SOLID WALL
PVC SEWER PIPE

PVCPIPE association

SEWER PIPE

TABLE OF CONTENTS

SEWER PIPE

INTRODUCTION:

This document has been developed by the Diamond Plastics Corporation for use as a field installation guide. General information regarding the correct installation of gasketed-joint solid-wall PVC sewer pipe is included. Relevant product standards are:

- ASTM D3034 “Standard Specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings”
- ASTM F679 “Standard Specification for Polyvinyl Chloride (PVC) Large-Diameter Pipe and Fittings”

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Installation of Diamond PVC pipe for sewers or other gravity flow applications should be in accordance with ASTM D2321, “Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.” This guide is meant as a supplement only—ASTM D2321 should be considered the governing document.

SEWER PIPE

RECEIVING:

When a load of pipe arrives at the job site, it is your responsibility to check it thoroughly. If possible, inspect each piece for damage. Check quantities against the shipping list. Each pipe shipment should be inspected carefully upon arrival. The carrier is responsible for delivering the pipe. Make certain all material listed on the bill-of- lading has arrived. The receiver must make certain there has been no loss or damage. It is important to note any errors or damage, on both the driver's copy and the delivery receipt. Make claim in accordance with the carrier's instruction. Do not dispose of any damaged material. Carrier will advise you of the procedure to follow for freight damage.

SEWER PIPE

UNLOADING AND HANDLING:

Pipe should be lowered, not dropped, from trucks to the ground or into a trench.
Do not cut bands that hold each unit together while the unit is on the truck.

The forklift truck, boom and sling, or other material handling equipment should be equipped to avoid excessive swinging.
DO NOT USE CHAINS AS A SLING. DO NOT ATTEMPT TO HANDLE PIPE BUNDLES BY PULLING ON STRAPPING OR PACKAGING MATERIAL. Avoid *all* impact blows, gouging, or abrasions caused by metal surfaces, rocks, material handling equipment, or any other source. **Do not roll the pipe off the truck.**

Cold Weather Handling: *Extra care* should be used in handling during cold weather.

WARNING: Carelessly unloading pipe can be hazardous. Use appropriate equipment and *stay clear* when removing tie-downs, banding, and dunnage material. Forklift tines must be long enough to support the bottom of all pipe within the bundle. The tines must have a vertical pad.

SEWER PIPE

The tables below are provided for use as guides in selection of handling equipment:

APPROXIMATE WEIGHT OF PIPE LENGTHS (lbs)

	20-Foot Lengths		14-Foot Lengths	
Pipe Size	DR35	DR26	DR35	DR26
(in.)				
4	22	30	16	21
6	50	67	35	47
8	89	120	62	84
10	140	190	98	130
12	200	270	140	190
15	290	390	200	270

	20 (22*)-Foot Lengths			14-Foot Lengths		
Pipe Size	PS 46	PS 75**	PS 115	PS 46	PS 75**	PS 115
18	410	480	650	290	340	460
21	570	670	900	400	470	630
24	720	840	1100	500	590	770
27	970	1100	1500	680	770	1100
30	1300	1500	2000	910	1100	1400
36	1800	2100	2800	1300	1500	2000
42	2400	2800	3800	1700	2000	2700
48	3200	3800	5100	2200	2700	3600
***54**	4700	5400	6500	3000	3400	4100
***60**	5500	6100	7400	3500	3900	4700

* 54” and 60” standard length is 22’, 14’ also available as special order

** PS75 special order item

SEWER PIPE

STORAGE:

If you can unload the shipment in unit packages, the pipe will be easier to store. Stack the packages on reasonably level ground. If you unload one piece at a time, place the pipe bevel to bell. Never stack over eight feet in height. Do not stack the pipe next to heat sources or engine exhausts. Gaskets should also be protected from heat, oil, and grease.
When prolonged exposure to direct sunlight is anticipated, PVC pipe should be covered with a light colored breathable material which will permit adequate air circulation to prevent heat accumulation.

