



Installation Guide

For



Table of Contents

Introduction	2
Disclaimer	2
Receiving and Handling	2
Inspection	
Unloading	3
Cold Weather Handling	
Storage	3
Trench Preparation	4
Stringing Pipe	
Trench Width	
Unstable trench walls	4
Depth	
Embedment	
Foundation	5
Haunching	5
Initial Backfill	
Final Backfill	
Assembly	5
Lubricant	6
Curvilinear Alignment	6
Field Cutting and Sealing	7
Sealing Internal Channels	7
Field Repairs	8
Manhole Connections	9
Casings	10
Filling the Annular Space (Grouting)	11
Field Acceptance Testing	11
Deflection Testing	11
Base Inside Diameter	
Air Testing	12
Infiltration/Exfiltration Testing	13
Field Tapping	14
Fittings	
Table -Dimensions	15
-Socket and Spigot	
Warranty	16

PRO-21® - PVC SEWER PIPE

Diamond **PRO-21®** Closed Profile PVC Sewer Pipe is manufactured to the requirements of ASTM F1803, and is made by extruding a rectangular profile cross-section consisting of a series of internal rectangular channels. This extruded profile is then wrapped onto a mandrel producing a circular tube with a helical heat fused seam where the adjacent profiles are welded together.

-Disclaimer-

Technical data contained in this Installation Guide is furnished without charge and is given and accepted at the recipient's sole risk. Every effort has been made to verify the information contained herein, however, Diamond Plastics Corporation makes no representation about and is not responsible or liable for use of information contained in this Installation Guide, or for which this guide was not intended. In no event shall Diamond Plastics Corporation be liable for incidental or consequential damages. Diamond Plastics Corporation reserves the right to update or change literature and this guide without notice. To assure accurate and current information, contact Diamond Plastics Corporation.

-Receiving and Handling-

Inspection: 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.



Unloading - 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.** Avoid severe impact blows, gouging, or abrasions caused by metal surfaces, rocks, or material handling equipment. **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 and they must be approximately seven feet long.

-Storage-

Pipe should be stored on a flat area so that the pipe is protected from damage. Pipe that has been stored for more than two years may have reduced impact resistance, however, other physical properties such as tensile and flexural strength are not affected by the prolonged storage. If the pipe is to be stored and exposed to sunlight for more than twenty-four months, it should be covered with canvas or other opaque material to shield the ultraviolet light. Prior to using pipe which has been in storage for an extended period of time, the gaskets should be inspected for deterioration. Aboveground applications require special considerations regarding thrust blocking, thermo expansion, and exposure to sunlight. For protection from UV exposure in aboveground applications, Diamond **PRO 21®** may be painted.



-Trench Preparation-

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. There should be no more trench prepared than the foot-

age of pipe which can be laid in a day. A typical trench cross-section and terminology are given in figure 1.

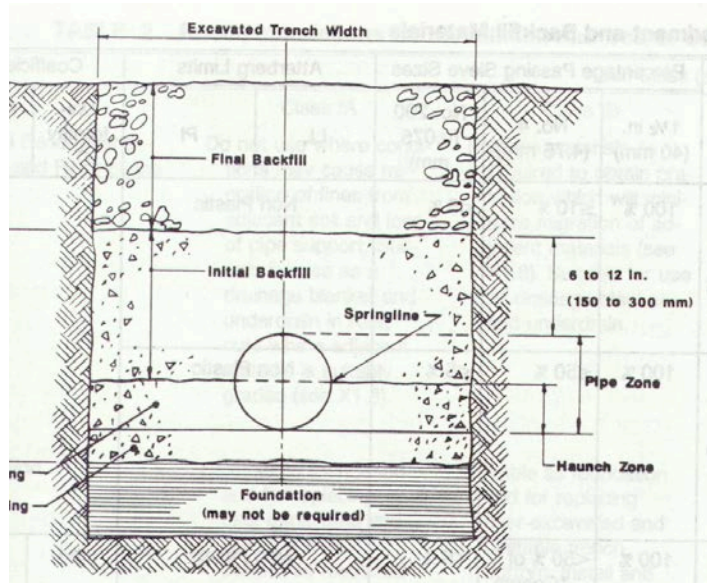


FIG. 1 Trench Cross Section Showing Terminology

Stringing Pipe: Pipe should be placed near the trench on the opposite side of the excavated earth. The bell end should be pointed in the direction of work progress.

