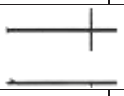
4. PVC-U Mini-Manhole Product Lineup

Code No.	Abbreviation		Size			Pipe Connection
5409-0100-0151	ST 		100	—	150	Solvent cement joint
5409-0100-0200			100	—	200	Solvent cement joint
5409-0150-1201			150	—	200	Solvent cement joint
1592-2150-1301			150	—	300	Rubber ring joint
1592-2200-1301			200	—	300	Rubber ring joint
5202-0100-1200	90L 	Left	100	—	200	Solvent cement joint
1593-9015-1301		Left	150	—	300	Rubber ring joint
1593-9020-1301		Left	200	—	300	Rubber ring joint
5202-0100-2200		Right	100	—	200	Solvent cement joint
1593-9015-2301		Right	150	—	300	Rubber ring joint
1593-9020-2301		Right	200	—	300	Rubber ring joint
5202-0100-0150		Left/Right	100	—	150	Solvent cement joint
5202-0150-0200		Left/Right	150	—	200	Solvent cement joint
5203-0100-1200	45L 	Left	100	—	200	Solvent cement joint
5203-0150-1200		Left	150	—	200	Solvent cement joint
1593-4515-1301		Left	150	—	300	Rubber ring joint
1593-4520-1301		Left	200	—	300	Rubber ring joint
5203-0100-2200		Right	100	—	200	Solvent cement joint
5203-0150-2200		Right	150	—	200	Solvent cement joint
1593-4515-2301		Right	150	—	300	Rubber ring joint
1593-4520-2301		Right	200	—	300	Rubber ring joint
5203-0100-0150		Left/Right	100		150	Solvent cement joint
5205-0100-1150	90Y 	Left	100	—	150	Solvent cement joint
5205-0100-1200		Left	100	—	200	Solvent cement joint
5205-0150-1200		Left	150	—	200	Solvent cement joint
5205-0100-2150		Right	100	—	150	Solvent cement joint
5205-0100-2200		Right	100	—	200	Solvent cement joint
5205-0150-2200		Right	150	—	200	Solvent cement joint
5207-0100-1150	45Y 	Left	100	—	150	Solvent cement joint
5207-0150-1200		Left	150	—	200	Solvent cement joint
5207-0100-2150		Right	100	—	150	Solvent cement joint
5207-0150-2200		Right	150	—	200	Solvent cement joint
5206-0100-1150	90YS 	Left	100	—	150	Solvent cement joint
5206-0100-2150		Right	100	—	150	Solvent cement joint
5227-0100-0150	WY 		100	—	150	Solvent cement joint
5209-0100-0150	WLS 		100	—	150	Solvent cement joint
5881-6151-0000	AI Light with Chain 		150			
5881-6121-0000			200			
5881-6131-0000			300			
5685-0200-9001	Inner Cover (CV-R) 		200			
5685-0300-0001			300			
6527-0120-0001	Cast Iron Cover 	T25A	200			
6527-0130-0001			300			
6528-0120-0001		T14A	200			
6528-0130-0001			300			
6529-0120-0001		T8A	200			
6529-0130-0001			300			
6710-0000-9000	Cast Iron Cover Opening/ Closing Jig 					
6730-0200-9000	Cast Iron Cover Frame 	For T25A and T14A	200			
6730-0300-0000			300			
6731-0200-9000		For T8A	200			
6731-0300-9000			300			

Caution **About the "left" and "right" designations for Mini-Manhole products**

Left	Right	Left/Right
Upstream side  Downstream side Direction of view 	Upstream side  Downstream side Direction of view 	 Can be used in either direction.

The arrow indicates the direction of water flow.

1. Vinyl-Base Adhesives

⚠ The adhesive must not be mixed with other adhesive. If the adhesive is mixed with other adhesive or a solvent, the adhesive strength decreases significantly.

Usage range of nominal diameters covered by supplied brush

Can size	Guideline range of nominal diameter
100 g	13~50
500 g	13~50
1kg	65~150

Tough dyne HI — Code No. 1039

Product conforms to Japan Water Works Association's standards JWWA S101


100 g can (with brush) 500 g can (with brush) 1 kg can (with brush)

Use Bonding of HI products (can be used on general pipes and fittings)
Property Low viscosity (A), quick drying (viscosity: 500 MPa·s)
Color Colorless

Tough dyne HI (White) — Code No. 1039

Product conforms to Japan Water Works Association's standards JWWA S101


500 g can (with brush) 1 kg can (with brush)

Use Bonding of HI products (can be used on general pipes and fittings)
Property Low viscosity (A), quick drying (viscosity: 500 MPa·s)
Color White

Tough dyne Red — Code No. 1039

Product conforms to Japan Water Works Association's standards JWWA S101


500 g can (with brush) 1 kg can (with brush)

Use Bonding of general pipes and fittings
Property High viscosity (B), quick drying (viscosity: 1,700 MPa·s)
Color Colorless

⚠ Caution
- **This adhesive cannot be used to bond HI products.**

Tough dyne Blue — Code No. 1039

Product conforms to Japan Water Works Association's standards JWWA S101


100 g can (with brush) 500 g can (with brush) 1 kg can (with brush)

Use Bonding of general pipes and fittings
Property Low viscosity (A), quick drying (viscosity: 150 MPa·s)
Color Colorless

⚠ Caution
- **This adhesive dries quickly; therefore, it is not suitable for bonding pipes with nominal diameter of 200 and more.**
- **This adhesive cannot be used to bond HI products.**

Tough dyne HT — Code No. 2039

Product conforms to the manufacturer's standards


100 g can (with brush) 250 g can (with brush) 500 g can (with brush)

Use Bonding of HT products
Property Low viscosity, quick drying (viscosity: 500 MPa·s)
Color Colorless

⚠ Caution
- **This adhesive cannot be used to bond general pipes/fittings or HI products.**

(Note) Expiration date is indicated only on the Tough dyne HT can. Please check the expiration date before using.

