarred pipe or fittings. Also, don't apply nut/bolt to the fittings directly.

◆ In cutting pipe, use a cutter for exclusive use(below the standard of 2 inches) or grinding stone cutter. (Don't use a metal cutter.)

◆ Don't cut the pipe at a tilt or remove the burr or impurities on the end of cut pipe because it is the cause of leakage or crack in connecting the pipe to the joint.

◆ Don't spray or apply the agents such as acetone, thinner, creosote and insecticide affecting harmfulness on the pipe.

◆ Be careful not to drop while transporting or piping with tools as impact strength is very strong.

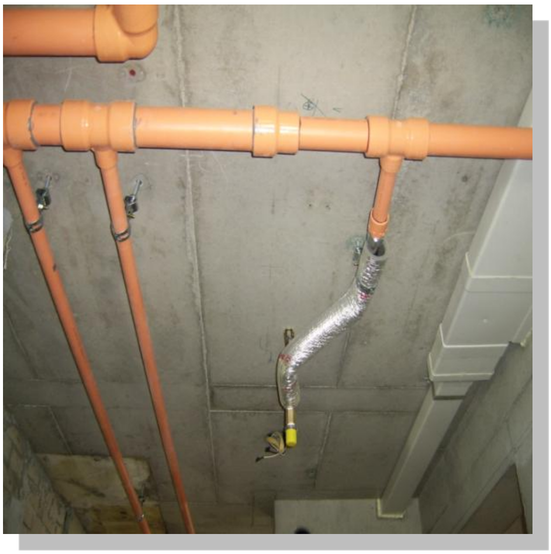
◆ In case of connecting M valve socket (25mm) to SP joint, avoid Teflon or adhesive on the thread of bolt/nut. (Any leakage may occur due to the damage of o-ring.)

3. CPVC Synthetic Resin Utilized Sprinkler Facility Technology

9) Example of CPVC Piping

Sprinkler Pipes of Apartment

Sprinkler Pipes of Apartment



Sprinkler Pipes of Apartment

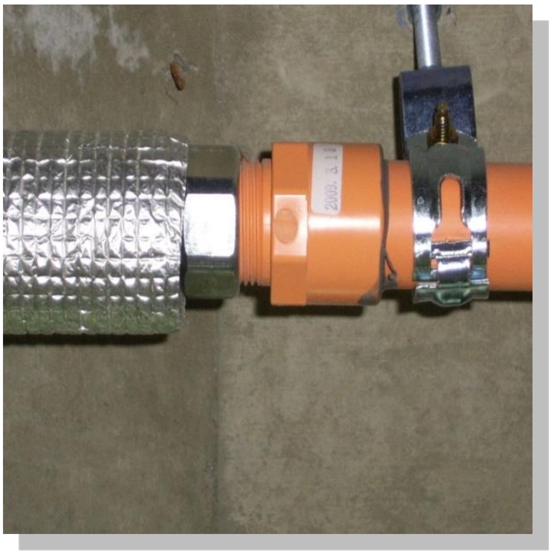
Pipes of Gray water Treating Facility

10) Example of CPVC Piping

SP Joint Connecting Pipe

SP Joint Connecting Pipe

SP Joint Connecting Pipe



CPVC Valve Socket + Sp Joint

11) Example of CPVC Piping

Connecting to Other Materials (Steel Pipe)

Connecting to Other Materials (Steel Pipe)

Connecting to Other Materials (Brass Fitting)

Connecting to Other Materials
(Water hammer Arrest)

(8) Examination of Dew condensation

① Present condition of the lagging material for the fire pipe of sprinkler in the apartment

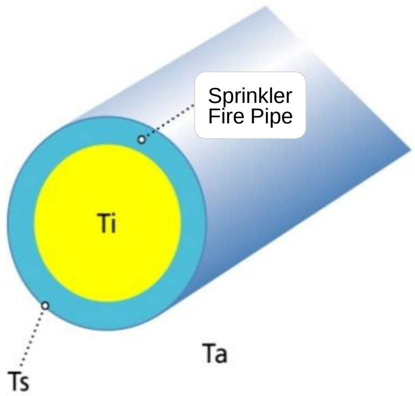
ⓐ Regulations related to Fire Law according to construction of lagging materials
- Regulations : Article 8, Fire Safety Standard of Sprinkler
- Contents : Materials should be installed at the place where any countermeasure for preventing freezing or no freezing occurs.