Trench width: Trench load and working space are two important considerations in determining the trench width to be used. Trench width should allow sufficient room to work safely, for proper alignment and assembly of the joints. The outside diameter of the pipe plus one foot should be considered the minimum trench width at the height of the top of the pipe. The maximum trench width at the top of the pipe is equal to the pipe outside diameter plus two feet. Enlargement of the trench width, if necessary, should be to the trench area above the top of the pipe.

Unstable Trench Walls: For deep excavations, particularly below ground water table, the excavation should be braced or sheeted to provide safe working conditions. When a trench box is used, it must be positioned so that compaction of bedding and backfill are not compromised when the box is advanced with work in progress.

Depth: The trench depth should be determined by the design engineer after consideration is given to the requirements for the foundation, bedding, grades, pipe size, and cover of the piping system. With special design considerations, one foot of cover may be adequate, however, four feet of cover is recommended



when surface loads are expected. The pipe should be buried below the depth of frost penetration.

-Embedment -

Foundation & Bedding: An adequate or stable foundation should be present (or provided) to uniformly support the full length of the pipe. When rock, hard pan, boulders, or other material (which might damage the pipe) are encountered in the trench, the trench bottom should be over excavated 1/4th of the pipe diameter, or a minimum of four inches to permit bedding. Bell holes should be provided at each joint to permit proper assembly and support of the pipe. Max-



imum particle size for embedment, which includes bedding, haunching, and initial backfill, is limited to material passing a 1½ inch sieve. (Limiting particle size to ¾ 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 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. Haunching material should be “shovel sliced”--to work in and compact embedment material to ensure complete contact with the bottom, haunch area, and sides of the pipe. Ensuring that the haunch zone is free of voids and is properly compacted is the key to preventing settlement and excessive deflection. Haunch material should be placed in layers of no more than six inches at a time up to the springline of the pipe. Compact as required by the designer of the pipe system. Bell holes should be utilized to reduce axial deflection and support the barrel of the pipe.

Initial backfill is again placed in no more than six inch layers from the springline to a point 6 to 12 inches above the top of the pipe. Both, the haunching and initial backfill material shall be free of large stones frozen material, or debris. It is not a requirement that the initial backfill be the same material as the bedding and haunching. Specific conditions of the application will determine what material is appropriate.

Final Backfill: 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.

-Assembly-

Clean dirt and foreign material from the gasketed socket and the spigot end. The gasket seals the joint against leaks, into or out of the pipeline.



Assembly of the pipe joint is made by sliding the lubricated spigot end into the gasketed bell end. Align the spigot to the socket to be assembled so that it is near contact with the gasket. Depending upon the pipe size, **PRO-21®** pipe requires 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. (refer to Encasements.) Push the spigot end in until the minimum reference mark on the spigot end is flush with the end of

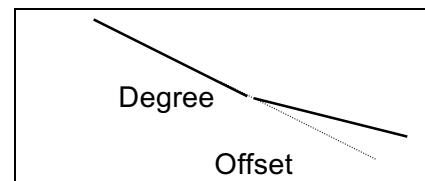
the bell and the maximum insertion reference mark is clearly visible outside the gasket lip of the socket. Joints may be assembled using mechanical equipment provided that the pipe is protected, properly lubed, and aligned. Use a wood block or sheet of plywood to protect the end of the pipe. A come-a-long may be preferred, but a swinging stab is not recommended. Assembly will require greater effort during cold weather.

-Lubricant-

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.

Curvilinear Alignment (Without Bending The Pipe.)

During construction, it may become necessary to make very slight changes of direction. When this situation is encountered, the clearance between the inside diameter of the socket and the outside diameter of the spigot may be utilized to accomplish curvilinear alignment without bending the pipe. Neither the pipe nor the joint should be axially deflected in any manner to cause stress at the joint. Assuming the spigot is not "over-inserted" beyond the insert reference mark, Diamond **PRO-21®** 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. The minimum radius of curvature for 14' joints is 800 feet, and for 20' joints the minimum curve radii is 1,146 feet. If the spigot is "over-inserted" beyond the insert reference mark, allowable joint offset and laying length will be lost. On long projects, the cumulative loss of laying length can be significant.