SEWER PIPE

TRENCHING:

Proper installation procedures and trench preparation are essential to successful PVC pipe performance. Trench preparation procedures for PVC pipe do not vary substantially from procedures used with other piping products. No more trench should be prepared than the footage of pipe that can be laid in a day.

Do not let the excavated material block sidewalks, drives, or utility outlets. Follow all safety rules and regulations. Protect workers by using sheeting and trench boxes in hazardous areas and by sloping the trench walls in dry soils. When sheeting or a trench box is moved, make sure that the pipe is not moved and that the side-support material is not disturbed.

SEWER PIPE

DE-WATERING:

Do keep the trench as dry as possible until the pipe has been installed and enough backfill placed to prevent the pipe from floating. PVC pipe will float if not filled with water or weighted down. The height of loose backfill material required to prevent flotation of empty pipe is conservatively equal to 1½ times the pipe diameter.

SEWER PIPE

FIELD CUTTING:

PVC pipe can be easily cut with a power handsaw or power-driven abrasive disc. Be sure you make a square cut. Bevel the end with a beveling tool, wood rasp, or power sander to the same angle and length as provided on the factory-finished pipe. Redraw the insertion line on the spigot using a factory-marked spigot as a guide.

SEWER PIPE

LOWERING PIPE INTO THE TRENCH:

Place the pipe and fittings into the trench using ropes and skids, slings on the backhoe bucket, or by hand. Do not throw the pipe or fittings into the trench or allow any part of the pipe to take an unrestrained fall onto the trench bottom. At this point, the pipe and other accessories are in a good position for final inspection. Ensure there are no damaged materials before assembly begins.

SEWER PIPE

CLEANING AND INSPECTION:

Remove any mud, sand, or other foreign material from the bell interior and spigot exterior that could prevent an effective seal between the bell and spigot. Carefully clean the gasket area. Do not remove the gasket from the bell. Make sure the gasket is seated uniformly in the groove by running your finger around the inner edge of the gasket.

SEWER PIPE

LUBRICATION:

An even, uniform application of gasket lubricant must be applied to the spigot including the bevel and to the insert reference mark as well as the contact surface of the gasket. Gasket lubricant may be applied with a swab, brush, or roller. An adequate amount of gasket lube is furnished with each truckload of pipe. Additional lubricant may be purchased from your distributor.

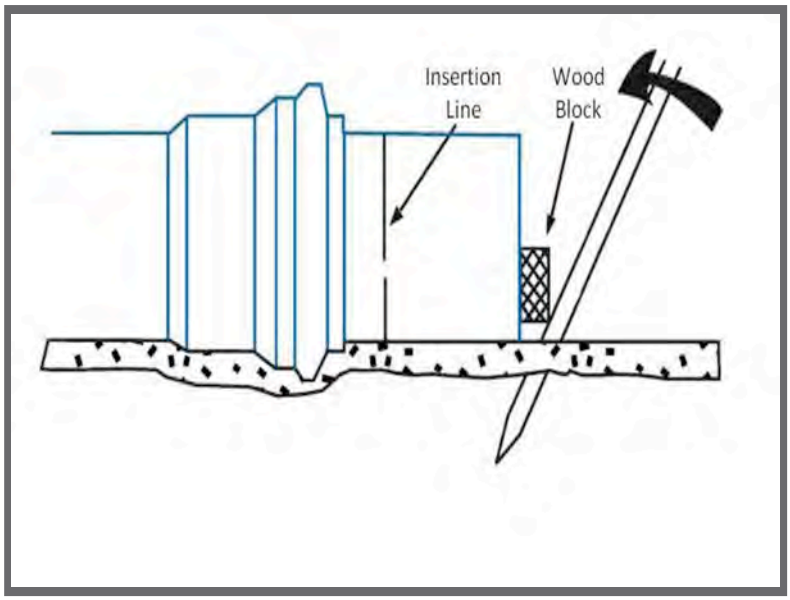
SEWER PIPE

JOINT ASSEMBLY:

