

**Installation Guide
for
CORR-21®
PVC Gravity
Sewer & Storm Drain**

PVC PIPE FOR THE 21st CENTURY

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CORR-21® - PVC SEWER PIPE

Diamond **CORR-21®** Corrugated PVC Sewer Pipe is manufactured to the requirements of ASTM F949 and ASTM F794.

-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. DO NOT ATTEMPT TO HANDLE**



pipe off the truck.

PIPE BUNDLES BY PULLING ON STRAPPING OR PACKAGING MATERIAL.

Forklift tines must be long enough to support the bottom of all pipe within the bundle (approximately 7 foot long.)

Avoid all impact blows, gouging, or abrasions caused by metal surfaces, rocks, material handling equipment, or any other source. **Do not roll the**



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 long enough to support each of the pipe on the bottom of the bundle.

-Storage-

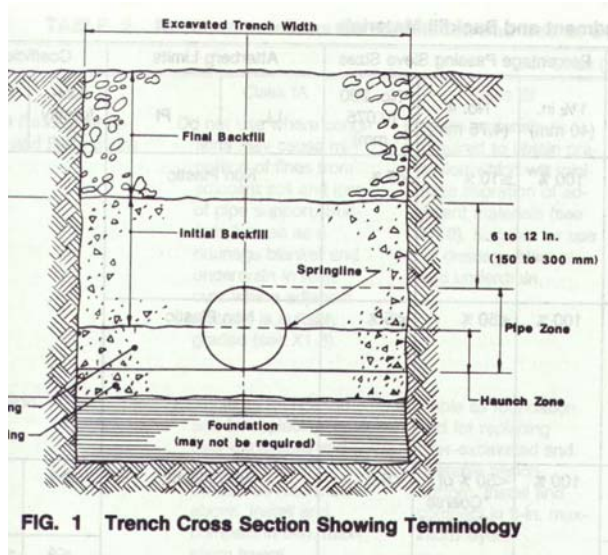
Pipe should be stored on a flat area so that the pipe is protected from damage. Pipe that has been stored for more than two years may have reduced impact resistance, however, other physical properties such as tensile and flexural strength are not affected by the prolonged storage. If the pipe is to be 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 **CORR 21®** may be painted.

-Above Ground Applications-

Above ground applications require special considerations regarding thrust blocking, thermo expansion, and exposure to sunlight. For protection from UV exposure in aboveground applications, Diamond CORR-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 footage of pipe which can be installed in a day. A typical trench cross-section and terminology are given in figure 1.



Stringing Pipe: Pipe should be placed near the trench on the opposite side of the excavated earth. Traditionally, the bell end is 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 as 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. 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 should be completed as the pipe is installed. 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-

Dirt and foreign material must be cleaned from the socket and the gasketed 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 gasketed spigot end into the lubricated 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, **CORR-21®** pipe requires from 500 to 1000 pounds force to assemble.

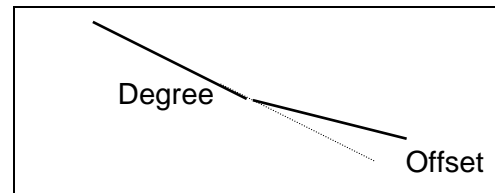
Keep the pipe lengths in proper alignment. Be careful not to let the lubricated section touch the dirt or backfill as foreign material could adhere to the surface and compromise joint integrity. So that previously completed joints in the line will not be “stacked,” “over belled,” or inserted past the reference mark, brace the bell while the spigot end is pushed through the gasket. (refer to Encasements.) Push the spigot end in until the reference mark on the spigot end is flush with the end of the lip of the socket. If the spigot is inserted beyond the insert reference mark, laying length will be lost. Loss of laying length can be significant on long footage projects. Also, joint flexibility is reduced when the spigot is over-inserted. Over-inserting the spigot 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. 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 inside surface of the bell to a depth of the third corrugation. Also, lubricate 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. Diamond **CORR-21®** will accommodate a 1° change in direction per joint. With 22' joints this is a 4 1/8" offset, and with 14' joints this is approximately 2 3/4" offset. The minimum radius of curvature for 14' joints is 803 feet, and for 22' joints the minimum curve radii is 1,261 feet. This, minimum radius of curvature, assumes the spigot is not inserted beyond the maximum insert reference mark. Inserting the spigot beyond the insert reference mark reduces allowable joint offset.