-Field Cutting and Sealing-

Diamond **PRO-21®** Closed Profile PVC Sewer Pipe is manufactured to the requirements of ASTM F1803, and is made by extruding a rectangular profile cross-section consisting of a series of internal rectangular channels. This extruded profile is then wrapped onto a mandrel producing a circular tube with a helical heat fused seam where the adjacent profiles are welded together.

Cutting the pipe: Occasionally it is desirable to cut standard 14 foot and 20 foot laying length pipe segments to accommodate accurate placement of fittings or manholes. Because the pipe has a visible helical line on the outside of it, it is tempting to cut along that line. The best way to make a field cut is to mark the pipe where it is to be cut with a standard ink marker by measuring the correct distance from a factory cut end. Several equidistant marks are then made around the circumference. Those marks are then connected by using tape, banding or another guide and then drawing a circular reference line between the marks. The result is a line that is perpendicular to the pipe axis that can be used as a cut line. PVC pipe is then easily cut with any sharp bladed saw.

Sealing internal channels by drilling into the cores: When the pipe is cut circumferentially the circular cut intersects the helical internal channels. On an end view you will see 5



(30" and 36" diameter) or 4 (42" to 60" diameter) locations where the internal channel has been exposed. The exposed rectangular channels are sealed on the bell and spigot ends at the factory prior to an each piece low-pressure air test. When the pipe is cut the channels are exposed and it is recommended that they be sealed any time a field cut is made. Sealing the core openings can be achieved by drilling holes in the invert of the field cut and filling cores through the holes with DP605.

Sealing the exposed internal channels: The exposed helical internal channels may be closed by inserting a block and filling the exposed channels with DP605. The field sealing kit is available from Diamond Plastics Corporation. The kit consists of 1) a sealing material cartridge (a two-part eurothane epoxy made by 3M called scotch weld DP605NS that comes in three different sizes of caulking tubes (50, 200 and 400ml), 2) a caulking gun sized for the three sizes of tubes, 3) a static mixing nozzle that mixes the material as it is pumped from the tube and 4) a plunger that presses against the two-part cartridge. These components are shown in adjacent photographs and those on the next page.



The material tube or cartridge is inserted into the gun or applicator. The mixing nozzle is placed on the end of the tube. A backing or dam is inserted into the exposed channel locations. This backing should be positioned inside the channel so that at least 4

inches of the sealing material may be placed between the backing and the open end of the channel. The nozzle is then inserted into the open end of the channel and the material pumped into the channel using the trigger of the caulking gun. The tip of the nozzle should be withdrawn gradually as the channel is filled. The desired result is to entirely fill the channel cross-section for a length of at least 4 inches. At room temperature the epoxy has a working time of five minutes and begins to cure in another 10 minutes. Tests to the seal should not be made until the seal has cured for at least 4 hours. Lower ambient temperatures require longer cure times.



-Field Repairs-

Occasionally pipe may be damaged during transportation, site handling or installation. When such damage is known the pipe should not be installed. However, there are occasions when damaged pipe does become installed and due to its dual wall nature closed profile pipe may be repaired in the field. The best way to make such repairs depends on the nature of the damage. The procedures outlined herein are intended to provide general guidance. However, in any specific case Diamond should be consulted to determine the best method and procedure for that individual case. *At no time should the safety of a worker be compromised. It is the responsibility of the contractor to ensure safe working conditions exist before any repair is attempted.*

Repair Evaluation: Only minor repairs should be attempted. These may be described as interior cracks less than 14 inches long and punctures less than three inches in diameter. Even these should only be attempted when the pipe zone around the pipe has been stabilized and is free of large rocks and debris. The pipe vertical deflection should be less than 7.5%.