Align the spigot to the socket to be assembled so that it is near contact with the gasket. Depending upon the pipe size, Diamond "Solid-Wall" PVC Sewer pipe may require from 500 to 1000 pounds force to assemble. Keep the pipe lengths in proper alignment. Be careful not to let the lubricated section touch the dirt or backfill as foreign material could adhere to the surface and compromise joint integrity. So that previously completed joints in the line will not be "stacked," "over belled," or inserted past the reference mark, brace the bell while the spigot end is pushed through the gasket. Push the spigot end in until the reference mark on the spigot end is flush with the end of the bell. If the spigot is inserted beyond the reference mark, laying length will be lost. Loss of laying length can be significant on projects with long footage. Also, joint flexibility is reduced when the spigot is over-inserted. Over-insertion may lead to excessive stress and joint failure. Joints may be assembled using mechanical equipment provided that the pipe is protected, properly lubed, and aligned. The end of the pipe must be protected from damage, and the joint must not be "over-belled" or inserted beyond the insert reference mark. Use a wood block or sheet of plywood to protect the end of the pipe. A come-a-long may be preferred, but a swinging stab is not recommended. Assembly will require greater effort during cold weather. The bar-and-block method of joint assembly is recommended, as the installer is able to feel the amount of force being used and whether the joint goes together smoothly. Larger pipe may require mechanical assistance to apply sufficient force to assemble the joint.

When mechanical devices are used, care must be taken to ensure that the spigot is inserted to the proper depth and that previously assembled pipe joints are not disturbed. This is accomplished by inserting only to the insertion line on the spigot end. If the spigot is over-inserted, back the pipe out until the insertion line is visible. In all cases, straight alignment of the pipe is essential for proper assembly. If the pipe is misaligned, over-inserted, or assembled with excessive force, the following are possible consequences:

- rolled gaskets
- failure to pass acceptance testing (e.g., low-pressure air testing and deflection-mandrel testing)
- over-insertion of previously assembled joints