-Field Cutting and Sealing-

Cutting the pipe: To accommodate accurate placement of a fitting or manhole, it may be desirable to cut a standard 14 foot or 22 foot laying length pipe segment into a shorter length. Because the corrugations are perpendicular to the axis of the pipe, the pipe can easily be cut to the desired length at the valley of the corrugation. PVC is easily cut with any sharp bladed saw. Remove the saw dust and any foreign matter from the valley cut, and install the gasket between the corrugations.

-Field Repairs-

Sleeve couplings are available for repairs. These couplings are manufactured to fit CORR-21 outside dimensions. They are constructed as a straight sleeve with no stop shoulders. This style coupling will facilitate most repairs. In the event two spigots need to be joined, socket couplings are available.

They are similar to repair couplings except that they employ a stop shoulder at the center of the coupling. Other types of flexible repair couplings may also be available. Before installing repair couplings, insure that the spigot, gaskets and bell/socket are properly cleaned and lubricated.

-Manhole Connections-

Three types of manhole connections are commonly available. They are rubber boots, A-LOK's and rigid grouted connections. CORR-21 can be utilized with any of these connections

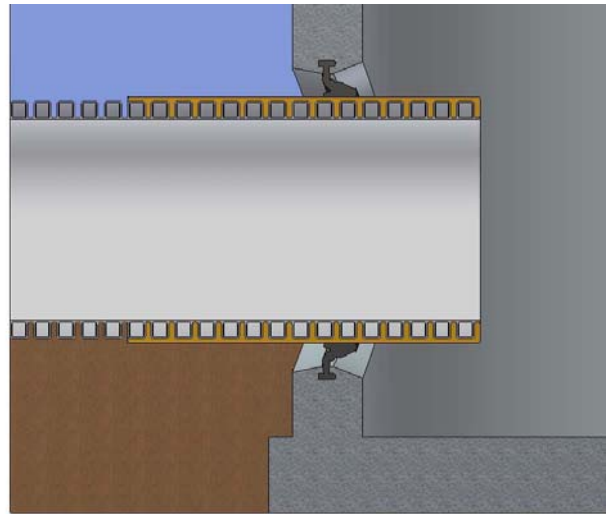


For rubber boot connection two "flat top" gaskets are positioned under the boot to ensure a water tight seal. Manhole boots should be sized to fit the outside diameter of CORR-21.

Diamond **CORR 21®** Average Diameters

	Avg (In.)	Maximum (In.)
12"	12.795	12.813
15"	15.658	15.681
18"	19.152	19.180
21"	22.630	22.663
24"	25.580	25.619
27"	28.860	28.909
30"	32.150	32.209
36"	38.740	36.819
42"	45.800	45.893
48"	52.800	52.908

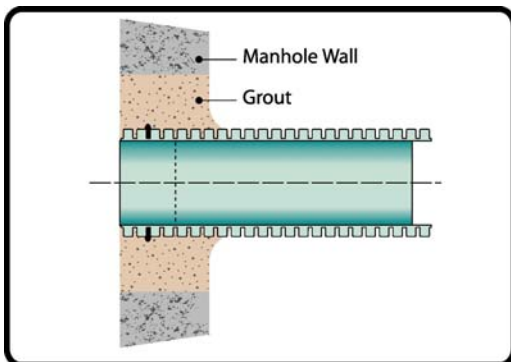
For A-LOK connections a CORR-21 A-LOK entry piece is utilized.



A-LOK Sizing

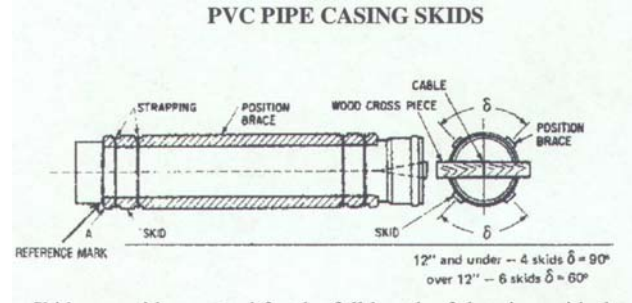
Pipe Diameter (Inches)	Urethane Adaptor O.D. (Inches)	Solid-Wall (D3034/F679) Adaptor O.D. (inches)
12"	13.250	12.500
15"	16.625	15.300
18"	20.000	18.701
21"	23.500	22.047
24"	26.000	24.803
27"	30.000	27.953
30"	32.875	32.000
36"	39.500	38.200
42"	47.250	44.500
48"	54.000	50.800

Where rigid manhole connections are utilized, a CORR-21 gasket can be positioned on the pipe in the center of the manhole wall (or concrete headwall or other structures for storm drain) then grouted as required.