Water Control: Any successful repair requires that the area to be repaired must be dry. A water activated chemical grout is used to seal the pipe from ground water infiltration. Any water flowing on the inside of the pipe that would interfere with the repair must be dammed or removed. The chemical grout may be applied to the outside of the pipe by pumping it through the damaged section or by simply tapping the pipe wall from the inside through both the waterway wall and the outside wall of the pipe cross-section. Any infiltrating ground water must be controlled. The purpose of this operation is to provide a dry working surface for preparing a structural repair that is described below.

Pipe Preparation: If a pipe has been cracked the ends of the crack should be removed or stopped by drilling a 3/8" diameter hole at the tip of each end of the crack. Next, additional 3/8" diameter holes may be drilled to allow the repair material to flow into the interior channels of the pipe and into the crack or opening to be repaired. Dust and chips from the drilling operation should be removed from the area to be repaired so as not to inhibit a good bond. Any remaining moisture or condensation should be removed as a final step in preparation for applying the repair material.

Structural Repair: Only 3M DP 605 is recommended as a repair material. It is a two-part urethane epoxy adhesive that bonds well to PVC. It has a tensile strength and modulus of elasticity that is higher than PVC and when repairs are properly made the finished repaired pipe can be made stronger than the original undamaged pipe. The kit consists of 1) a sealing material cartridge (a two-part urethane epoxy made by 3M called scotch weld DP605NS that comes in three different sizes of caulking tubes (50, 200 and 400ml), 2) a caulking gun sized for the three sizes of tubes, 3) a static mixing nozzle that mixes the material as it is pumped from the tube and 4) a plunger that presses against the two-part cartridge. Each part of the kit must be for the same size. The adhesive should be applied per the instructions that come with the adhesive. The cure time is dependent upon the temperature. The material consistency is a moldable paste or putty but has a short (approximately 10 minute) working time. The nozzle should be used to inject material directly into the access holes or crack or opening that is being repaired. The material should be applied until the entire interior channels are filled for a distance of at least 4 inches in each direction from the crack or repair. The channels should be stuffed with a material as wadding material. The wadding serves as a dam against which the repair material is pumped so that the voids are easily filled. The material should be pumped into the cracks until it flows to the pipe surface. The interior surface can be smoothed with a putty knife while the material is still workable or it may be sanded smooth after it has completely cured. (Page 6 contains wadding illustrations.)

-Manhole Connections-

Manhole construction techniques may vary from one region to another. However, the outer wall of Diamond **PRO-21®** provides a smooth surface and facilitates an easy connection. Generally, methods acceptable for solid wall PVC pipe can also be applied to **PRO-21®** pipe. 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 **PRO 21®** PVC Sewer Pipe by using a properly sized rubber coupling.



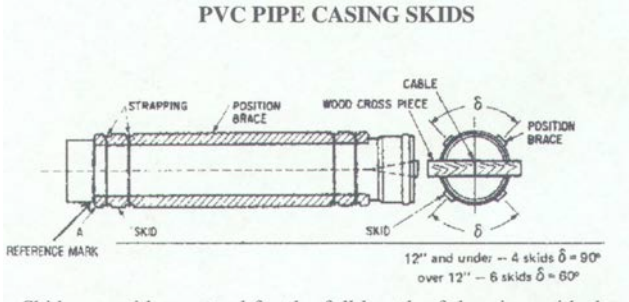
Diamond PRO 21® Average Diameters

30"	31.606
36"	38.036
42"	44.200
48"	50.570
54"	57.100
60"	63.932

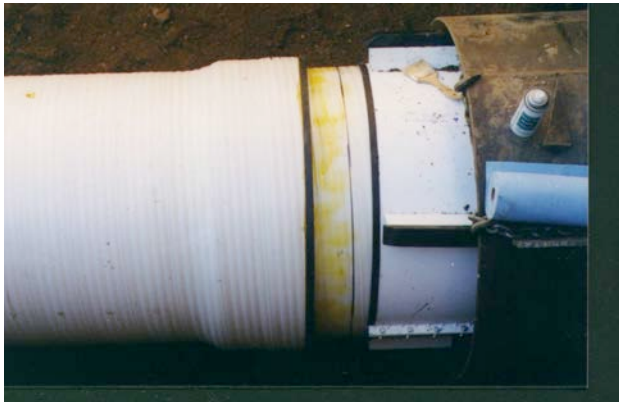
The manhole foundation and bedding material should be compacted to 95% Proctor Density. Compaction of the bedding and haunch material at the manhole connection is critical in controlling settlements. Settlements can cause shear failures and/or excessive deflection.