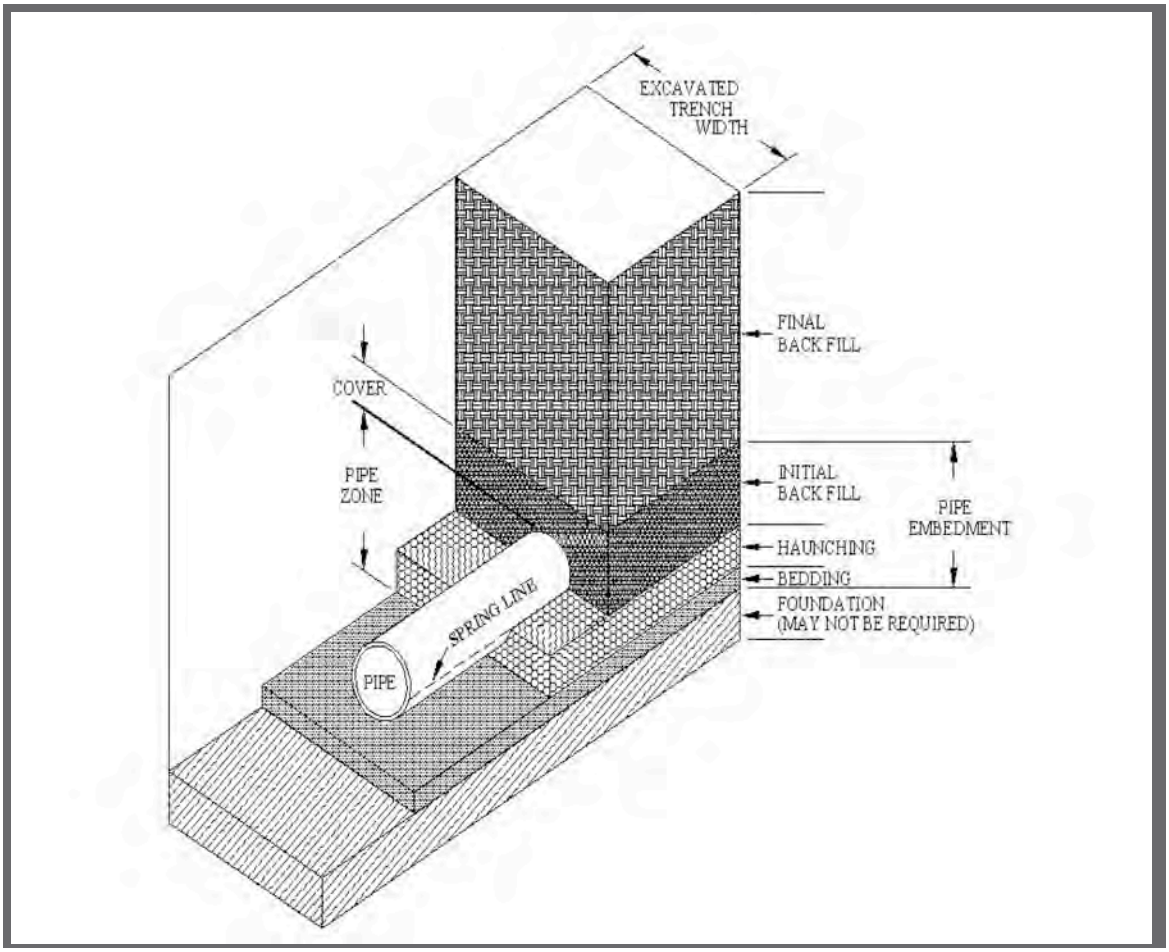


Manual Bar-and-Block Method

SEWER PIPE

TRENCH CONSTRUCTION:

Terms used in pipe installation are illustrated in the trench cross-section below. The use of proper embedment materials is very important to trouble-free operation of pipe systems. The particle size of material in contact with the pipe shall not exceed 1½ inches.



FOUNDATION:

A foundation is required when the trench bottom is unstable. The bottom of the trench is over-excavated and brought back up to grade with suitable material. Where over-excavation occurs, ensure that the elevation under the entire length of the pipe is brought up (rather than only at the bells). Proper placement of new foundation materials will support the pipe and prevent sagging between joints.

SEWER PIPE

BEDDING:

Bedding may be used to bring the trench bottom up to grade before the pipe is installed. Its purpose is to provide continuous and uniform support. Where bedding is required, a maximum compacted depth of 4 to 6 inches is typical. Holes for pipe bells should be provided at each joint to ensure uniform support for the pipe. Bell holes should be no larger than necessary for pipe assembly. Maximum particle size for embedment, which includes bedding, haunching, and initial backfill, is limited to material passing a 1½ inch sieve. (Limiting particle size to 3/4 inch or less enhances placement of embedment material for nominal pipe sizes 8 inch through 15 inch. For smaller pipe, a particle size of about 10% of the nominal pipe diameter is recommended.) Unstable trench bottoms shall be stabilized by methods and with materials, required by the specifying engineer, to provide adequate and permanent support for the conditions encountered.

HAUNCHING:

Haunching should be completed as the pipe is laid. The haunching material should consist of an evenly graded, free flowing, granular material which is free of large stones, frozen clods or other hard particles. If imported material is required, haunching material should be the same as the bedding. Placement and compaction of the haunching material are the most important factors affecting pipe performance and deflection. Proper placement and compaction of material in the haunch reduce voids and increase pipe support. Granular materials may be properly placed using techniques such as shovel slicing. Place material under the haunches and at least halfway up the pipe to provide side support. Make sure material is properly compacted. DO NOT DISTURB SIDE SUPPORT WHEN MOVING SHEEETING OR TRENCH BOX.

SEWER PIPE

INITIAL BACKFILL:

Keep the initial backfill free from rocks which could damage the pipe during final backfill. Depth of the initial backfill should be at least 6 inches over the top of the pipe. Initial backfill protects the pipe from damage during final backfill. Machine compaction of initial backfill directly over the pipe is not desirable unless adequate cover has been provided to protect the pipe. Adequate cover will depend on the type of compaction equipment. For adequate cover to prevent pipe damage or deflection, consult the project engineer.