ⓑ Research of the example for the lagging materials

Classification		Piping Material	Construction of Lagging materials	Remark
Public Housing	J Construction	Copper Pipe + SP Joint	Foaming PE 10t	
	S Construction	Copper Pipe + SP Joint	Foaming PE 10t	
Private Housing	H Construction	Steel Pipe + SP Joint	Foaming PE 10t	
	HR Construction	C-PVC + SP Joint	Foaming PE 10t	
	G Construction	Steel Pipe + SP Joint	Foaming PE 10t	

② Examination of Dew condensation for Main Pipe

ⓐ Examination of Determining Dew condensation



Ts : Surface Temperature of Pipe (℃)
Ta : Indoor Temperature for Residence (℃)
Ti : Temperature of Water in the Pipe (℃)
T" : Dew Point Temperature (℃)
λ : Thermal Conductivity (W/mk)
α : Convection Current Coefficient of Surface (w/m^2k)
Di : Inner Diameter of Pipe (мм)
Do : Outer Diameter of Pipe (мм)

$$T_s = T_a + \frac{T_i - T_a}{1 + \frac{\alpha}{2\lambda} \ln \frac{D_o}{D_i} \cdot D_o}$$

(KS F 2803)

∴ Condition of Dew Condensation
: Surface Temperature(Ts) ≤ Dew Point Temperature(T")

ⓑ Examination of Dew condensation for Main Pipe

- Comparison of Specification by Each Pipe Material (Φ25mm)

Classification		Steel Pipe	Copper Pipe	C-PVC Pipe	Remark
λ	Thermal Conductivity (W/mk)	42.74	320	0.137	
α	Convection Current Coefficient of Surface(W/㎡K)	8	8	5.7	
Di	Inner Diameter(mm)	27.5	26.4	28.48	
Do	Outer Diameter(mm)	34.0	28.58	33.4	

- Examination of Dew Condensation by Each Pipe Material

Unit of Temperature : ℃

Ti	Indoor Temperature & Humidity		Surface Temperature of Pipe			Dew condensation
	Dry-bulb Temperature (Ta)	Dew Point Temperature (T″) (Relative Humidity 70%)	Steel Pipe	Copper Pipe	C-PVC Pipe	
5	0	-4.2	2.7	3.6	0.0	
5	10	4.8	7.3	6.4	10.0	Steel Pipe, Copper Pipe
5	20	14.4	11.9	9.1	19.9	Steel Pipe, Copper Pipe
10	5	0	7.7	8.6	5.0	
10	10	4.8	10.0	10.0	10.0	
10	20	14.4	14.6	12.7	19.9	Copper Pipe
10	30	23.9	19.2	15.4	29.8	Steel Pipe, Copper Pipe
15	10	4.8	12.7	13.6	10.0	
15	20	14.4	17.3	16.4	20.0	Steel Pipe, Copper Pipe
15	30	23.9	21.9	19.1	29.9	Steel Pipe, Copper Pipe
20	10	4.8	15.4	17.3	10.0	
20	20	14.4	20.0	20.0	20.0	
20	30	23.9	24.6	22.7	29.9	Steel Pipe, Copper Pipe

DONGBU INSURANCE CO., LTD.