Color Tough dyne Blue — Code No. 1039

Product conforms to the manufacturer's standards


500 g can (with brush) 1 kg can (with brush)

Use Bonding of DV fittings
Property Low viscosity, quick drying (viscosity: 500 MPa·s)
Color Blue

⚠ Caution
- **Use Tough dyne Yellow for drain pipes with nominal diameter of 200 and more.**
- This adhesive must not be used to bond pipes and fittings for water supply such as for drinking water.
- **Be sure to wipe off the adhesive adhered on the base material. The dye contained in the adhesive penetrates the sheet over time. As a result, the blue dye appears on the surface.**

Tough dyne Yellow — Code No. 1039

Product conforms to the manufacturer's standards


1 kg can (with brush) 3 kg can

Use Bonding of general pipes and fittings (nominal diameter of 200 and more)
Property High viscosity, slow drying (viscosity: 1,000 MPa·s)
Color Colorless

⚠ Caution
- **This adhesive must not be used to bond pipes and fittings for water supply such as for drinking water.**
- **When applying to pipes with large diameters, pour a necessary amount of adhesive into a different metal container and use a large brush.**

2. Selection of Vinyl-Base Adhesive to Use

◎Recommended ○Usable × Cannot be used

Pipeline Classification	Pressurized Pipeline						Nonpressurized Pipeline		
Application Classification	Water Supply/Hot Water Supply			General Pressurized Pipe			Drain and Vent		
Pipe Product Classification	HI Product	General Pipe	HT Product	HI Product	General Pipe		HT Product	General Pipe	
Nominal Diameter Classification	150 and less			150 and less	150 and less	200 and more (Note 1)	150 and less	150 and less	200 and more (Note 1)
Tough dyne HI	◎	○	×	◎	○	×	×	○	×
Tough dyne HI (White)	◎	○	×	◎	○	×	×	○	×
Tough dyne Red	×	○ (Note 4)	×	×	○ (Note 4)	◎	×	○ (Note 4)	◎
Tough dyne Blue	×	◎	×	×	◎	× (Note 2)	×	◎	× (Note 2)
Tough dyne HT	×	×	◎	×	×	×	◎ (Note 3)	×	×
Color Tough dyne Blue	×	×	×	×	◎	×	×	◎	× (Note 2)
Tough dyne Yellow	×	×	×	×	×	◎ (Note 2)	×	×	◎

Note 1. When applying the adhesive to pipes with nominal diameter of 200 and more, pour a necessary amount of adhesive into a different metal container and use a large brush.
Note 2. Tough dyne Blue and Color Tough dyne Blue dry quickly; therefore, they are not suitable for bonding pipes with nominal diameter of 200 and more.
Note 3. When bonding HT-DV products to general pipes, such as for the connection of the drain pipe from a dishwasher, use Tough dyne HT.
Note 4. Tough dyne Red is recommended for nominal diameters of 65 and more.
Note 5. Tough dyne Yellow must not be used to bond pipes and fittings for water supply such as for drinking water.
Note 6. Use Tough dyne HI for HI pipes and fittings with nominal diameter of 200 and more.

3. Lubricants for Rubber Ring Joints

V Soap

Code No. 7000 Product conforms to the manufacturer's standards

1 kg resin container (with brush)

2 kg resin container

Use Connecting pipes to fittings with rubber ring
Property Liquid
Main component Potassium soap

V Spray

Code No. 7000 Product conforms to the manufacturer's standards


340ml

Use Connecting pipes to fittings with rubber ring
Property Spray
Main component Silicone oil

4. Amount of Adhesive and Lubricant to Apply

1. The amount of adhesive/lubricant indicated in the tables are guideline figures. When ordering, add 20% to 30% more to compensate for the loss that can occur at the construction site.
2. The indicated amount is the amount applied on the socket and pipe at one location.

Amount of vinyl-base adhesive to apply (reference)

For TS socket g/location

Nominal Dia.	13	16	20	25	28	30	35	40	50	65	75	100	125	150	200	250	300	350	400	450	500	600
Tough dyne HI/ HI (White)	0.6	0.8	1.1	1.6	—	2.1	—	3.3	4.8	6.6	8.1	13	20	30	55	—	—	—	—	—	—	—
Tough dyne Red	0.9	1.2	1.7	2.4	2.6	3.2	3.5	5.0	7.1	9.9	12	20	30	45	80	130	180	—	—	—	—	—
Tough dyne Blue	0.6	0.8	1.1	1.6	1.7	2.1	2.3	3.3	4.8	6.6	8.1	13	20	30	—	—	—	—	—	—	—	—
Tough dyne HT	0.6	0.8	1.1	1.6	—	2.1	—	3.3	4.8	6.6	8.1	13	20	30	—	—	—	—	—	—	—	—
Tough dyne Yellow	—	—	—	—	—	—	—	—	—	—	—	—	—	—	70	105	150	205	265	330	410	595

Note The indicated amount is for a surface area of $1m^2$. The amount in the table were calculated based on 300 g for Tough dyne Red, 200 g for Tough dyne HI and Tough dyne HI (White) , and 250 g for Tough dyne Yellow.

For DV socket g/location

Nominal Dia.	20	25	40	50	65	75	100	125	150	200	250	300	350	400	450	500	600	700
Tough dyne Blue	—	—	4	5	7	10	15	20	30	—	—	—	—	—	—	—	—	—
Color Tough dyne Blue	—	—	4	5	7	10	15	20	30	—	—	—	—	—	—	—	—	—
Tough dyne HT	0.8	1.1	4	5	—	10	—	—	—	—	—	—	—	—	—	—	—	—
Tough dyne Yellow	—	—	—	—	—	—	—	—	—	55	90	125	175	220	275	350	525	700

Amount of lubricant for rubber ring joint to apply (reference)

g/location

Nominal Dia.	40	50	75	100	125	150	200	250	300	350	400	450	500	600
Amount of V Soap used	5	5	7	10	15	20	25	35	50	65	90	115	140	190

Number of application locations per can

Nominal Dia.	150	200	250
Number of joint location per V Spray can	35	23	15

IPerformance and Quality

1. Operating Temperature and Pressure

(1) Operating temperature ranges and operating pressure for HI-VP, VP, VU and major fittings

Pipe	Major fitting	Use	Operating temperature range (see notes)		Operating pressure range (see notes)
HI-VP pipe for water supply VP pipe for water supply	HI-TS fitting TS fitting	Water pipe	Ordinary temperature (5 - 35ºC)		0.75 MPa (hydrostatic pressure)
VP pipe for general purposes	TS fitting	Pressure pipe	Ordinary temperature (5 - 35ºC)		1.0 MPa (hydrostatic + water hammer pressure)
	DV fitting	Non-pressure pipe	W/o external pressure	5 - 60 ºC	–
			W/ external pressure	5 - 45 ºC	
VU pipe for general purposes	VU fitting	Non-pressure pipe	W/o external pressure	5 - 60 ºC	–
			W/ external pressure	5 - 45 ºC	

Notes: 1. The operating temperature range and pressure may vary with the fitting type or joint technique.
2. Since PVC-U pipes expand and contract due to temperature differences, exposed PVC-U pipes require a means to absorb thermal expansion and contraction.