FINAL BACKFILL:

Final backfill is often specified by the project engineer based on site design. Material selection, placement, and compaction should meet the project requirements. After placement and compaction of pipe embedment materials, the balance of backfill materials may be returned to the trench. The material should not contain large stones or rocks, frozen materials, or debris. Compaction procedures of the remainder of the backfill should be in accordance with the contract specification.

ACCEPTANCE TESTING:

After the installed PVC pipeline is thoroughly cleaned, one or more of the following tests may be performed:

- Visual inspection
- Deflection test
- Leakage test

Visual Inspection: Sewer pipelines can be inspected visually to verify accuracy of alignment and freedom from debris and obstructions. The test is typically performed by closed-circuit TV.

Deflection Testing: Deflection testing is usually performed with a properly sized "go/no-go" mandrel. Mandrel sizes for 7½% deflection of the base inside diameter are found in the ASTM product standards (D3034 and F679) and are also given in the *Handbook of PVC Pipe: Design and Construction*.

The following table provides base inside diameters for SDR35/PS46 pipe and the subsequent mandrel dimensions, which are derived from them.

Size and Mandrel Dimensions

Pipe size (in.)	Pipe size (mm)	Average O.D. (in.)	Base I.D.* (in.)	Base I.D.* (mm)	7.5% Mandrel Size (in.)	7.5% Mandrel Size (mm)	5% Mandrel Size (in.)	5% Mandrel Size (mm)
6	150	6.275	5.742	145.8	5.31	134.9	5.45	138.4
8	200	8.400	7.665	194.7	7.09	180.1	7.28	184.9
10	250	10.500	9.563	242.9	8.84	224.5	9.08	230.6
12	300	12.500	11.361	288.6	10.51	266.9	10.79	274.1
15	375	15.300	13.898	353.0	12.86	326.6	13.20	335.3
18	450	18.701	17.054	433.2	15.77	400.6	16.20	411.5
21	525	22.047	20.098	510.5	18.59	472.2	19.09	484.9
24	600	24.803	22.587	573.7	20.89	530.6	21.46	545.1
27	675	27.953	25.445	646.3	23.54	597.9	24.17	613.9
30	750	32.000	29.151	740.4	26.96	684.8	27.69	703.3
36	900	38.300	34.869	885.7	32.25	819.2	33.13	841.5
42	1050	44.500	40.491	1028.5	37.45	951.2	38.47	977.1
48	1200	50.800	46.209	1173.7	42.74	1085.6	43.90	1115.1
54	1350	57.560	52.359	1329.9	48.43	1230.2	49.74	1263.4
60	1500	61.610	55.961	1421.4	51.76	1314.8	53.11	1350.3

* Base I.D. is a minimum pipe inside diameter derived by subtracting a statistical tolerance package from the pipe's average inside diameter.

SEWER PIPE

Leakage Testing: Low-pressure air testing is an acceptable method of insuring integrity of the installed sewer system. ASTM F1417 "Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air" provides procedures for leakage testing of plastic sewer lines. Water-infiltration testing is an alternative method which is accurate only when the pipe is completely under water. Water-exfiltration testing is a rarely used method that can be complicated by entrapped air.

The recommended duration of the test time for a 1.0 or 0.5 air pressure drop is provided in the following tables. These recommendations are taken out of the Uni- Bell PVC Pipe Association document Uni-B-6, "Recommended Practice for Low- Pressure Air Testing of Installed Sewer Pipe". These recommendations are for all products not just PVC. Specific information on conducting this test can be found in Uni- B-6.

With large diameter pipe the duration of the test can become excessively long. **It is the industry recommendation that if there is no loss of pressure after one hour of testing that the test section shall be accepted and the test ended.** If there is any loss of pressure during the first hour the test should run its full duration.