-Encasements-

To provide long-term support of the pipe and to prevent damage to the pipe during installation where open excavation is not desirable, for example, under highways, runways, or railways, **PRO 21®** may be installed in an encasement. Casings may be installed by boring. Skids (see figure1) or casing spacers (see figure2) must be securely fastened to the pipe being installed in the encasement. *The pipe must not rest on the sockets.* Gasket lubricant, bentonite, or other suitable non-petroleum based lubricant may be placed between the casing and the spacer to reduce the pushing load.



The installer must insure the pipe is not “over-belled” or inserted beyond the insert reference



mark. When the skids or casing spacers are aligned with the reference mark on the spigot, the skid or spacer will bear the pushing load. Pipe socket diameters and diameters of encasement are listed in Table 1.

PIPE SIZE (in.)	BELL OD (in.)	MINIMUM CASING (in.)
30	34.26	48
33	38.13	48
36	41.13	54
42	48.50	60
48	54.63	66

Placing pipe in the casing: **PRO-21®** should be braced in the casing at not less than three places on each pipe. Once, on each side of the joint at a point just behind the bell and just outside the second assembly mark. The third brace should be at the mid-point of the pipe. The load-bearing surface shall match the curvature and O.D. of the pipe so the load is evenly distributed. The contact area at each location should be at least one-half a square foot or 72 square inches (12 in. X 6 in.) To reduce the pushing loads during the installation of **PRO-21®** pipe into an encasement, lubricants are applied to the skids or to the casing spacers. Some casing spacers feature reduced friction pads and do not require additional lubricant. *Petroleum based lubricants are not recommended for use with PRO-21® pipe.* Assembly should be made with the factory supplied joint lubricant making certain the entire circumference of the pipe is covered.

Nominal Pipe Diameter (in.)	Max. Length (lin.ft.)
30	750
33	600
36	500
42	500
48	400

(See Assembly on page 4.) Assembly should be made with a steady even pressure on pipe joints that are in straight alignment. Table 2 lists the maximum recommended length of pipe to be pushed or pulled into the casing.

Filling the annular space: If the encased pipe will be below the water table, the pipe should be braced in the casing or backfilled to prevent flotation. As in routine trench excavation, the ground should be dewatered to allow the backfill to be placed around the installed pipeline. Procedures will vary greatly depending on the backfill chosen. Sand, gravel, sand-cement mixtures or cellular grouts may be placed in the annular space, however, the annular space must be completely filled. Care should be taken to prevent erosion of the pipe when blowing abrasive materials into the annular space. Pressure grouting should be limited to 5 psi. The delivery pressure should be monitored throughout the installation with a gauge that has 1 to 2 psi graduations. Since encasements are not routine operations, and since the project specifications may have special requirements, the designing engineer should approve specific procedures.

-Field Acceptance Testing-

It is quite common for sewer pipe specifications to include some type of installation acceptance test(s). These tests are typically required to assure the owner that the materials used and the installation techniques employed have resulted in the completion of a high quality sewer system. Typically the owner wants to be assured the line will not leak water into the system or sewage will not leak out of the system. He also wants to know that the pipe is laid to proper line and grade and that the pipe has not excessively deflected.

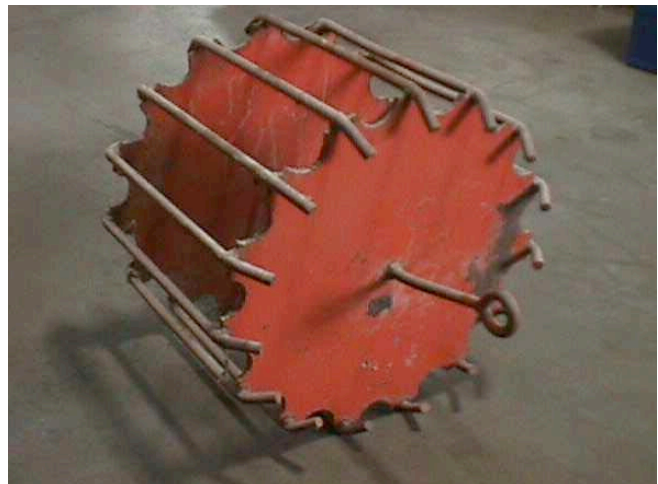
Typical acceptance tests for large diameter sewer pipe are:

- Deflection Test
- Low Pressure Air Test
- Infiltration/Exfiltration Test
- Visual Inspection Test

The engineer shall specify the type of test to be performed and the manner in which it shall be conducted.