(2) Maximum operating pressures for HT pipes at various temperature

Use	Nominal Dia	Max. operating pressure various temperatures (hydrostatic + water hammer pressure)				
Pipes for hot water and hot-spring water supply (pressure pipe)	13-50	Operating temperature (ºC)	50-40	41-60	61-70	71-90 (see Notes)
		Max. operating pressure	1.0 MPa	0.6 MPa	0.4 MPa	0.2 MPa
	65-150	Operating temperature (ºC)	50-40	41-60	61-70	71-85 (see Notes)
		Max. operating pressure	1.0 MPa	0.6 MPa	0.25 MPa	0.15 MPa

Notes: 1. The continuous operating temperature range for pressure pipes is 5 to 85ºC for nominal diameters of 13 to 50 and 5 to 80ºC for nominal diameters of 65 to 150.
2. Since the thermal expansion coefficient of HT pipes due to temperature differences is four to six times those of copper and steel pipes, a means to absorb thermal expansion and contraction are important for HT pipes.

2. Performance Specification for VP and HI-VP Pipes for Water Supply

(excerpt from JIS K 6742: 2007)

Performance attribute		Performance	Applicable pipe
Tensile yield strength		Min. 45 MPa for the tensile strength at yield at 23ºC.	VP
		Min. 40 MPa for the tensile strength at yield at 23ºC.	HI -VP
Pressure resistance (hydrostatic pressure 4.0 MPa x 1 min at ordinary temperature)[1]		There shall be no leaks and other defects.	VP, HI-VP
Flatness		There shall be no cracks.	VP, HI-VP
Impact resistance		There shall be no anomalies.	HI-VP
Vicat softening temperature		MIn. 76ºC	VP, HI-VP
Opacity		Visible light transmittance shall be 0.2% or less.	VP
Leachability	Turbidity	Max. 0.5 degree	VP, HI-VP
	Chromaticity	Max. 1 degree	
	Organic matter (TOC)	Max. 1 mg/L	
	Lead	Max. 0.008 mg/L	
	Zinc	Max. 0.5 mg/L	
	Reduction in residual chlorine	Max. 0.7 mg/L	
	Odor	There shall be no anomalies.	
	Taste	There shall be no anomalies.	

Note: 1. 4.0 MPa is the pressure for the hydrostatic pressure test to check product quality. The maximum operating pressure of VP and HI-VP Pipes for water supply is 0.75 MPa and the maximum operating pressure (water hammer + hydrostatic pressure) is 1.0 MPa.

3. Performance Specification for VP Pipes for General Purposes

(excerpt from JIS K 6741: 2007)

Performance attribute	Performance	Applicable pipe
Tensile yield strength	Min. 45 MPa for the tensile strength at yield at 23ºC.	VP,VM, VU
Pressure resistance (VP: hydrostatic pressure 2.5 MPa x 1 min at ordinary temperature)[1]	There shall be no leaks or other defects.	VP,VM, VU
Joint pressure resistance[1,2]	There shall be no leaks or other defects.	VP,VM, VU
Flatness	There shall be no cracks.	VP,VM, VU
Vicat softening temperature	Min. 76ºC	VP,VM, VU

Notes: 1. 2.5 MPa is the pressure for the hydrostatic pressure test to check product quality. The maximum operating pressure (water hammer + hydrostatic pressure) of VP pipes for general purposes is 1.0 MPa.
2. The joint pressure resistance applies to pipes with rubber ring and bonding-type ends for pressure applications. For these pipes, this joint pressure resistance test may be substituted for a pressure test.

4. Performance Specification for HT-VP Pipes for Hot Water Supply

(excerpt from JIS K 6776: 2007)

Performance attribute		Performance		Applicable pipe
Tensile yield strength		Min. 50 MPa for the tensile strength at yield at 23ºC.		HT
Pressure resistance (hydrostatic pressure 4.0 MPa x 1 min at ordinary temperature)[1]		There shall be no leaks other defects.		HT
Hot internal pressure creep performance		There shall be no leaks other defects.		HT
Flatness		There shall be no cracks.		HT
Vicat softening temp erasure		Min. 95ºC		HT
Leachability[2]	Turbidity	Max. 0.5 degree		HT
	Chromaticity	Max. 1 degree		
	Organic matter (TOC)	Max. 1 mg/L		
	Lead	Max. 0.008 mg/L		
	Zinc	Max. 0.5 mg/L		
	Odor	There shall be no anomalies.		
	Taste	There shall be no anomalies.		
	Reduction in residual chlorine	Leachate at 90±2ºC[3]	Max. 1mg/L	
		Leachate at ordinary temperature[4]	Max. 0.7mg/L	

Notes: 1. 4.0 MPa is the pressure for the hydrostatic pressure test to check product quality. The operating temperature and the maximum operating pressure of HT Pipes for hot water supply are as per item1.
2. Unless otherwise specified, a leachate at 90±2ºC shall be used in the leaching test.
3. “Leachate at 90±2ºC” means a leaching test using a leachate at 90±2ºC.
4. “Leachate at ordinary temperature” means a leaching test using a leachate at ordinary temperature.