If any test section loses more air pressure than that specified the contractor shall, at his own expense, locate and repair the defective section. If a failure is noted the first things to check are the hoses, gauges, and valves and plugs associated with the test equipment. After these are ruled out as the problem any laterals on the system should be checked. After this is ruled out individual pipe joints should be checked. Isolating the individual section, which is leaking is the key to resolving the problem.

MINIMUM SPECIFIED TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015

Pipe Size	Min. Time m:s	Lgth. Min. Time	Time for Longer line	100 ft.	150 ft.	200 ft.	250 ft.	300 ft.	350 ft.	400 ft.	450 ft.
4	3:46	597	.380L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
36	34:00	66	30.768L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46
42	39:48	57	41.883L	69:48	104:42	139:37	174:30	209:24	244:19	279:13	314:07
48	45:34	50	54.705L	91:10	136:45	182:21	227:55	273:31	319:06	364:42	410:17
54	51:02	44	69.236L	115:24	173:05	230:47	288:29	346:11	403:53	461:34	519:16
60	56:40	40	85.476L	142:28	213:41	284:55	356:09	427:23	498:37	569:50	641:04

Note: If there has been no leakage (zero psig drop) after one hour of testing, the test section shall be accepted and the test complete.

SEWER PIPE

MINIMUM SPECIFIED TIME REQUIRED FOR A 0.5 PSIG PRESSURE DROP FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015

Pipe Size	Min. Time m:s	Lgth. Min. Time	Time for Longer line	100 ft.	150 ft.	200 ft.	250 ft.	300 ft.	350 ft.	400 ft.	450 ft.
4	1:53	597	.190L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	.427L	2.50	2.50	2.50	2.50	2.50	2.50	2.51	3:12
8	3:47	298	.760L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5235L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16
24	11:20	99	6:837L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17
27	12:45	88	8.653L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54
30	14:10	80	10.683L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
36	17:00	66	15.384L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23
42	19:54	57	20.942L	34:54	52:21	69:49	87:15	104:42	122:10	139:37	157:04
48	22:47	50	27.352L	45:35	68:23	91:11	113:58	136:46	159:33	182:21	205:09
54	25:31	44	34.618L	57:42	86:33	115:24	144:15	173:05	201:56	230:47	259:38
60	28:20	40	42L738L	71:14	106:51	142:28	178:05	213:41	249:18	284:55	320:32

Note: If there has been no leakage (zero psig drop) after one hour of testing, the test section shall be accepted and the test complete.

SEWER PIPE

SPECIAL CONSIDERATIONS:

Changes in Direction:

1. Pipe bending – Some changes in direction may be accomplished without the use of bends, sweeps, or other fittings. Controlled bending within acceptable limits can be accommodated by PVC pipe. A general rule of thumb for the minimum bending radius (R_b) calculation is R_b = 200 OD. Tighter bending radii may be achieved for certain products. Consult the manufacturer for specific product information. In most cases, bending should be accomplished manually. It is not recommended to attempt bending pipes greater than 12 inches in diameter due to the forces required.

2. Joint deflection – During construction, it may become necessary to make very slight changes of direction. Changes in direction may also be accomplished through joint deflection. Allowable joint deflection is dependent on pipe size and joint design. Neither the pipe nor the joint should be axially deflected in any manner to cause stress at the joint. Diamond "Solid-Wall" PVC Sewer Pipe will accommodate a 1° change in direction per joint. With 20' joints this is a 4" offset, and with 14' joints this is approximately 2 ¾" offset.

3. Combined pipe bending and joint deflection – Either joint deflection or longitudinal bending may be used for changes in direction, BUT NOT BOTH on the same length of pipe.

Manhole Connections: Proper manhole connections are essential to good system performance. The following precautions are recommended:

- Insure stable foundation and bedding for the manhole and connecting pipe to prevent shifting which could damage the connection.

- Use a water-stop gasket produced from elastomeric material which prevents leakage while allowing longitudinal pipe movement.