Deflection Testing: Diamond Plastics along with the Uni-Bell PVC Pipe Association recommend a long-term deflection limit of 7.5%. This is based upon a safety factor of 4:1 against reverse curvature. Through performance testing it has been determined that reverse curvature does not begin until 30% deflection or greater.

The most common and economical method of testing deflection limits is with a "Go/No-Go" mandrel device. A rigid mandrel with a specified outside diameter is pulled through the line. If it is able to pass through, the line has deflected less than the specified allowable limit. If it will not go through, the deflection limits have been exceeded.



It is very important to clean the line before attempting to pull the mandrel. Debris in the line can cause the mandrel to become stuck. This would provide a false indication that the line is over deflected. If in fact a test section does fail the mandrel deflection test, and there is no debris in the line, it indicates that the combined stiffness of the pipe and soil is inadequate to resist the applied loads. The most likely culprit is improperly placed and compacted embedment. Those sections, which will not permit the mandrel to pass should be re-bedded and tested until it passes. Caution must be observed to assure damage has not occurred to the pipe during the re-bedding process.

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

**TABLE X
PRO-21 Mandrel Dimensions**

Pipe size		Base I.D.*		7.5% Mandrel Size		5% Mandrel Size	
(in.)	(mm)	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)
30	750	28.350	720.09	26.22	665.99	26.93	684.02
33	840	31.249	793.73	28.91	734.31	29.69	754.13
36	915	34.106	866.29	31.55	801.37	32.40	822.98
42	1070	39.880	1012.95	36.89	937.01	37.89	962.30
48	1220	45.639	1159.23	42.22	1072.39	43.36	1101.27
54	1370	51.403	1305.64	47.55	1207.77	48.84	1240.54
60	1520	57.167	1452.04	52.88	1343.16	54.31	1379.48

* Base I.D. is calculated by subtracting an out-of-roundness tolerance from pipes specified minimum I.D.

Rigid Go/No-Go mandrels are commercially available and can be purchased through local distribution.

Deflection testing is not required when using proper construction practices and inspection during pipe installation and when using properly selected embedment material which has been properly placed and compacted.

Air Test: 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.

**TABLE XI
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 100 ft. Longer line	150 ft.	200 ft.	250 ft.	300 ft.	350 ft.	400 ft.	450 ft.	
30	28:20	80	21.366L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
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.

**TABLE XII
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 100 ft. Longer line	100 ft.	150 ft.	200 ft.	250 ft.	300 ft.	350 ft.	400 ft.	450 ft.
30	14:10	80	10.683L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
33	15:35	72	12.926L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57
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	42.738L	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.

Infiltration/Exfiltration Test: Infiltration testing is an acceptable method of leakage test only when the ground water level is above the top of the pipe throughout the length being tested. The infiltration rate for any portion of sewer system should be measured by placing a weir or current meter in the appropriate manhole. It should not exceed 25 gallons per inch of internal diameter per mile per day, including manholes.

Exfiltration testing is an acceptable method of test only in dry areas, or when the line is sufficiently deep and the ground water level above the pipe is suitably low to develop test pressures which

exceed the external pressure generated by the level of ground water above the pipe. The allowable exfiltration for any length of sewer pipe between manholes should not exceed 25 gallons per inch of internal pipe diameter per mile per day. During testing the maximum internal pipe pressure at the lowest end should not exceed 25 feet of water or 10.8 psi and the water level inside the manhole should be 2 feet higher than the top of the pipe or 2 feet higher than ground water level, whichever is greater.

Visual Inspection Test: All sewer lines shall be inspected visually to verify accuracy of alignment and freedom from debris and obstructions. The full diameter of the pipe should be visible when viewed between consecutive manholes. The method of test can be photography, closed circuit television or visually lamping with mirrors and lights.