5. General Properties of VP, HI-VP and HT-VP Products

	Attribute	Units	VP	HI	Test method	HT	Test method
Physical properties	Color	—	Gray	Grayish blue	—	Brown	—
	Specific gravity	—	1.43	1.40	JIS K 7112 Sink-float method 20ºC	1.48	ASTM D 792 20ºC
	Hardness	Rockwell R	115	115	ASTM D 785 20ºC	140	JIS K 7202 20ºC
	Water absorption	One week at ordinary temperature mg/cm^2	Max. 0.15	Max. 0.15		Max. 0.15	
Mechanical properties	Tensile strength	MPa (kgf/cm^2)	49-54(500-550)	49-54(500-530)	JIS K 6742 23ºC, eta.	49-54 (500-550)	JIS K 6776 20ºC
	Longitudinal elastic modulus	MPa (kgf/cm^2)	2942 (3X10^4)	2942 (3X10^4)	JIS K 7113 20ºC	2942 (3X10^4)	ASTM D 747 20ºC
	Elongation at fracture	%	50-150	50-150	JIS K 6741 20ºC	40-80	JIB K 6741 20ºC
	Bending strength	MPa (kgf/cm^2)	78.5-98.1 (800-1000)	78.5-98.1 (800-1000)	JIS K 7203 20ºC 65%RH	89 (900)	ASTM D 970 20ºC
	Bending elastic modulus	MPa (kgf/cm^2)	2746(2.8X10^4)	2746(2.8X10^4)	JIS K 7203 20ºC 65%RH	—	—
	Compression strength	MPa (kgf/cm^2)	69(700)	64(650)	JIS K 7208 20ºC 85%RH	69 (700)	ASTM D 695 20ºC
	Poisson's ratio	—	0.35-0.40	0.35-0.40		0.38	—
	Charpy impact strength	kJ/m^2 (kgf•cm/cm^2)	6.9-9.8(7-10)	Min. 17.7		7.84X10^{-2} (8.0)	ASTM D 256
Thermal properties	Vicat softening temperature	ºC	Min. 76	Min. 76	JIS K 6742	Min. 95	JIS K 6776
	Linear expansion coefficient	1/ºC	6-8X10^{-5}	6-8X10^{-5}		6-8X10^{-5}	
	Specific heat	J/(kg•K) (cal/g•ºC)	1.05X10^3 (0.25)	1.05X10^3 (0.25)		1.05X10^3(0.25)	
	Thermal conductivity	W/(m^2•K) (kcal/m•h•ºC)	0.15 (0.13)	0.15 (0.13)	DIN 8061	0.15 (0.13)	DIN 8061
	Combustibility	—	Self-extinguishability	Self-extinguishability		Self-extinguishability	—
Electrical properties	Voltage resistance	kV/mm	Min. 40	Min. 40		Min. 40	—
	Volume resistivity	Ωcm	5.3X10^{15}	5.3X10^{15}	30ºC 65%RH	5.3X10^{15}	ASTM D 257
	Dielectricity 60 Hz	—	3.2	3.2	30ºC 55%RH	3.2	ASTM D 150
	Dielectricity 10^3 Hz	—	3.1	3.1		—	—
	Dielectricity 10^6 Hz	—	3.0	3.0		—	—
	Power factor 60 Hz	10^2	1.18	1.18	30ºC 55%RH	—	—
	Power factor 10^3 Hz	10^2	1.91	1.91		—	—
	Power factor 10^6 Hz	10^2	1.72	1.72		—	—

Note: The above values indicate typical values.

6. Chemical Resistance of VP and HI-VP Products

The chemical resistance in the table is only for reference. Please consult us when using VP and HI-VP products for chemicals.

	Chemical name	Temperature (ºC) 20	40	60		Chemical name	Temperature (ºC) 20	40	60		Chemical name	Temperature (ºC) 20	40	60
Acids	Hydrochloric acid 35%	◎	◎	△	Alkali	Aqueous ammonia 30%	◎	○	△	Organic chemicals	Ethyl acetate	×	×	×
	Sulfuric acid 60%	◎	◎	△		Lime milk	◎	◎	◎		Ethylene chloride	×	×	×
	Sulfuric acid 98%	×	×	×	Salts	Most metal chlorides, nitrates, sulfates	◎	◎	○		Formalin	◎	○	○
	Nitric acid 70%	○	△	×		Potassium bichromate 10%	◎	○	△		Carbon bisulfide	×	×	×
	Nitric acid 95%	×	×	×		Potassium perchlorate 1%	○	△	×		Acetaldehyde	×	×	×
	Mixed acid H_2SO_4 + HNO_3 50-10%:20-40%	◎	○	○		Potassium permanganate 15%	◎	○	△		Gasoline	△		
	50%:50%	△	×	×		Sodium hypochlorite	△*	△*	×		Petroleum	×	×	×
	Mixed acid: CrO_3 : H_2SO_4 25%:25%	×	×	×	Organic chemicals	Methylene chloride	×	×	×		Aromatic hydrocarbon	×	×	×
	Hydrogen fluoride 10%	◎	◎	△		Triol (toluene)	×	×	×		Glycerin	◎	◎	◎
	Phosphoric acid	◎	◎	△		Trichloroethylene	×	×	×		Oil, fat	◎	◎	◎
	Acetic acid 95%>	○	△	△		Acetone	×	×	×		Cresol solution 5%	×	×	×
	Acetic acid =>95%	△	×	×		Ketones	×	×	×		Lacquer, thinner	×	×	×
	Aminoformic acid 50%	◎	○	×		Methyl alcohol	◎	△	×	Gas	Dry chlorine gas 100%	△	×	×
	Oxalic acid	◎	◎	◎		Ethyl ether	×	×	×		Wet chlorine gas 5%	△	×	×
	Lactic acid	○	△	△		Ethyl alcohol	◎	○	△		Ammonia, many other gaseous wastes	◎	○	○
	Hydrogen peroxide 30%	◎	○	△		Butyl alcohol	◎	○	△	Other	Seawater, brine	◎	◎	◎
Alkali	Caustic soda 40%>=	◎	◎	○		Aniline	×	×	×		Ant repellent	×	×	×
	Caustic potash 40%>=	◎	◎	○		Benzene	×	×	×		Wood preservative (creosote)	×	×	×
						Carbon tetrachloride	×	×	×					
						Chloroform	×	×	×					

Notes: ◎: not eroded at all ○: not apparently eroded △: slightly eroded ×: unusable
For chemical marked with *, VP and HI-VP products may not be used depending on the service conditions. Please consult us.

7. Chemical Resistance of HT-VP Products

The chemical resistance in the table is only for reference. Please consult us when using HT-VP products for chemicals.