- Use a non-shrinking or expansive type grout for making connections of pipe and water-stop to manhole walls.

Manhole construction techniques may vary from one region to another. However, the smooth surface of Diamond "Solid-Wall" PVC Sewer Pipe facilitates an easy connection. A watertight system requires a flexible seal or waterstop between the PVC pipe and the manhole structure. With precast or poured in place concrete manholes, use an elastomeric seal, or flexible boot to facilitate a seal as concrete will not bond directly to PVC. Fiberglass or polyethylene manholes may be connected to Diamond PVC Sewer Pipe by using a properly sized rubber coupling. The manhole foundation and bedding material should be compacted to 95% Proctor Density. Compaction of the bedding and haunch material at the manhole connection is critical in controlling settlements. Settlements can cause shear failures and/or excessive deflection.

Cold Weather Installation: Extremely cold temperatures result in increases in pipe stiffness and tensile strength and decreases in impact strength. The decrease in impact strength requires care in handling during installation in cold temperatures.

SEWER PIPE

Risers: Sewer risers or vertical stacks may be required in deep sanitary sewers to minimize excavation for services lines. Risers are generally permitted where the main sewer line is deeper than 7 feet.

The vertical riser pipe creates a load scenario not common in other sewer installations. Any settlement of material alongside the riser produces a “drag-down” load due to the frictional forces at the pipe/soil interface. Additionally, settlement of the lateral fitting assembly produces a similar drag-down load. These loads must be mitigated or transferred harmlessly off the stack to prevent problems such as over-insertion, fitting fracture, main sewer line deflection/misalignment, etc.

The following practices are considered appropriate for all riser installations:

- Transitions from horizontal to vertical should be smooth and well supported. This may be accomplished withfitting combinations, gradual bends and/or trench geometry.
- Service laterals from the main sewer should exit at an angle no greater than 45 degrees from the horizontal. A single length of lateral pipe should be used for the riser section whenever possible.
- To minimize or eliminate settlement and the resulting loading, compaction is critical beneath the main line sewer and lateral connections.

Soil Migration: Where running or standing water occurs in the trench or substantial seasonal water table changes are expected, consideration must be given to preventing soil migration. Migration could cause loss of soil support for installed pipe. Materials used for underdrains, bedding, and haunching should be of proper gradation and thickness to prevent migration of material from fine-grained native soils.

SEWER PIPE

CHECKLIST:

- Take all precautions necessary to protect workers and materials.
- Plan ahead for fittings.
- Use trench boxes or shoring in unstable conditions.
- Do not disturb installed pipe when moving trench boxes or shoring materials.
- Properly assemble pipe joints by inserting the spigot end until the insertion line is even with the bell lip.
- Insure watertight seals at manhole connections.
- Keep the trench bottom as dry as possible.
- For detailed installation recommendations, see ASTM D2321 “Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.”
- Consult the pipe manufacturer for specifics regarding gaskets and lubricants.
- Check with the project engineer regarding specifications and procedures.

SEWER PIPE

Recommended Standards

UNI-B-1 “Recommended Specifications for Thermoplastic Pipe Joints, Pressure and Non-Pressure Applications”

UNI-B-6 “Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe”

Technical Reports

UNI-TR-1 “Deflection: The Pipe/Soil Mechanism”

UNI-TR-3 “Maintenance of PVC Sewer Pipe”

UNI-TR-5 “The Effects of Ultraviolet Radiation on PVC Pipe”

LIMITED WARRANTY AND LIABILITY

Diamond Plastics Corporation, 1212 Johnstown Road, P. O. Box 1608, Grand Island, NE 68802, does hereby warrant subject to the limitations hereinafter stated, its PVC Pipe to be free from defects in material and workmanship under normal use and service for a period of twelve (12) months from the date of invoice. This limited warranty extends only to the original purchase for use, and will be void if the product is used under conditions other than those for which it was designed or if it is not used in compliance with all instructions contained in any operating manual or specification sheets provided for such product.

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