DONGBU FINANCIAL CENTER #891-10, DAECHI-DONG, GANGNAM-GU, SEOUL, KOREA
TELEPHONE : 1588-0100 FAX : 2262-3439

PRODUCTS/COMPLETED OPERATIONS LIABILITY POLICY

POLICY NO. : **472100000154000**

NAMED INSURED : ㈜애강리메텍
MAILING ADDRESS : 충남 아산시 음봉면 월랑리 #151-1
FORM OF BUSINESS :
☐Individual ☐Partnership ☐Joint Venture ▣Organization (Other Than Partnership or Joint Venture)
BUSINESS DESCRIPTION : Manufacturing

POLICY PERIOD : **From** Dec. 29, 2010 **To** Dec. 29, 2011
at 12:01 A.M. Standard Time at your mailing address shown above.

RETROACTIVE DATE (CLAIMS-MADE BASIS ONLY)
Coverage A of this insurance does not apply to "bodily injury" or "property damage" which occurs before the Retroactive Date, if any, shown below.

RETROACTIVE DATE : **: 2000.12.29 and 2005.12.29 iro Canada**

LIMITS OF INSURANCE (Combined Single Limit)

USD 1,000,000.-any one claim / in the aggregate

ORIGINAL

PREMIUM BASIS : **Estimated Annual Turnover : KRW 52,000,000,000.-**
PREMIUM : **USD 19,480.-**
ENDORSEMENT ATTACHED TO THIS POLICY : Refer to the attached

IN WITNESS WHEREOF **DONGBU INSURANCE CO., LTD. SEOUL, KOREA** has caused this policy to be signed by its President or authorized representative, and countersigned on the Declarations page by a duly authorized representative.

대한민국정부
인 지 세
1 0 0 원
삼 성 세무서
후납승인2004-3

DONGBU INSURANCE CO., LTD.

Countersigned at Seoul, Korea
this 24th day of Jan. 2011

BY Jeongnam Kim

Authorized Representative

4. Product/completed Operations Liability Policy

SCHEDULE

1. POLICY NO.	**472100000154000**
2. INSURED	**(주)에강리메텍**
3. RISKS	Product Liability to the third party arising out of the Insured's product manufactured and exported to the coverage territory through vendors by the Insured. ■ **Product Item Covered : Pipes, Conncetors, etc (PB, PPC, DX & XL, PIPE/FITTINGS/MAINFOLD/TAP PLATE, etc)**
4. MAILING ADDRESS	충남 아산시 음봉면 월랑리 #151-1
5. PERIOD	From Dec. 29, 2010 To Dec. 29 , 2011 (1 year) at 12:01 A.M. Standard Time at your mailing address shown above.
6. LIMIT OF LIABILITY	Combined Single Limit : USD 1,000,000.-any one claim / in the aggregate (단일보상한도 : USD 1,000,000.-1 청구당 / 연간보상총액)
7. DEDUCTIBLE	USD 5,000.-any one claim (USD 5,000.-1 청구당)
8. TERMS & CONDITIONS	1) Product/Completed Operations Liability(II) - Claims Made Basis 2) Additional Insured(Vendors) Clause 3) Punitive Damage Exclusion Clause 4) Premium/Claim Payment Clause 5) Deductible Liability Insurance Clause 6) Millennium Exclusion Clause 7) Costs & Expenses are included within the limit of liability 8) Total Pollution Liability Exclusion 9) Terrorism Exclusion Clause 10) EMF Exclusion Clause 11) Inefficacy Clause 12) Product Guarantee Exclusion 13) Estimated Annual Turnover : KRW 52,000,000,000.- 14) Nuclear Energy Liability Exclusion Clause 15) Asbestos Exclusion Clause 16) Retroactive Date : 2000.12.29 and 2005.12.29 iro Canada 17) Territory & Jurisdiction : Worldwide excluding USA
9. PREMIUM	**USD 19,480.-**

ORIGINAL

Issued on : Jan. 24, 2011

DONGBU INSURANCE CO., LTD.

Jeongnam Kim

Authorized Representative

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