	Chemical name	Temperature (ºC) 20	40	60	80		Chemical name	Temperature (ºC) 20	40	60	80		Chemical name	Temperature (ºC) 20	40	60	80
Acids	35% hydrochloric acid	◎	◎	◎	○	Alkalis	50% caustic soda	○	○	△	×	Organic chemicals	Oil, fat	◎	◎	◎	○
	Nitric acid 70%=>	○	×	×	×		60% caustic potash	◎	○	○	○		Ethyl ether	X	—	—	—
	Sulfuric acid 90%=>	◎	◎	○	△		Saturated ammonia water	◎	◎	◎	○		Hexane	◎	—	—	—
	Hypochlorous acid	△	×	×	×	Gas	Chlorine, sulfurous acid	○	—	—	—		Creosote	×	×	×	×
	50% chromium acid	△	×	×	×		Ammonia	◎	◎	○	△		Benzol	×	×	×	×
	Acetic acid 95%=>	○	△	×	×	Salts	Most metal chlorides	◎	◎	◎	○		Formalin	◎	◎	○	—
	Chloroacetic acid	◎	○	○	×		Potassium perchlorate	◎	◎	◎	○		Benzin	×	—	—	—
	Oxalic acid	◎	◎	◎	◎	Organic	Ethanol	◎	○	○	△		Ketones	×	—	—	—
	Lactic acid	◎	◎	○	○		Butanol	◎	◎	◎	○		Plating solutions	◎	◎	○	○
	Fatty acid	○	○	○	△		Carbon tetrachloride	×	×	×	×	Other	Petroleum	×	×	×	×
	Maleic acid	◎	◎	◎	◎		Glycerin	◎	◎	◎	◎						

Note: ◎: not eroded at all ○: not apparently eroded △: slightly eroded (usable with restrictions on length of period and pressure) ×: unusable

2. Installation Design for Drain and Vent Pipes

2.1 Installation design

(1) Pipeline must be protected against expansion and contraction

A PVC-U pipe expands and contracts by about 0.07 mm per meter when the temperature changes by 1°C.
If there is a large temperature difference in the ambient temperature or in the water flowing in the installed drain pipeline, the pipe must be protected against expansion and contraction. Pipes are in a fully expanded condition when they are installed during the mid-summer. Therefore, when the pipes installed in summer contract during the winter and large force is applied to the fittings. This causes breakage in some cases. Be sure to include expansion fittings when designing pipe installation.

(2) Drain water temperature must be lower than 60°C.

Make sure that the temperature of drain water is lower than 60°C. For drain pipelines for high-temperature miscellaneous waste water, avoid draining high-temperature water or take a measure to reduce the water temperature below 60°C. (* As a general rule, take a measure to reduce the water temperature to lower than 45°C before drainage.)

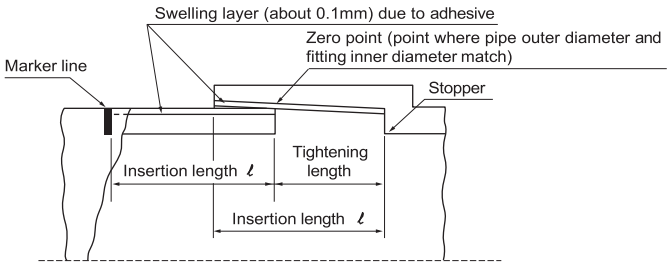
(3) DV fittings must not be used on pressurized pipelines.

DV fittings are designed for use on drain or vent pipes. Do not use DV fittings on pressurized pipelines. Using DV fittings on a pressurized pipe may cause water leakage or damage to fittings.

3. Bonding DV Products

3.1 Bonding DV products

DV joint



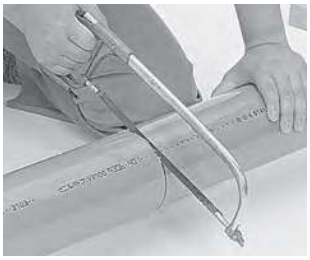
- Most PVC drain pipes can be joined together using DV fittings. This technique is generally called TS connection, which a pipe is bonded to a DV fitting with a tapered inserted end, using the swelling of the PVC pipe due to the adhesive as well as the elasticity of the pipe.
- When a PVC adhesive is applied to a pipe and fitting, a 0.1 mm thick swelling layer is formed on the surface. These layers facilitate the insertion of the pipe into the fitting. After insertion, the swelling layers of the pipe and the fitting mix and melt to combine the bonding surfaces, resulting in excellent water tightness.
- The insertion lengths of DV fittings are shorter than those of pressure pipe fittings, and the taper angles are smaller than those of pressure pipe fittings (for nominal diameter up to 150 mm). These allow a pipe to be inserted right up to the stopper, forming a flat joint surface. The inner corners of elbows and Y-fittings are round enough to ensure a smooth flow of effluent.

⚠ Note: DT fittings are designed for drain and vent applications, and should not be used for pressure pipe applications.

3.2 Cutting and chamfering

(1) Determine the cutting length of the pipe, considering the insertion length of the fitting. Draw a cut line all around the pipe with an oil-based pen to ensure that the pipe will be cut at right angles to the longitudinal axis of the pipe. Use a wide piece of paper or tape when drawing the line.

(2) Use a saw with fine teeth. Cut the pipe evenly and shallowly all around the circumference along the cut line rotating the pipe.



(3) Remove burrs and shavings on the cut surface. Chamfer the outer circumference with a chamfering tool (about 1 mm size) or a rasp.

(4) After chamfering the pipe end, measure the insertion length of the fitting and draw a marker line with an oil-based pen.

3.3 Bonding

(1) Clean the inner surface of the fitting and the outer surface of the inserting end of the pipe with a dry cloth. Wipe off any oil on the pipe with thinner. Make sure that the pipe end has been treated and a marker line indicating the insertion length has been drawn on the pipe.

(2) Apply the adhesive thinly and evenly to the inner surface of the fitting first and then the outer surface of the inserting end of the pipe. For pipes with large nominal diameters, put the adhesive into a larger can and use a larger brush to work efficiently. An animal hair brush should be used. A plastic brush will melt, which reduces the adhesion of the adhesive.

(3) After applying the adhesive, immediately push the pipe into the fitting lightly, and align their axes so that there is no twisting. Then, insert the pipe straight into the fitting to the marker line without a pause. For pipes with larger nominal diameters, two persons should work together to ensure that the pipe is inserted in the fitting to the stopper. Do not hammer in the pipe.