Fittings: Several manufacturers, such as Specified Fittings, Nyloplast and GPK offer fabricated fittings for PRO-21®. Fittings for these diameters (30", 33", 36", 42", 48", 54", and 60") are fabricated and are manufactured specifically for projects. They are not inventory items. These fittings are generally sold through local distribution. It is recommended that several weeks notice be given to assure your specific needs are met. El-



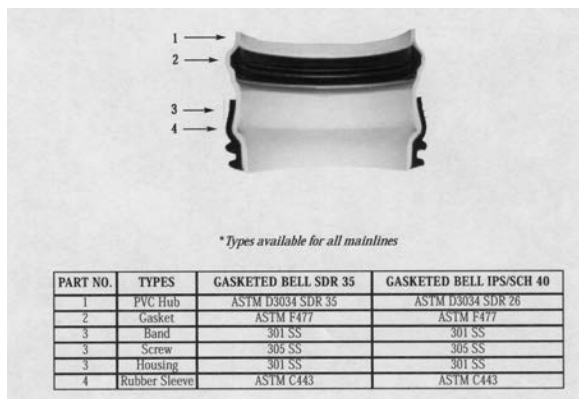
bows (90°, 45°, 22½°), tees, wyes and specialty configurations are all available through these manufactures.



tees, wyes and specialty configurations are all available through these manufactures.

FIELD TAPPING

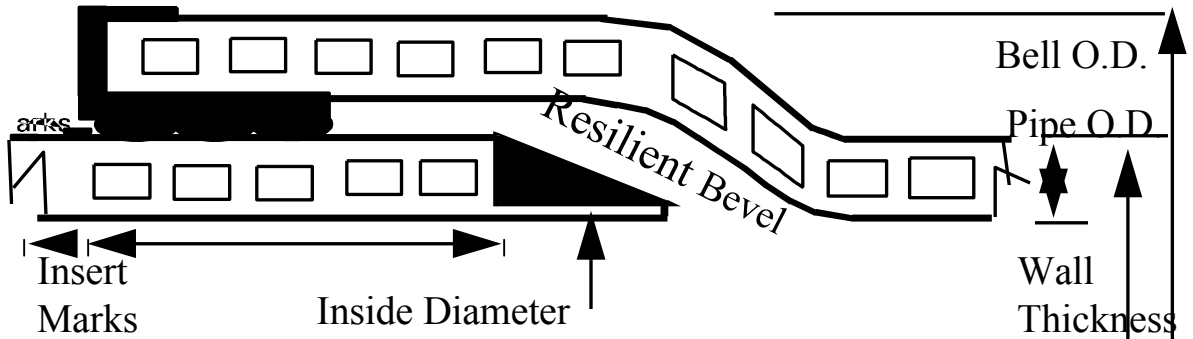
There are two methods of tapping PRO-21®. Either tapping saddles or Inserta-Tees® are acceptable. There are several manufacturers of tapping saddles. Those saddles, which are recommended for use on smooth wall PVC pipe, are acceptable for use with PRO-21®. Installation should be in accordance with the saddle manufacturer recommendations.



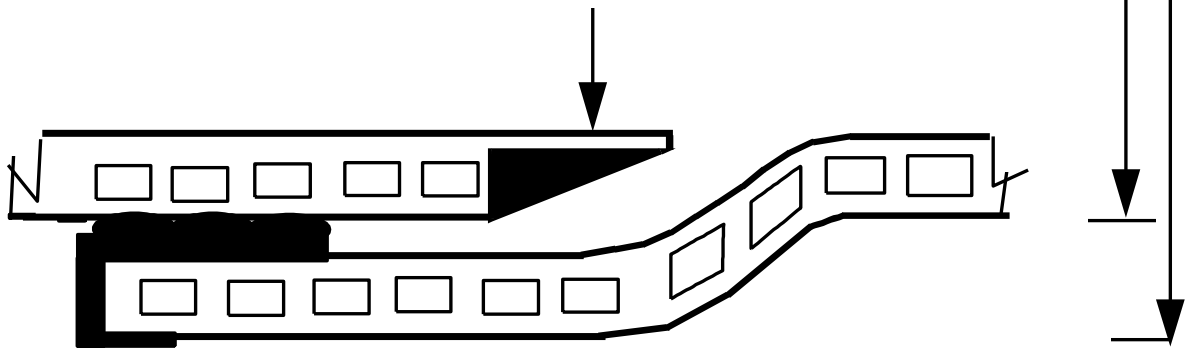
Inserta-Tees® are manufactured to tap all types of products. There are three working parts to an Inserta-Tee®. They are:

- Rubber sleeve (grommet) Meets or exceeds ASTM C443
- PVC Hub SDR 35 meeting ASTM D3034
- Clamp 302 stainless steel with screw jack

The rubber sleeve is manufactured specifically for the wall of the product being tapped. It is therefore very important that when ordering you advise your supplier that you are using PRO-21®. With every Inserta-Tee® you receive there are installation directions attached.



PRO-21 Socket / Spigot Illustration



Diameter Dimensions (inches)

Size	Average Outside Diameter (inches)	(mm)	Wall Thickness	Bell O.D.	Minimum I.D.	Insert Marks	
30"	31.606	802.79	0.965	34.3	29.410	7	9
33"	35.036	889.91	1.150	38.2	32.405	7	9
36"	38.036	966.11	1.150	41.2	35.395	7	9
42"	44.200	1,122.68	1.350	48.5	41.375	7	9
48"	50.570	1,284.48	1.535	54.7	47.360	7	9
54"	57.100	1,450.34	1.750	61.4	53.350	7	9
60"	63.932	1,623.87	2.216	69.1	59.340	10	12

These drawings are not to scale and actual product may vary from them. Tolerances of Product Standards are applicable to nominal dimensions. General dimensions of diagrams are furnished for estimating purposes and to indicate approximate profile scheme.

LIMITED WARRANTY AND LIABILITY

Diamond Plastics Corporation, 1212 Johnstown Road, P.O. Box 1608, Grand Island, NE 68802, does hereby warrant subject to 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 purchaser 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, installation guide or specification sheets provided for such product.

The sole obligation of Diamond Plastics Corporation, under this limited Warranty, and the exclusive remedy of the Purchaser under this limited warranty is the repair or replacement, without charge, FOB shipping point, of such products or parts of products only, specifically excluding any labor or installation thereof, which Diamond Plastics Corporation, after inspection, determines to be defective. Purchaser must notify Diamond Plastics Corporation, in writing at its address shown above within ten (10) days from the date of discovery of any claimed defect specifically stating the details of such defect, and if requested by Diamond Plastics Corporation, return the defective product, freight prepaid, to Diamond Plastics Corporation, FOB shipping point as shown on Diamond Plastics Corporation's order acknowledgment.

Diamond Plastics Corporation shall not be liable for any other damages, whether direct or consequential. Specifically, but without limitation, Diamond Plastics Corporation shall not be liable for any crop damage or any other incidental or consequential damages resulting from any breach of warranty, express or implied, or from any defects in its products.

No statement, remark, agreement, representation, promise or understanding, oral or written, made by Diamond Plastics Corporation or any agent, representative or employee thereof, which is not contained herein, will be recognized by, or be enforceable or binding upon Diamond Plastics Corporation. There are no understandings or undertakings of any kind with respect to the products or any part thereof which are not expressly set forth and contained herein, and all sales are made without any representation or warranty by Diamond Plastics Corporation that the goods are suitable for any particular purpose. In the event any provision of this LIMITED WARRANTY AND LIMITATION OF LIABILITY is held to be illegal or unenforceable by any court of competent jurisdiction, the remaining provisions shall remain in full force and effect.

STATUTE OF LIMITATION: Any action for breach of this LIMITED WARRANTY AND LIMITATION OF LIABILITY must be commenced within one (1) year after the cause of action has occurred.

THERE ARE NO EXPRESSED OR IMPLIED WARRANTIES BY DIAMOND PLASTICS CORPORATION, OTHER THAN THOSE SPECIFICALLY SET OUT ABOVE. THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE IN CONNECTION WITH ANY SALE EXCEPT AS SET FORTH ABOVE.