-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, **CORR 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. The inside diameter of the casing should be at least two inches greater than the maximum of the socket, casing spacer, pipe skids, cradle runners, or other appurtenance.

Placing pipe in the casing: **CORR-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 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 **CORR-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 **CORR-21®** pipe.* Assembly should be made with the factory supplied joint lubricant making certain the inner surface of the bell is covered to the third corrugation. (See Assembly on page 4.) Assembly should be

TABLE 1. MAXIMUM RECOMMENDED ASSEMBLED LENGTH TO BE PUSHED OR PULLED INTO A CASING

Nominal Pipe Diameter (in.)	Max. Length (lin.ft.)
12	1,000
15	1,250
18	1,250
21	1,250
24	1,250
27	1,250
30	1,250
36	1,500
42	1,500
48	1,500

made with a steady even pressure on pipe joints that are in straight alignment. Table 1 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 installed 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
CORR-21 Deflection Mandrel Dimensions

Pipe size		Base I.D.*		7.5% Mandrel Size		5% Mandrel Size	
(in.)	(mm)	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)
12	300	11.340	288.04	10.49	266.45	10.77	273.56
15	350	13.862	352.09	12.82	325.68	13.17	334.52
18	450	16.963	430.86	15.69	398.55	16.11	409.19
21	550	20.004	508.1	18.5	469.9	19.00	482.6
24	600	22.656	575.5	20.98	532.4	21.52	546.6
27	700	25.514	648.1	23.60	599.4	24.24	615.7
30	800	28.429	722.1	26.3	668.0	27.01	686.05
36	915	34.210	868.9	31.64	803.7	32.5	825.5
42	1050	40.009	1016.2	37.01	940.1	38.01	965.45
48	1200	45.784	1162.9	42.35	1075.7	43.49	1104.65

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.

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

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.	
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	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

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.
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	5.235L	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	19:74	57	20.942L	34:54	52:21	69:49	87:15	104:42	122:10	139:37	157:04
48	22:47	50	27.532L	45:35	68:23	91:11	113:58	136:46	159:33	182:21	205:09

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, GPK and Soileau Industries offer fabricated fittings for **CORR-21®**. Fittings for these diameters (12", 15", 18", 21", 24", 27", 30", 36", 42", and 48") 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. Elbows (90°, 45°, 22½°), tees, wyes and specialty configurations are all available through these manufactures.

FIELD TAPPING

There are two methods of tapping **CORR-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 **CORR-21®**. Installation should be in accordance with the saddle manufacturer recommendations.

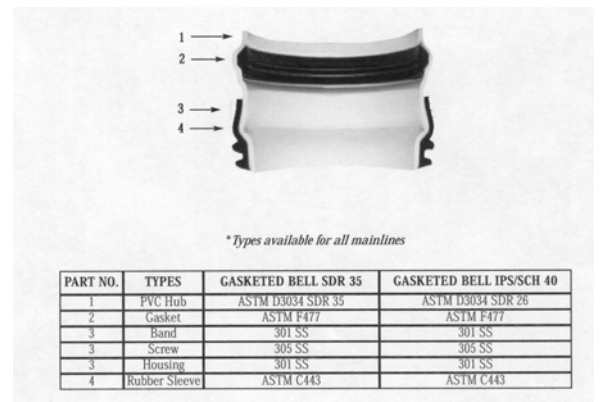
Inserta-Tees® are manufactured to tap all types of products. There are three working parts to an Inserta-Tee®. They are:

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 **CORR-21®**. With every Inserta-Tee® you receive there are installation directions attached.



CORR-21™ Pipe Dimensions



Nominal Pipe Size	Average Outside Diameter	Approximate Bell Socket Diameter	Socket Depth	Insert Reference Mark	Pipe Stiffness
12	12.795	16 ½"	7 ½"	6"	50
15	15.658	18 ½"	8"	7 ½ "	50
18	19.152	22 ½"	8 ½"	7"	50
21	22.630	26 ½"	10 ½"	9"	50
24	25.580	29 ½"	11 ½"	10"	50
27	28.860	33 ½"	11 ½"	9"	50
30	32.150	37"	11 ½"	9"	50
36	38.740	44 ½"	11 ½"	11"	50
42	45.80	52 ½"	10 ½"	10"	50
48	52.800	60 ½"	14"	13"	50

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

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