(4) Always keep the force holding the fitting and the pipe together applied for a while after bonding them. Otherwise, the pipe may be disconnected from the fitting due to the tapered inner surface of the fitting. The holding time varies with the amount of adhesive applied, dimensional tolerance and temperature. Typical holding times are shown in the table below. Remove any adhesive coming out the joint surface immediately.

Typical holding time for DV fittings

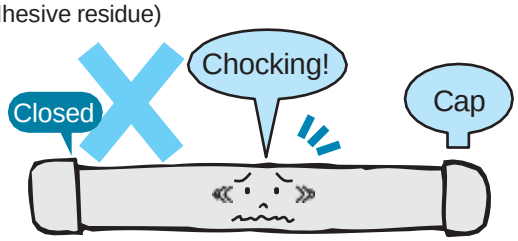
Nominal Dia.	150 and less	200 and more
Holding time	At least 30 sec. in summer At least 60 sec. in winter	At least 1 min. in summer At least 3min. in winter

Note: For nominal diameters 200 and more, Tough dyne Yellow, a high-viscosity, slow drying adhesive for large pipes, is typically used. Therefore, the holding time becomes longer.

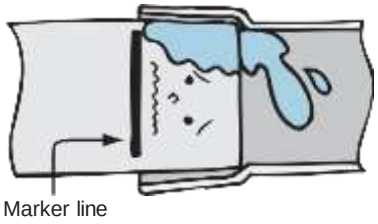
IV Preventing Solvent Cracking

Solvent cracking is a phenomenon which hairline cracks occurs when a solvent is added to objects.
The hairline cracks would grow larger after starting the service and increase the possibility of leakage. For PVC-U or PVC-C pipes, the possibility of leakage increases particularly when the following factors occur.
When all these factors are combined, the possibility increases furtherer.

Pipe clogging after bonding
(adhesive residue)

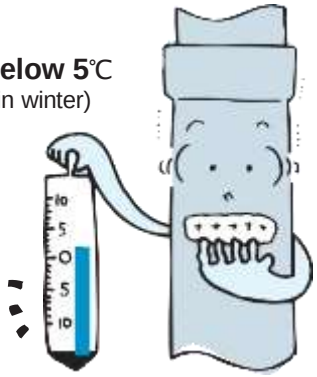


Presence of solvent
Adhesive coming out of the inner surface of the pipe due to excessive adhesive applied or the presence of chemicals that have adverse effects (such as preservatives) on the surface



Unreasonable stress being applied
(Thermal stress, pipe flattening, pipe bending)

Low temperature below 5℃
(Particularly piping work in winter)

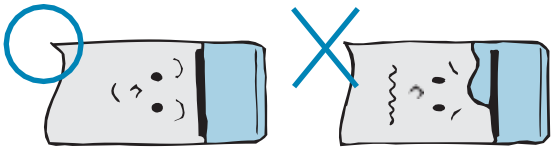


Preventing solvent cracking

During bonding work

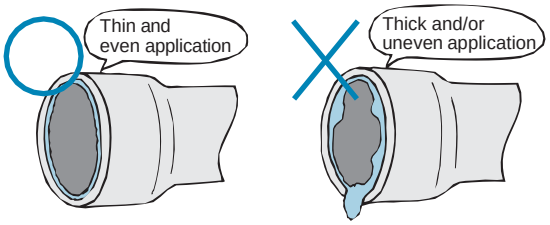
Position to apply the adhesive on the outer surface of the pipe

⚠ Do not apply the adhesive beyond the marker line.



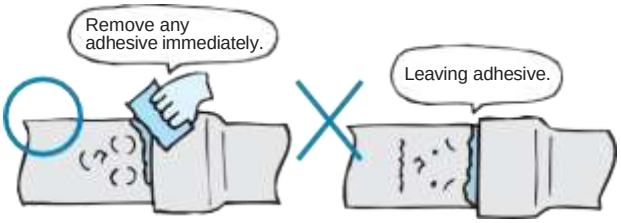
Adhesive coming out to the pipe inner surface

⚠ **Apply the adhesive thinly and evenly to the inner surface of the TS fittings.**



Removing excessive adhesive

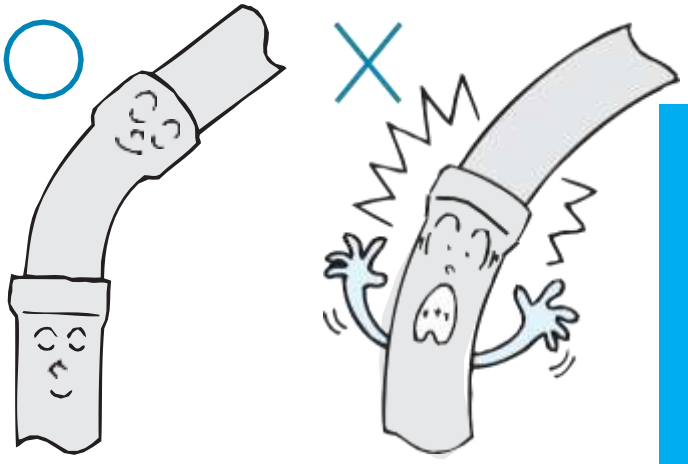
⚠ After inserting the pipe into the fitting, remove adhesive coming out of the joint surface with a cloth.



During piping work

Use bends

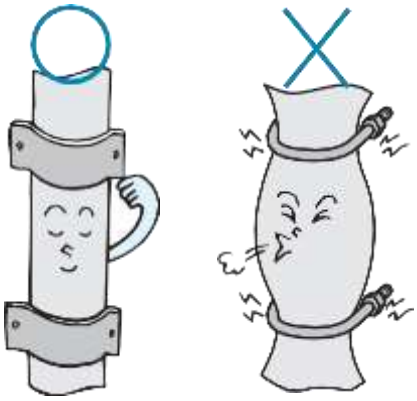
⚠ Use bends at pipe corners. Do not bend the pipe.



Reference

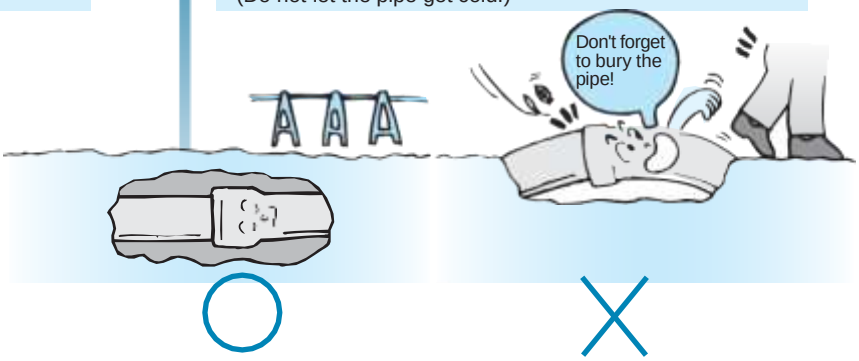
Pipe supports

⚠ When supporting the pipe with saddle bands, use wide fastener bands. Do not use U-bolts. Be careful not to tighten the bands excessively.



Backfilling

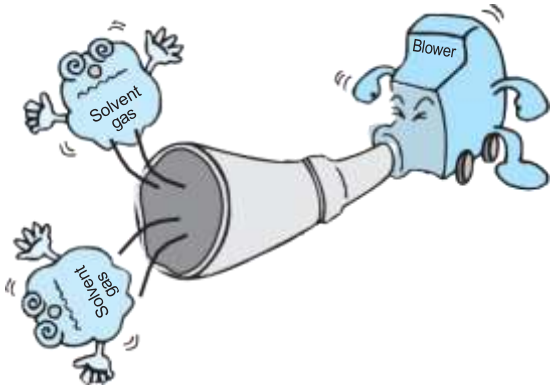
⚠ Backfill the pipe as quickly as possible to prevent thermal stress due to temperature differences or external impact. (Do not let the pipe get cold.)



Removing the solvent gas after bonding work

Ventilation

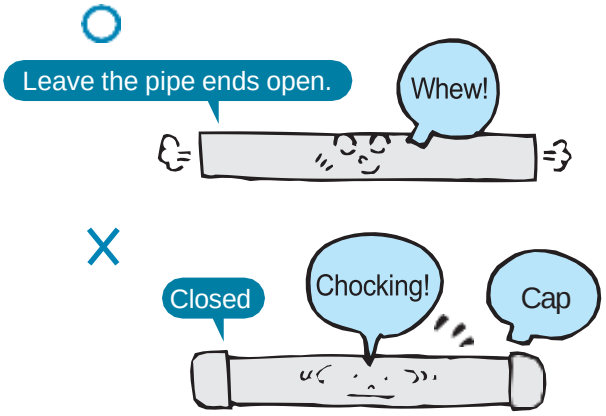
⚠ After bonding work, remove the solvent gas using a blower (low pressure type) or other means.



Washing with water avoiding water pressure in the pipe

⚠ Pour water into the pipe 30 minutes after the bonding work for nominal diameter 50 and less and one hour after the bonding work for nominal diameters 65 and more. Do not make any water pressure in the pipe.

Opening the pipe ends

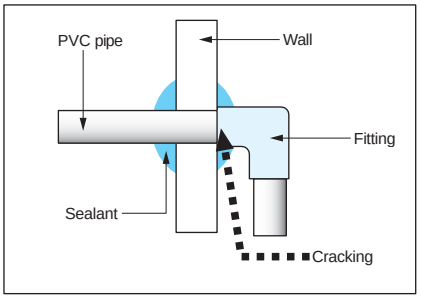


⚠ Do not close the pipe ends. Leave them open to remove the adhesive vapor.

Other important information

There is a recently developed technique which installs a PVC-U or PVC-C pipe through an interior wall and then the gap between the pipe and the wall is filled with a sealant. Some sealants contain a plasticizer, such as DOP and phthalate ester, or a solvent such as xylene and toluene, which may cause solvent cracking to PVC pipes. Usually, these plasticizers and solvents are contained in polyurethane sealants but not in silicon sealants.

However, plasticizers and solvent may be added to silicon sealants to improve their performance in the future. It is advisable to contact the sealant manufacturer for details.



V User Instructions

This section is about do's and don'ts in order to make the most of the performance of Okubo Plumbing Co., Ltd PVC-U or PVC-C pipes and fittings. Please read carefully and use the instructions in the safety manual where appropriately.

● Please observe the following instructions.
Classes of actions are represented by the following graphic symbols.

indicates that the action needs to be taken carefully.	indicates that the action is prohibited.	indicates that the action must be taken.

1. Instructions for the treatment of left-over material and scraps

No on-site burning

Do not burn PVC pipes and fittings on site. Toxic chlorine gas will be released into the air, by burning.

Laws and regulations

Left-over and scrapped PVC pipes and fittings should be treated according to local laws and regulations. Do not crush leftovers and scraps with a hammer. Crushed pieces may fly away.

2. Carrying instructions

Wear gloves

Wear rubber-coated gloves with a firm grip to prevent injury.

Careless handling is dangerous

Large PVC pipes are heavy. Also, PVC pipes which are bundled together can be heavier than expected. Handle them with care to prevent injury. Careless handling is dangerous.

Do not step on pipes

Do not step on pipes. The surface of PVC pipes is slippery, which may lead to an accident.

Use a cushion

Place cushions between pipes and the truck bed and on the parts of a pipe that are secured with a rope to prevent scratches and deformation.

Careful handling

When loading and unloading the PVC pipes from truck, do not throw or drag PVC pipes into the truck. Handle with care to prevent scratches and damage to the pipes and injury.

Prevent collasping during transport

Take measures to stop ropes from becoming loose or coming off to prevent pipes from falling off the truck.

Carefully lift and lower pipes

If a truck with a hoist is used, balance the load when lifting to prevent injury.

3. Storage instructions

When storing pipes horizontally indoors

When storing PVC-U or PVC-C pipes, pile them in a crisscross pattern or in a staggered pattern to prevent them from warping or deforming. Put stoppers at the pipe ends to prevent the pile from collapsing.

When storing pipes outdoors

When storing pipes outdoors, put a simple roof over the storage area or an opaque sheet on the pipes to block direct sunlight. When a sheet is used, provide a good air flow.

Storing pipes vertically

When there is no choice but to store pipes vertically, take measures to prevent them from falling over, such as securing them with ropes.

Storing fittings

Fittings should be stored indoors with the pipes. When there is no choice but to store them outdoors, put a sheet over them to protect from sunlight. Always put a cover on fittings with a rubber ring to protect from direct sunlight which will degrade the performance quality of rubber rings.

4. Installation instructions

Pipes and fittings should be installed using the standard installation techniques recommended by Okubo Plumbing Co., Ltd, in order to ensure work safety and the performance of pipe lines. If installation conditions do not allow this, please contact us.

Using the proper tools

Select tools with the proper specifications for tasks such as cutting, drilling and joining. Read and ensure that you fully understand the instruction manuals of the tools before using.

Ventilation after bonding work

After bonding work, ventilate the bonded pipe well. Do not close the bonded pipe. Otherwise, solvent cracking or a bad odor may result. Solvent cracking is a phenomenon which hairline cracks occur in a PVC-U or PVC-C pipe due to residual solvent vapor in the adhesive. Residue of bad odor in drinking-water pipes affects the smell and taste of the water. It should be noted that, particularly in the winter, solvents do not easily evaporate and tend to remain in the pipe.

Caution against the use of organic chemicals

PVC-U or PVC-C pipes and fittings can be eroded by organic chemicals, and should not be allowed to come into contact with creosote (wood preservative), termite and other pesticides or paint. If soil contaminated by these chemicals is expected along the pipe line route, take measures to protect against contamination by avoiding contaminated areas when installing the pipe line.

Treatment for thermal expansion and contraction

For pipes bonded to fittings, expansion fittings should be used to prevent pipes from becoming disconnected from their fittings or damaged due to thermal expansion and contraction.

Do not bend pipes

Do not bend pipes. Otherwise, the strain will remain, causing potential pipe rupture. If curved pipes are required, always use bends.

About thrust protection

For buried pipes subject to hydrostatic pressure, thrust protection should be provided to prevent the pipes from becoming disconnected from their fittings at corners and branches. The standard installation technique recommended by the Japan PVC Pipe and Fittings Association and Okubo Plumbing Co., Ltd should be used.

Do not heat pipes on site

Do not heat pipes on site. Pipes may become scorched or burnt, resulting in reduced strength.

About protective insulation cover

Avoid installing pipes near steam and hot-water pipes in order to prevent deformation and damage due to high temperatures. If this is not possible, put a protective insulation cover around the pipe.

Public space used for pipes

When pipes are buried under public roads, follow the burying standards or instructions provided by the road administrator. For siphon pipes across a river and pipes buried under railways, follow the instructions provided by the respective administrators.

Squeeze-off tools

Squeeze-off tools for polyethylene pipes should not be used to repair small water pipes. The ductility of PVC-U or PVC-C pipes is smaller than that of polyethylene pipes. If water sealing work is carried out with squeeze-off tools, whitening due to plastic deformation may occur to the pipe which lead to damage in the future.

Freeze protection

In cold regions, pipes should be buried 20 cm deeper than the maximum freeze depth. Thermal insulation should be wrapped around the exposed part of a vertical water pipe to protect against freezing.

Cutting small pipes

Do not use a pipe cutter to cue small pipes. The cutter may cause chippings or deformation to the cut section of the pipe.

Joining a hydrant

Since a hydrant has parallel pipe threads, water cannot be sealed by inserting the threads into the female threads of a water fitting with sealing tape. When joining a hydrant to a water fitting, place a gasket between the hydrant flange (the face with the gasket on) and the water fitting.

Do not thread PVC pipes and fittings

Do not thread PVC-U or PVC-C pipes and fittings directly. These pipes have a large notch effect, and their strength decreases if cracks or notches are made.

Use of lubricant specifically designed for joining fittings with a rubber ring

A lubricant specifically designed for rubber rings should be used to joint fittings with a rubber ring to a pipe. Do not use adhesive or oil. It may damage the rubber ring.

Insertion force joining pipes to TS fittings

When joining a pipe to a TS fitting, unreasonable stress may be applied to the fitting depending on the dimensional combination of the pipe and the fitting if the pipe is inserted up to the stopper in the fitting. In terms of the relation between the bonding length and the pressure resistance, it has been confirmed that a practically sufficient hydrostatic resistance can be achieved by inserting the pipe up to one-third of the insertion length of the fitting from the insertion length position without any adhesive applied (zero point position).
In order to prevent the bonded pipe from becoming disconnected from the fitting due to the elasticity of the pipe, the insertion force should be applied for over 30 seconds for nominal diameters 50 and less and for over 60 seconds for nominal diameters 65 and more.

Joining steel pipes to fittings with a tapered female thread

Do not insert the tapered male threads of a metal pipe into a hydrant fitting. The joint may be damaged. Normally, a metal socket should be joined to the tapered male thread of the metal pipe. Then, a valve socket should be joined to the metal socket. When strength is required for the inserted section, a valve socket with a metal male thread should be joined to the metal socket.

5. Instructions for handling PVC adhesive

Do not use adhesives for other applications

PVC and plastic adhesives were developed to bond PVC pipes to PVC fittings, and should not be used for other applications.

Use of appropriate adhesives

There are three types of adhesive: one for HI products, one for HT products and one for other products. The adhesives are designed to provide appropriate joint strength to pipes and fittings. Therefore, it is necessary to use the adhesive appropriate for the type of pipe.

If adhesive enters the eye

If adhesive enters the eye, do not rub the eye. Seek medical attention immediately

Storage according to laws and regulations

Adhesives are hazardous substances under the Fire Defense Law. Follow applicable laws, regulations and municipal ordinances when storing adhesives.

Ventilation and fire prevention

When using an adhesive, ventilation should be provided to prevent intoxication. Also fire sources should be kept away from organic solvents.

Use of gloves

Wear gloves to protect against skin irritation and sores. Do not touch the adhesive directly. If the adhesive touches the skin, wash it off with soap and water immediately.

Washing hands and gargling

After using the adhesive, wash your hands and gargle well.

Store in a cool and dark place away from fire sources

Adhesives contain organic solvents. After using the adhesive close the lid of the can securely and store it in a cool and dark place indoors. Be sure to keep away from fire sources.

Do not use old and expired adhesives

Do not use an old and expired adhesive that has jelled or that has no pungent solvent odor. Do not thin the adhesive with thinner. This will decrease the adhesion, leading to the pipe disconnection from the fitting and causing leakage.